LOGISTIC REPORT TO DSIR ANTARCTIC

Mount Erebus Eruption Mechanism Study, K-044

AIMS

To make a seismic refraction survey on the summit plateau of Erebus, and find if it is underlain by thick low velocity material capable of causing the previously observed 1.5 second delay to the seismic waves from strombolian explosions in the lava lake.

To continue to record the strombolian explosions seismically and by TV surveillance until the refraction survey is completed.

To remove the VUW-owned TV station, infrasonic microphones and amplifiers, and electromagnetic from the mountain, and the recording equipment from Scott Base, leaving the sites clean and tidy, and pack it up ready for installation at another volcano away from Antarctica.

PLANNING

Planning was based on providing Mr B. O'Brien with data for his own M.Sc. thesis on Erebus activity, and terminating the program before my compulsory retirement at age 65, so that I could confirm my results from Erebus at another similar volcano elsewhere. I was also concerned that I did not prejudice the programs of my International collaborators unnecessarily in withdrawing my equipment and support.

No planning problems occurred this year, except that Prof Kaminuma was unable to participate, and Brent O'Brien was invited to take his place. Special thanks are due to the VUW Grants Committee for covering the additional expenditure.

A suggestion concerning Tekapo is that the training course program document is a valuable record of the participants, but omits first names. Even initials are hard to find.

CARGO

One cargon was sent down containing parts of the Nimbus seismograph, and as well a dismantled second cargon for the return of my equipment to New Zealand. Space was supposed to be available in A. Pyne's returning cargon as well, but instead a third box was provided by Pat Nolan for the gel-cell batteries. The excess allowance for the Nimbus was adequate and essential.

PERSONNEL

Dr. R.R. Dibble, 81 Oriel Ave. Tawa, Wellington.
Mr. Brent O'Brien, 2-66 Burnham St. Seatoun, Wellington
Mrs. Alla Fradkin, 49/70 Nairn St, Wellington

I wish to commend Brent O'Brien for his able and often strenuous work on Erebus, and his expertise with the recording computer in the Science Lab.

PREPARATIONS FOR THE FIELD

(i) We were pleased to find that our Grizzly toboggan had been flown up to Fang as a training exercise at no charge to our helo hours before we arrived.

Preparing for our put-in involved servicing the recording equipment in the science lab, and preparing it for augmented recording involved replacing the VUW telemetry receivers and discriminators with the NSF equipment removed to McMurdo in 1987. Bill McIntosh of S-081 had returned this to Scott Base for the purpose. (Note that the NSF equipment has University of Alaska labels, because it was purchased by Juergen Kienle, a foundation member of IMESS from Alaska.) We also had to prepare enough "no useful data" videotapes for reuse, and archive the digital earthquakes to disk and clear the acquisition computer so that recordings could be continuous while we were on Erebus.

(ii) All the field equipment requested was available and in good condition. Cooking oil and long plastic tent pegs were in short supply.

(iii) The addition of vehicle training to survival training was a welcome improvement, and very well organised by Nick Groves. Alla Fradkin especially benefitted, and proved to be a very able driver on Erebus.

(iv) Delays at Scott Base were minimal. Our put-in was only 1 day behind my planned date.

FIELD TRANSPORT

(i) NZARP Vehicles

Grizzly G5 was flown up the mountain before we arrived in Antarctica, and had been selected at short notice. It was in good condition with adequate power, and we achieved all our objectives with it, but the brakes needed adjusting before it was safe to drive on the mountain, and no tools had been provided. Later, the brake lever came loose on the handlebar, and no clamp screw could be found. Glue had been used to lock the lever in place. As Scott Base had previously removed the right hand brake lever, great strength and care were necessary to control the vehicle down steep slopes. We decided not to drive down the long steep hill to Fang for the flight back to Scott Base, and left G5 at the lower hut.

(ii) Helicopter operations.

These were faultless, except that in spite of my letter to the Manager, Ant. Div. on 13 March 1990, listing the equipment and weights to come off Erebus, and my complaints at Tekapo that the number of helo flights on the draft directive was inadequate, only two flights off the mountain were scheduled. The effect was to cause a polite conflict between Nick, Scott Base and myself over priorities, because the total load of 4 + 3560 lb was impossible on two flights. We flagged the piles of gear, and my top priority was the VUW equipment, because I had to pack it to go to another volcano. We were all taken off Erebus before any gear, and only Nick had a head-set. Subsequently good VUW equipment was left behind even after NSF rubbish was brought down. It took 3 more flights to rectify the error. and with the resupply flight for electric detonators, it was unnecessarily expensive.

Event Diary

We arrived late on 16 Nov 1990.

17-22 Nov:

1. Checked and serviced all IMEEMS equipment at Scott Base, and replaced the VUW telemetry receivers with NSF ones (Ray). Downloaded digital computer seismograph and printed out seismograms (Brent); Checked all video tapes, and labelled those with useful recordings of eruptions and convection in the lava lake, and prepared tapes for recording while we are on Erebus (Alla).

2. Attended survival school, Alla and Brent 2 days and 1 night; Ray 2nd day only on crevasses, and a toboggan shake down journey up the west side of Hut Point Peninsula, and crossing the Peninsula north of Castle Rock.

3. Check all field equipment, and assemble in IMEEMS cage (Store). Every item issued by Scott Base was unpacked, operated, and repacked. Food box contents were checked, and missing items requested and added. Frozen meat and other perishables not kept in food boxes were requested from storeman and cook. Fuel drums, tools, electronic test equipment and spares were checked and assembled in cage. All packages were labelled and weighed. Helicopter loads were listed and sorted into 1000 pound lots, to make sure that no one was "put-in" on the volcano without their tent, pack, bag, food, cooking equipment and radio.

23-26 Nov. Put-in, and acclimatizing at Fang.
Flew to Fang in 2 loads. Nick and Brent walked up to replace the MACZ station seismometer, replaced the TV camera window, and brought 3 batteries down. Ray drove 65 up to the lower hut and back, and Nick and Brent drove up with a load, and left the Grizzly at the hut during this time. Alla was a bit slower to acclimatize.

27 Nov. Helo lift to lower hut. Explosives and plain det's arrive.
28 Nov. Reconnoitre seismic refraction line from CONZ station.
Helo delivers electric detonators and DFA.

29 Nov. Install refraction spread 1 and fire shot 1 near CONZ. Drive up to upper hut with drill, explosives and shot equipment.

30 Nov. Nick and Brent fire shots 2 & 3 in Side Crater, while Ray and Alla record them, changing to spread 2 for shot 3.

1 Dec. Nick and Brent fire shot 4 near Cones. Then all shift spread and recording tent to spread 3. Nick and Brent walk up to Side Crater to fire shot 5, and down to Cones for shot 6 to complete the survey, and finish off all the explosive. One of the Yamaha's fails, and is left near Cones.

2-3 Dec. Rest day and windy day at lower hut. Tow Yamaha from Cones to lower hut.

4 Dec. Nick Brent and Alla bring 3 more batteries down from TV station while Ray attempts to fix Yamaha magneto. No go!

5-7 Dec. Pull out electromagnetic loop wire encircling the crater, starting at the upper hut. As we near the main crater rim, the wire becomes more and more difficult to find, because it was broken and buried by bombs from the 1984 eruption. Only about 60% could be recovered. However the heavy "Spiral-4" wire and reels abandoned by NSF in 1984/5 season were much in evidence, and Nick advised Scott Base that he would remove it. Although I disagreed because it had been arranged to be done by a separate team from Scott Base at a later date, I admired Nick and Brent tremendously for digging out and carrying about 300 kg of wire, large reels and batteries across steep slopes. Alla and I helped, and also collected the Erebus crystals requested by DSIR Antarctic, and brought down the long period horizontal seismometer belonging to NIPR from E1.

8 Dec. Visited the Sauna Cave discovered by Bill McIntosh a few years ago. It is an old lava tube underlying the steam source for the ice tower 470m from E1 in direction 199 deg E, at spot height 3569.3m on L & S map 1253. Access is via a 15m deep shaft at the base of the ice tower. The rock roof of the cave is uncomfortably hot. Air quality is good, not to wet, and 35-40 deg C. A flannel to mop up sweat, and towel to dry off with before dressing for the cold outside are necessary. Later we set out to retrieve the TV station, but the 16 day spell of fine weather ended suddenly with blowing snow and dark cloud.

9-10 Dec. Poor weather, but Cones station was visited to dismantle the VUW infrasonic microphone and bring in the transmitter box from Cone to remove the VUW preamp/VCO.

11 Dec. Cloud and wind at the hut, but when Cones was visited to reinstall the transmitter, the weather was seen to be good everywhere else. My radio request for Nick to set a time to start the TV station recovery was unpopular, but above Ray's Gully the weather was very good. The plan was for Alla to drive loads down Ray's Gully to the hut, but 2 trial empty runs down the steep part proved too fast for Alla. Ray disconnected the TV components and carried most of them down, while Nick and Brent coiled up the cables, and Alla

sawed off the steel stakes which fastened the camera tripod and solar panel to the ground. All stakes were then driven below ground level, because Nick found them impossible to dig out. Ray drove full loads down Ray's Gully at fast but safe speed (because the gully flattens out before uneven surface is reached), but before returning for the last load, Brent arrived with a frozen finger. I had given him a chemical hand warmer, but he had felt no need to use it, and was unaware until he took his glove off. He was exhausted from holding on to the passenger handles of the Yamaha behind Alla, while wearing a heavy pack. If he had held on to her waist the problem may not have occurred.

Apply rapid thaw treatment as in the manual, and consult Scott Base. Third left finger frozen short of the first joint. Keep Brent in the heated hut, and follow manual.

12-13 Dec. Strong winds and blowing snow prevent collection of last load. Make scheduled descent on 13 Dec impossible. Reschedule on 14th, and advise weights of: Lower hut, 4+1140 lb Ant Div gear, 890 IMEEMS equip, 230 NSF retro; Fang camp and Grizzly 1000; Upper hut 400 lb NSF retro, but allowed sked is only 2 flights: 800 lb gear to S.B., and 2+390 to Fang adding 2+250 to S.B. Sort gear into flagged piles and argue priorities. Begin 24 hour weather watch. Clears at 0230 am on 13th, and Nick and I collect last load, and then go to E1 to remove infrasonic microphone and 2 preamp/VCO belonging to VUW. Grizzly gets a rock jammed in its track at the upper hut after Nick has descended to a photo point, and I walk down thinking the track suspension has collapsed. Advise Scott Base, then walk up and free the rock and return. We are then ready to descend and the weather is OK!

14-19 Dec. Orographic cloud cap forms and wind rises to full gale. Tears outer skin of a panel of the Jamesway roof, which we cover with a cargo net. Radio comms with Scott Base deteriorate, and VHF repeater begins to switch on and off rapidly. Set up Compac again and recharge batteries from the TV ones (2x12V in series). Nick prefers to use VHF out in the storm. Weather settles, but orographic cloud remains, with clear patches some evenings. Achieve notoriety by suggesting an evening flight!

20 Dec. Weather clearing, but amazing that Gentle 10 found its way in with only 400m visibility at the hut. Still only two flights scheduled. First is 4+0, but two more are flown, leaving mostly VUW IMEEMS equipment. Nick had the head-set, and explained the priorities.

21 Dec. Nick, Brent and Alla prepare to leave on schedule but are held over, due to the lack of a backup aircraft, until next morning.

21-27 December. Ray dismantles the Victoria University IMEEMS installation in the Science Lab, comprising the TV receiver, antennae, time coder, VCR, and the Compaq computer, monitors (2) and printer. Also the Philips FM telemetry receivers, and one rack of discriminators, and all the manuals, floppy disks, videotapes, and spares. He washes TV equipment from the mountain to remove acidic deposits from the volcanic gases and packs TV equipment in one cargon, VUW seismic amplifiers, discriminators, computer/monitor/printer, and microphones in another, ready for shipment to another volcano. Inevitably this takes longer, and is less perfect than planned with 3 people, especially as 3 extra flights arranged with S-081 were necessary to bring the remaining equipment down. The first in quite clear weather on 22 Dec. did not land due to contrailing. The second on 23 Dec. landed only at Fang, and retrieved the camp. The 3rd on 27 Dec. with Phil Kyle, Nelia Dunbar, and John Alexander, brought the NSF weather station down from the summit, and the VUW equipment from the lower hut. I was able to clean and pack it before leaving for NZ that night.

ACCIDENTS

Incidents with G5 were as follows:

26 Nov. While driving up with a load, Nick slid 20m backwards down the mountain side above Fang camp until G5 stopped suddenly on soft snow, and overturned, throwing Nick clear, and spreading the load down the mountain side. The right handlebar required straightening, and the load collected up. Ray had driven the route twice the day before, and Nick had checked it for ice, but encountered some while seeking a better route.

1 Dec. The left hand track shock absorber broke off the bogie while Ray was creeping over some exposed rocks on the plateau. A bungi-cord was used to secure the loose end, and track performance was unimpaired.

13 Dec. The throttle cable jammed twice, due partly to freezing up near the carburettor and partly to fraying at the handlebar. This increased the concern about brakes, because the throttle must be blipped when starting down a steep hill in order to actuate the centrifugal clutch and engine braking.

13 Dec. A head sized rock jammed between the left track and rear inner sprocket wheel, causing apparent suspension collapse. The vehicle had disturbed the rock in passing so it rolled on to the track. It needed tipping to find and extract it.

FIELD EQUIPMENT

(i) All the clothing and equipment provided were of a good standard.

(iii) Instant noodles and chocolate wheaten biscuits should be available for field parties.

(v) The hollow pin holding the cutter on the mate auger sheared, and the cutter was lost down the hole.

RADIO COMMUNICATIONS

(i) The Tait VHF and Compac radios were in good condition, except for a dead compac battery.

(ii) Although Scott Base assured us that the Mt Newell repeater was working before our put-in, we could not raise Scott Base on VHF when we landed at Fang. Communications were mostly good from the lower hut, except on 14-16 December when the repeater switched on and off rapidly during our transmissions.

(iii) General efficiency was good, and news service well received.

HATHERTON GEOSCIENCE LABORATORY

I am most grateful to have shared with the IMESS and IMEEMS groups the 10 years of continual use of the laboratory for recording the telemetry data from Erebus. The space and facilities made available have been excellent, and very generous. The technicians have helped immeasurably, and have made this one of the most effective volcano observatories in the world today. I hope it continues the work after I leave the program.

If I have one regret, it is that the laboratory is not visited more by members of the Scott Base staff, and by visitors from other bases. The amount of work done is appreciated by only a few. The notice prohibiting entry to the lab is the immediate cause, but a display area in the passages would help. Perhaps some good quality displays will spin off from the International Antarctic Research Centre.

My other suggestion is that the senior technician be given a small annual budget for tools and components. At present he is very poorly off relative to the engineering and communications staff, and has no hopes for improvement.

RDRC-91.SCI

IMMEDIATE SCIENCE REPORT

K-044: Mount Erebus Eruption Mechanism Study

New Zealand Antarctic Research Program, 1990/91

Event Personnel: R.R. Dibble (Leader)
B. O'Brien
A. Fradkin
N. Groves (Field Assistant

P Kraak (NZARP Sci. Lab. Tech.)

Period: November-December 1990

Financial support:	Vice Chancellors Fund	$4600
	Institute of Geophysics	800
	Internal Research Grant	3200

Abstract of Scientific Work Achieved

During the field season, 25 days of seismic telemetry and TV video recording were made of the eruptive and seismic activity of Erebus volcano. The lava lake was in the form of two main pools, which were convecting and fuming without strong explosive activity. No eruptions were witnessed while we were on the mountain, although members of the party were at or above the upper hut on 7 days.

A seismic refraction survey was made on the summit plateau over a 1.4km distance between shot points in the Side Crater and near Truncated Cones. Three contiguous 330m spreads of the Nimbus seismograph were shot from each end of the line, using shots up to 10kg in one meter deep holes. The arrivals were weak but readable. They have been interpreted by ray-tracing as showing a 1.3km/s sub-permafrost layer up to 100m thick overlying a refractor with lateral velocity variations between 1.6 and 3.7 km/s. The maximum delay time relative to a homogeneous 4 km/s model is only 0.21s, and shows that the delays of 1.5s previously found in the waves from explosions in the lava lake do not originate under the summit plateau. The elimination of this possibility makes it more certain that the delay originates in the lava lake due to reduction of the velocity in lava due to vesiculation.

Prior to removing the Victoria University television station, infrasonic microphones, and preamplifiers, and the NIPR long period seismometer from the mountain, the 3 NSF telemetry stations in the summit area were serviced. The E1 station seismometer has shorter period and lower sensitivity than standard, but the only spare was itself faulty. NSF equipment abandoned between the main and side craters after destruction by the 1984 eruptions was removed and the mountain left tidy. The magnetic induction loop was also pulled out of the ground were possible, and all equipment and non-burnable rubbish was returned to New Zealand, with much appreciated help from Scott Base staff.

Proposed Program

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.

Scientific Endeavours and Achievements

To eliminate the possibility that the observed delay to seismic waves from strombolian explosions was caused by thick and/or very low velocity layers under the recording stations on the flanks of the volcano, a seismic refraction line was run between the warm ground in the Side Crater near E1, and the somma rim at the edge of the summit plateau near CON station (at Truncated Cones). E1 is a first order trig station, and CON transmitting antenna is 20m from an aerial photography "field station" marker. Running the seismic line revealed a 272.7m mistake in the survey position of Con station, which has now been revised to 77 deg 32' 04.68" S, 167 deg 05' 06.54" E. The effect will ripple through all previous seismic results.

We flew to the Fang Glacier acclimatization camp in 2 lifts on 23 November after servicing all the equipment at Scott Base, and reinstalling the NSF telemetry receivers in place of the Victoria University ones. The NSF equipment was provided by S-081 so that Erebus could continue to be recorded by NIPR equipment.

During the 3-day acclimatization at Fang, trips were made to replace a faulty seismometer at MAC station, to retrieve batteries from the TV station for use in the refraction survey, and to check out the toboggan route to the lower hut. We commenced the seismic survey on 29 November, drilling all the holes at the south end of the line, and shooting spread one from the south end. Leaving the spread with the Nimbus seismograph in a heated insulating box inside a dome tent, the party moved explosives, drill, and shot-firing/transmitting equipment to the upper hut with the Grizzly. On 30 November, Nick and Brent drilled all the shot holes in the side crater and fired two shots. Ray and Alla recorded the first on spread one and shifted to spread 2 for the second. On 1 December, spread 2 was shot from CON, and the whole team shifted the spread and recording site to spread 3, which Nick and Brent shot first from the Side Crater, and then from CON to complete the line. Completing in 3 days was an excellent achievement by Nick and Brent, and I wished we had taken more explosive to extend the work. The seismic arrivals were weak, and radio switching noise affected the digital recordings until we changed to clearing the record memories after giving the a "fire in 5 seconds" command. Our preliminary result is stated in the abstract.

After a rest day and a windy day, we brought down 3 more batteries from the TV station, and then on 5 December retrieved the buried electromagnetic loop wire shown on L & S map 1253. Only about 60% of it could be pulled up, because it had been chopped up, displaced, and further buried by the eruptions of 1984. Our field assistant judged that NSF cables and buried batteries, abandoned at the summit after damage in the 1984 eruptions, had higher priority. We had no authority from NSF, and it usurped a second trip to the summit planned by a Scott Base recovery team, but majority ruled, and we spent 2 days returning about 200 kg of Carbonnaire batteries to the upper hut, and spiral-4 cable to the lower hut. Again this was a remarkable achievement by Nick and Brent.

On 8 December we visited the Sauna Cave 470m from E1 in Azimuth 199 deg.E at spot height 3569.3m on L & S map 1253. Access is via a 15m deep shaft at the base of an impressive ice tower, and the rock cave (an old lava tube) underlies the source of the fumarole feeding the tower. The rock roof in the upper reaches of the cave is uncomfortably hot to touch, and the air is good and hot. Later that day we set out to retrieve the TV station but the 16 day spell of fine weather ended suddenly with blowing snow and dark cloud.

December 9 and 10 were also poor, but the CON transmitter was brought in and the VUW preamp/VCO removed from it. Reinstallation on 11 December showed that the mountain was clear except at the lower hut, and we were able to retrieve the TV station, except for one load left at the toboggan terminal in Ray's Gully when Brent reported his ring finger frozen nearly to the first joint. He had a chemical hand-warmer with him, but didn't appreciate the problem until he took his glove off. We applied the rapid warm-up treatment, and confined Brent to the heated hut. The finger blistered badly, and the nail came off, but it has since healed satisfactorily.

December 12 was bad, and we rescheduled our descent for the 14th, and began a 24 hour watch. Clearance at 2:30am on 13th enabled us to complete the TV retro, and remove the 2 VUW preamp/VCO's from the E1 station, and so we were ready to descend on 14th. However, an orographic cloud cap formed, and persisted until the 20th, when Gentle 10 miraculously found its way through the clouds, and took all 4 of us off without any gear. Two more flights brought down most of the gear and rubbish, but much of the VUW equipment remained on the mountain, even though it had been carefully sorted and flagged.

Brent, Alla and Nick barely had time to pack their own gear before their scheduled departure on 21 December (held over to the next morning due to lack of a backup aircraft), but the major task of packing the VUW equipment from the mountain and the lab for shipment to another volcano remained to be done. The cost to VUW and myself of removing the abandoned NSF gear was now apparent. DSIR Antarctic kindly rescheduled my return flight and by working all hours, including three flights with S-081 (at their expense) to recover the remaining equipment at the lower hut, and the camp at Fang, I completed the packing with an hour to spare before my return flight on 27 December.

The Erebus program remains one of excellent international cooperation, but this season Phil Kyle of S-081 went up Erebus after our descent, and Katsu Kaminuma could not arrange funding for a Japanese collaborator.

Often disguised by our field event program, has been the work of maintaining a major recording facility in the Scott Base lab, and of processing the data from a whole years recordings. The processing is shared between Prof Katsu Kaminuma of NIPR Tokyo, who locates most of the earthquakes, and myself and Mr O'Brien (M.Sc. candidate) who have been studying the explosion earthquakes and video records.

Publications

A list of publications with VUW authors is attached. A book in the Antarctic Research Series of A.G.U. to be entitled Volcanological Studies of Mount Erebus is being prepared under Prof Kyle's editorship. The provisional list of titles and authors is attached.

Environmental Impact

The impacts of the VUW contribution to the IMESS and IMEEMS programs have gone with the exception of the degradation of the ice caves described by Giggenbach (1975). By enlarging the opening to install seismographs in 1974, I altered the air/steam balance, and thus the conditions required to maintain the ice tower around the opening. Considerable natural ablation of the small glacier above the upper hut has contributed to this. The summit area has been tidied by the removal of NSF wire and batteries abandoned after the 1984 eruptions.

Future Research

The study of seismicity and eruptive activity will be continued by Prof Phil Kyle with support from NSF, and by Prof Katsu Kaminuma of the National Institute of Polar Research. At present, the NSF telemetry receivers/demodulators and the Japanese analogue recording equipment continue to operate in Scott Base, recording from a six station seismic net at E1, CON, MAC, HOO, ABB and BOM, which is entirely owned and operated within NSF. On the completion of the McMurdo Science Lab, the receiving/recording equipment might be moved to that lab. The trend there may be towards a permanent Erebus Volcano Observatory (EVO).

The proposed future program of Dr.R.R. Dibble is to reinstall his TV surveillance station, and infrasonic microphones, augmented with 3 seismometers on another volcano showing continuous strombolian activity, to check the conclusion that the seismic waves of explosion earthquakes are delayed by low velocities in vesiculated lava below the event. Yasur volcano (Vanuatu), Arenal (Costa Rica) and Pacaya (Guatemala) are suitable volcanoes, but negotiations are not yet complete.

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. However, the threatened departure of all the seismic recording programs from the Scott Base laboratory disturbs me.

Acknowledgements

Everyone concerned has been helpful to our program, but the consideration accorded us by Malcolm McFarlane and John Alexander in facilitating the field work, Peter Kraak and Bruce McGregor in operating the recording equipment, and Pat Nolan in stores and freight were especially appreciated. Special thanks also to Phil Kyle of S-081 for generous help in bringing the VUW equipment down from Erebus in time for me to pack it for shipment to a new volcano, and to the Vice Chancellor's Committee, VUW grants committee, and Institute of Geophysics for financial support.

K047

1990/91

LOGISTICS REPORT

K047 : ALLUVIAL AND PALEOBOTANICAL STUDIES AT ALLAN HILLS

New Zealand Antarctic Research Programme 1990/91

K.J. Woolfe and P.J. Barrett

(~~DRAFT~~)

Event Personnel:
K Woolfe
P Barrett
J Francis
M Arnot
N Smith

December 1990 - Jan 1991

NZARP REPORT No 2 : LOGISTIC REPORT TO DSIR ANTARCTIC

1) AIMS

The objectives of this seasons Beacon Studies project (K047) were to:

a) Resolve the apparently enigmatic occupance of sheet sandstones in a meandering river sequence observed during the 1988-89 field season (Woolfe 1989*)

b) To determine to process responsible for the formation of hummocky cross stratification and swaley cross stratification in a nonmarine regime.

c) To document and sample for paleoclimatic studies the extensively exposed Permian high-latitude forest.

d) To produce a 1:20,000 scale geological map of Allan Hills and an accompanying text.

All of these objectives were met beyond our original expectations. In addition evidence for the existence of a previously unrecorded Jurassic glaciation was uncovered and detailed paleocurrent measurements are expected to provide new insights into the depositional modes of meandering rivers.

2) PLANNING

At all stages planning proceeded efficiently. No problems were encountered either before, during or after Tekapo. Valuable assistance was provided by DSIR Antarctic staff during this phase of the event.

3) CARGO

Cargo to Scott Base was consigned along with equipment for other VUW projects. It consisted of small items of field equipment and air photos.

Approximately 250 lbs of rocks and general cargo were returned to Wellington at the end of the season. An additional quantity of rocks (about 600 lbs) were shipped indirectly to Leeds.

All cargo, both two and from Antarctica, arrived at its destination on time and intact.

4) PERSONNEL

Dec 1 - Jan 23

Ken Woolfe	Field Leader	Antarctic Research Centre, Victoria University P.O. Box 600, Wgtn.
Malcolm Arnot	Geologist	" "
Jane Francis	Paleoclimatologist	Geology Dept, University of Adelaide,

Jan 3 - Jan 23

Peter Barrett	Event Leader	Antarctic Research Centre, Victoria University of Wellington.

Norman Smith	Sedimentologist	Geology Dept, University of Illinois, Chicago.

5) PREPARATIONS FOR THE FIELD

Preparations for the field proceeded smoothly, thanks largely to the efforts of the Scott Base team.

6) FIELD TRANSPORT

Helicopter Operations:

There were no problems with the put it flights to Allan Hills. The Apple was under-slung and was flown at up to 60 kts, but even so it still required two lifts from C. Roberts to Allan Hills.

All helo operations proceeded on time and with on undue problems. An unscheduled visit from US Navy staff provided an opportunity flight to transport two pax plus a total station to Baldrick.

7) EVENT DIARY

Nov 28	Arnot and Francis to Christchurch.
Nov 29	Woolfe to Christchurch.
Nov 30	Aircraft delay.

Dec 1	Aircraft delay, Francis and Woolfe collect wood samples near Arthurs Pass.
Dec 2	Arnot, Francis and Woolfe to Scott Base.
Dec 3	Event briefing and field preparation.
Dec 4	Preparation for field, Francis on Survival School.
Dec 5	Arnot and Woolfe to Survival School.
Dec 6	Arnot and Woolfe to Allan Hills, accompanied by P. Harding (Base Engineer). Apple Hut moved from C. Roberts to Allan Hills by helo.
Dec 7	Francis to Allan Hills, Harding returns to Scott Base. Local geology and recce in late afternoon.
Dec 8	Party leaves for short recce of Feistmantel Valley before lunch, but becomes so excited by the discovery of a possible Jurassic tillite that lunch is cancelled.
Dec 9	Party measures paleocurrent and describes tree stumps and logs in Wce western side of Feistmantle Valley.
Dec 10	Paleocurrent measuring and section description in Pond Valley.
Dec 11	Fine, freshening southerlies. Party visits Feather Bay, easy travel across blue ice in Manhaul Bay. Logs and tree stumps along with silicified peat rafts discovered in Feather Conglomerate.
Dec 12	Fresh southerlies, Arnot and Francis locate and describe Permian tree stumps and logs on Wce platform just east of camp. Woolfe measures ripple and bar orientations in Pond Valley.

Dec 13 Fine and calm, party examines Mawson Formation west of Feistmantel Valley, documenting evidence for a Jurassic glacial event. Comms with Scott Base fade out during Tx.

Dec 14 No comms with Scott Base this morning. Freshening southerlies, party to Roscollyn Tor, via ridge to the north of Trudge Valley and Windwhistle Peak. Strong winds make sample collection and description impossible, party returns to camp late evening.

Dec 15 Strong southerlies with blowing snow on the peaks forces an office day. The Apple really proves its worth, enabling the party to work in comfort on what otherwise would have been a pit day. Weather clearing late afternoon, Francis examines trees in Wce, Arnot and Woolfe measure paleocurrents close to camp.

Dec 16 Cloudy and calm, strong southerlies by late afternoon. Arnot and Francis examine paleosols in first embayment north along eastern arm ("Paleosol Valley"). Woolfe maps Trudge Valley and eastern ridge of Watters Pk.

Dec 17 Fresh southerlies, party revisits Mawson exposures west of Fiestmatel Valley to collect samples, including plants. Late evening, Arnot and Woolfe recce Watters Peak.

Dec 18 Calm at first! Party works on paleosols in Feather exposures south of Trudge Valley.

Dec 19 Mostly light winds, passing snow showers. Arnot measures sections, Francis investigates trees and Mawson Formation and Woolfe looks at paleocurrents, all in Fiestmatel Valley.

Dec 20 Fine and sunny, cold fresh southerlies. Party splits up to thrash the trees, ripples and sections in Fiestmatel Valley some more.

Dec 21 Fine, light winds. Francis lake sediments and trees, arnot section measuring, Woolfe paleocurrents.

Dec 22 Light winds, mostly cloudy, snow flurries. Arnot to Trudge Valley, Francis to Fiestmantle, Woolfe to Jacquie.

Dec 23 Light winds, mostly cloudy, snow flurries. Arnot continues section measuring, Francis to Jacquie, Woolfe to Pond Valley.

Dec 24 Fine and calm. Francis to Watters Peak and work around Camp. Arnot and Woolfe complete mapping circuit of both the western and eastern arms.

Dec 25 Fine light winds. Rest day.

Dec 26 Mostly fine with light winds, team to examine wcf split eastern side of Pond Valley.

Dec 27 Fine, cold southerlies. Arnot plots up section data at camp, Francis works between camp and Pond Valley, Woolfe to Paleosol Valley returning via Hidden Ponds.

Dec 28 Fine, fresh southerlies with blowing snow on ridges, brief northerly change late in the day brings light snow. Local geology.

Dec 29 Fine, fresh southerlies easing, Arnot and Francis to Roscollyn Tor, Woolfe drafts map text.

Dec 30 Fine fresh southerlies becoming strong. Arnot and Woolfe to Trudge Valley, section and paleocurrent measuring. Francis paleobotany between camp and

Westend Platform.

Dec 31	Northerlies developing, mostly cloudy intermittent light snow. Party maps south arm as far south as Alex.
Jan 1	Fine, light southerlies. Arnot to Fiestmantle Valley, Francis local geology, Woolfe to Trudge Valley.
Jan 2	Fine, cold southerlies. Party to Feather Bay. Barrett and Smith to Scott Base after a boomerang earlier in the day.
Jan 3	Mostly cloudy light winds, Arnot to Pond Valley, Francis and Woolfe to Fiestmantle. Barrett and Smith survival training.
Jan 4	Mostly cloudy and calm, passing heavy snow showers, snow lying. An office day due to lack of exposure. Barrett and Smith finalise their preparations for the field.
Jan 5	Mostly calm with scattered cloud. Hourly met obs from 0630 NZST (about 0200 Allan Hills time!). Barrett and Smith arrive Allan Hills by Helo. Party reviews local geology.
Jan 6	Fine, southerlies fresh at times, Arnot and Woolfe to Fiestmantle Valley and then Baldrick. Barrett, Francis and Smith examine trees on wce platform east of camp.
Jan 7	High level could, southerly strong at times. Arnot to Hidden Valley, Barrett and Smith to Pond Valley, Francis to Fiestmantle, Woolfe works on wcc.
Jan 8	Strong to gale southerlies, blowing snow on ridges. Mostly an office day, team visits lower Fiestmantle Valley in afternoon.
Jan 9	Fine, strong southerlies easing. Arnot and Woolfe take opportunity flight to

Baldrick and return leaving total station on site, establish ground marks at Camp, Lisa and Jacquie, then return on foot to Baldrick and survey in local control. Barrett and Smith to Trudge Valley, Francis hunting Vertebraira.

Jan 10 Fine and calm, late afternoon cloud. Arnot and Woolfe surveying, Barrett and Smith to Trudge Valley, Francis to Westend Platform.

Jan 11 Fine southerlies becoming strong. Arnot and Woolfe surveying, Barrett and Smith to Pond Valley, Francis to Westend Platform.

Jan 12 Strong southerlies, Arnot to eastern end of Trudge Valley, rest of team work locally.

Jan 13 Fine, fresh southerlies, Arnot samples coal for DSIR Geology and Geophysics, Barrett and Smith to Pond Valley, Francis local geology, Woolfe to Wce Saddle.

Jan 14 Cloudy with light winds, light snow later. Arnot and Woolfe to western end of Trudge Valley, Barrett and Smith to Pond Valley, Francis local geology.

Jan 15 Cloudy passing snow showers, mostly light easterlies. Arnot, Francis and Woolfe survey western Fiestmantle Valley, mission abandoned before lunch due to poor visibility. Arnot and Woolfe to Hidden Valleys, Barrett and Smith to wc1, Francis works at camp.

Jan 16 Mostly cloudy with light winds, Arnot to Hidden Valleys and Jacquie, Barrett and Smith work on wc1, Francis western Fiestmantle, Woolfe local geology.

Jan 17 Fine and calm. Arnot to eastern Trudge Valley, Barrett and Smith to Westend Platform, Francis local geology, Woolfe to Balance Peak, Roscollyn Tor and Scythian Nunatak.

Jan 18	Fine with light winds, Arnot and Francis pack samples, Barrett local mapping, Smith to Pond Valley, Woolfe to Pond Valley then Ship Cone.
Jan 19	Fine at first cloudy and light snow later. Party to Westend Platform and vicinity. Smith to ridge south of Baldrick.
Jan 20	Light winds, passing snow flurries, Arnot, Francis and Woolfe start breaking camp, finish packing samples and stage loads at helo pad. Barrett and Smith local geology.
Jan 21	Fine light winds. Party returns to Scott Base leaving all non-essential cargo at Marble Point.
Jan 22	Preparing for departure, Smith to CHCH.
Jan 23	Arnot, Barrett, Francis and Woolfe return to CHCH.

9) WEATHER

The party experienced "good" weather for most of the trip. During this time several patterns emerged which greatly aided daily planning.

Fine weather with easterlies or northerlies was almost invariably followed by cloud (usually st or sc at about 8000') very light snow and gentle breezes.

Clear skies with fresh to strong southerlies were the norm. These conditions may continue for days with out significant change.

Low level clouds were observed on several occasions lying along the Mawson and lower Odell Glacier but these had little or no effect on the weather experienced at Allan Hills.

On most days sc and st built up durring the afternoon and evening over the higher parts of the Convoy Range. While this near daily pattern had little or no effect on field work at Allan Hills it can make helo operations difficult.

In general morning weather was better, and the Convoy Range clear.

10) LOSS AND DAMAGE TO EQUIPMENT

All field equipment functioned without problem. With the exception of a grey Brunton Compass (belonging to Woolfe), which was lost, all items were returned from the field.

Several pairs of crampons suffered point losses as result of prolonged use on blue ice. This emphasis the need for parties working in known blue ice areas to carry extensive crampon spares.

11) FIELD EQUIPMENT

As usual issued field gear was of a high standard and functioned well. The use of the Apple Hut warrants specific mention.

Apple Hut.

The apple proved to be an ideal deep field structure and without it we would not have been able to so readily achieve our objectives. We were provided with a small lpg heater but on sunny days the heater was not necessary and a primus was sufficient to heat the apple to a comfortable level for computing.

The hut was positioned on flat rock and secured by metal pegs placed in 20-30 cm deep drill holes. These were cemented in place with water. Care must be taken when opening the door in windy conditions. Ideally the hut should be orientated so that the door opens back to the prevailing wind direction.

There can be little doubt that the apple made a significant contribution to the success of the expedition. The use of such structures in the future should be encouraged.

12) RADIO COMMUNICATIONS

HF communications with Scott Base were generally good and no problems were encountered with the Compac. The comms operators at Scott Base and the Vanda crew provided excellent support and their tolerance of our "flexi sked" is appreciated.

With the increasing amount of communications taking place between Scott Base and other non-NZARP stations (both bases of other nations and ships) there is a need for a clear statement on traffic priory. On a number of occasions we were kept waiting at our prearranged sked time while Scott Base management chatted to ship-borne observers. On one occasion the delay exceeded 45 minutes. It is suggested that field party skeds be given priory over social or routine communications between other bases and ships.

Tait hand helds were used from time to time in the field. These were invaluable during surveying operations and at times when the party was widely spread.

Three solar panels were used to charge batteries for both the three hand helds, the compac and a 12 volt gel cell for the computer.

13) EVENT STATUS ON LEAVING ANTARCTICA

The event returned to New Zealand on time. All rocks samples and other general cargo has subsequently arrived safely in Wellington and Cambridge as required.

All materials, with the exception of the Apple, were returned from Allan Hills prior to our departure from the field. On leaving Scott Base the apple was still at Allan Hills but this has been subsequently returned to Cape Roberts. It is not known whether the metal pegs were recovered at this time.

K047

1990/91

IMMEDIATE SCIENCE REPORT

K047 : FLUVIAL AND PALEOBOTANICAL STUDIES AT ALLAN HILLS

New Zealand Antarctic Research Programme 1990/91

K.J. Woolfe and P.J. Barrett

(DRAFT)

Event Personnel: K Woolfe
P Barrett
J Francis
M Arnot
N Smith

December 1990 - Jan 1991

NZARP REPORT No. 1 : IMMEDIATE SCIENTIFIC REPORT TO THE ROSS DEPENDENCY RESEARCH COMMITTEE

1) ABSTRACT

During the 1990-91 field season three geologists from Victoria University's Beacon studies project revisited Allan Hills, an area where Beacon Supergroup sediments are exceptionally well exposed. The party also included a paleoclimatologist from the University of Adelaide and a sedimentologist from the University of Illinois.

The project was extremely successful, meeting all of its original objectives and discovering unexpected geological features. A 1:20,000 geological map was completed to draft stage, as was an accompanying text. A remarkable Permian fossil forest was documented and samples collected for paleoclimate studies. About 10,000 anchient river flow directions were measured, which along with lithologic observations have provided the basis for a more realistic model to explain the presence of sandstone sheets in meandering river complexes. Evidence was found of glaciers still existing in highlands to the east of Allan Hills during the period that the forest flourished. New field data suggest a previously unrecorded glaciation in Early to Mid-Jurassic times.

Allan Hills exposures are far more significant than originally anticipated. The Weller Coal Measures are superbly exposed and contain abundant fossil trees many in upright position. In addition the area contains the only known occurrence of large fossil trees in the Feather Conglomerate. These and other features have led to a proposal that part of Allan Hills be managed as a Specially Protected Area.

2) PROPOSED PROGRAMME

The objectives of this season's Beacon Studies project (K047) were to:

a) Resolve the apparently enigmatic occupance of sheet sandstones in a meandering river sequence observed during the 1988-89 field season (Woolfe 1989*)

b) To determine the process responsible for the formation of hummocky cross stratification and swaley cross stratification in a nonmarine regime.

c) To document and sample for paleoclimatic studies the extensively exposed Permian high-latitude forest.

d) To produce a 1:20,000 scale geological map of Allan Hills and an accompanying text.

3) SCIENTIFIC ENDEAVOURS AND ACHIEVEMENTS

Introduction:

The 1990-91 Beacon Studies project received excellent support from Scott Base and no logistic problems were encountered. In contrast to previous seasons the project experienced good weather conditions resulting in considerably more science being undertaken than was originally anticipated. The use of an Apple Hut at Allan Hills provided a warm and comfortable base for map drawing and computing. The inclusion of two overseas scientists in the party provided valuable additional expertise in specialist fields.

These factors combined with a strong team identity resulted in a very successful field season. All of our original objectives were achieved and a number of additional problems were addressed.

Results:

Geological Mapping

Field mapping at a scale of 1:20,000 was completed as planned. The Weller Coal Measures being mapped to member level. A draft map and text was completed in the field, and it is expected that this will be submitted for publication later this year (woolfe et al. in prep). Additional geographical control was established using a total station and three GPS sites established by the USGS-DOSLI program. Three cairns were established near the head of Manhaul Bay and tied into the GPS network. Details of these sites will be included in a volume of geological data to be published later this year.

Enigmatic Sandstone Geometries

Field relationships and paleocurrent analysis has shown that the apparently enigmatic sandstone geometries resulted from the interaction of two different sedimentary systems. Some of the sheetlike geometries probably represent episodic advances of a sandy alluvial fan originating in highland to the east while other originated within the meandering system itself.

This interpretation leads to two significant findings. Firstly, paleocurrent analysis of the fan derived sheets show that highlands of crystalline basement rocks existed to the East of Allan Hills during the Permian. Of more significance is the finding that meandering rivers can deposit extensive sandstone sheets with internally complex geometries and diverse paleocurrent directions. This contrasts strongly with accepted models of meandering river deposition and suggests that a previously unrecognised process was occurring.

Further work is required to fully document an alternative model. However, it is envisaged that the sheet sandstones were deposited by blind swamp-draining meandering rivers. The unusual bed geometry results from biogenic aggradation of the flood plain (swamp) exceeding the clastic accumulation of the meandering system (Woolfe et al submitted).

Paleobotanical Studies

Paleobotanical studies revealed evidence for the in situ formation of Gondwana Coals a previously unrecognised feature (Francis et al. accepted). This evidence included the presence of Vertebraria roots in shaly units both within and at the base of major coal seams and the occurrence of upright stumps within coal seams.

Further laboratory studies are required to document fully the climate record contained in the fossil wood, but the occurrence of outsized clasts, ice needle impressions and a striated boulder in associated strata suggest that the climate was at least cold enough for the formation of winter ice locally, and perminent ice fields with glaciers higher in the drainage basin. Wide growth rings in the trees indicate that conditions were favourable during the growing season.

Hummocky and Swaley Cross Stratification

Paleocurrent determinations, facies associations and geometric considerations show that many of the structures resembling HCS and SCS within the Weller Coal Measures are drape features. Where pre-existing channel floor topography has been mantled by planar or ripple laminated sediment deposited in waning flood stage. It is believed that drape features of this type have not been previously documented.

Permian Glaciation

Several lines of evidence have led to the conclusion that glaciers still occupied highlands to the east of Allan Hills during the deposition of the Weller Coal Measures (Barrett et al. submitted). These include:

a) Rhythmically laminated muddy sandstone and sandy mudstone. Rhythmic lamination is unusual in fluvial systems other that those controlled by seasonal ice melting.

b) Pockets of outsized clasts, these are typically pebbles 2-5cm in diameter contained within sandy or muddy horizons. These grouped pebbles are interpreted as having been ice rafted by lake or glacier ice floating down current during of after major thaws.

c) A large striated boulder was found in WC1 in "Camp Valley". Multidirectional striae show that the boulder was striated prior to its inclusion in the surrounding sediment and the fine preservation suggests limited fluvial transport.

Paleocurrent Relationships

An extensive suite of paleocurrent measurements (about 10,000) were made during the field season. Primary data processing was conducted in the field using at Toshiba T1600 laptop and a tailor made software package (PC 0.1, Zwartz in prep).

Further processing of this data base is required. However, initial results indicate that the relationships between ripples, crossbeds, bar sets, paleochannel directions and sinuosity are probably more complex than previously thought. It is anticipated that the data set will allow, possibly for the first time, a quantative analysis of preservation potential and bias within a meandering river complex. The entire data set will be made available in published form later this year (Woolfe (ed) in prep).

Jurassic Glaciation

The Mawson Formation was subdivided into two lithostratigraphic members based on clast composition and textural differences. The lower of these members, Mawson A (Woolfe et al. in prep), is interpreted as being of glacial origin. This interpretation is supported by:

a) An extensive erosion surface (Mawson Erosion Surface (Woolfe et al in prep)) which separates Beacon and Ferrar rocks at Allan Hills. This surface has over 400 m of sharp relief at Allan Hills and indicates a period of uplift and erosion prior to the main magmatic phase of the Ferrar event.

b) Mawson A is directly underlain by locally intensely folded sediments of the Beacon Supergroup. The intensity of folding decreases downwards from the erosion surface over a few tens of metres. Within the zone of most intense folding, metre and decametre scale isoclinal folds have formed during complex brittle failure of interbedded sandstone and shale while cataclastic flow occurred in some coal seams. Strain is partitioned into a zone subparallel with the Mawson Erosion Surface.

The style and distribution of deformation is closely analogous to that observed locally beneath the Sirius Formation, a known glacial deposit. This suggests that both the sub-Mawson and sub-Sirius strain resulted from similar processes. We believe that the deformation resulted from ice contact drag folding at the base of a dry-based glacier.

c) Several striated clasts were found within Mawson A. It is unlikely that these could have survived prolonged transportation and they are taken as direct evidence that diamictite and the sub-erosion surface deformation were glacially produced.

Sirius Formation

Extensive exposures of the Sirius Formation occur through Allan Hills. Although the formation was not studied in detail during the 1990-91 a number of features were recorded which could form the basis of a more detailed study in the future.

a) Glacial striae are preserved in several locations both adjacent to and beneath the Sirius Formation. These could be used to supplement geomorphic and fabric studies in order to constrain paleo-ice flow directions.

b) At a number of localities Sirius Formation directly overlies well exposed deformed Beacon sediments. It is believed that these underlying rocks were deformed by ice contact drag folding. A study of the structural styles of both the sub-Sirius and sub-Mawson deformed zone could provide a better understanding of ice-rock interactions.

c) Several different emplacement mechanisms are suggested by the geomorphic position of the diamictite exposures. These include valley floor, valley wall and ridge line deposits.

4) PUBLICATIONS

The expedition is expected to result in a number of journal publications, conference papers and an addition to the Victoria University Antarctic Data Series. The status of those publications on which work has already started is as follows:

ACCEPTED:

Francis, J. E.; Woolfe, K. J.; Arnot, M. J.; Barrett, P. J. : Permian fossil forests and climates of Allan Hills, Antarctica. 8th International Gondwana Symposium, Hobart.

SUBMITTED:

Barrett, P. J.; Smith, N. D.; Woolfe, K. J. : Early Permian glaciation in Antarctica - Evidence from Allan Hills. 6th International Symposium on Antarctic Earth Sciences, Tokyo.

Woolfe, K. J.; Arnot, M. J.; Barrett, P. J.; Francis, J. E. : Contrasting fluvial styles in the Weller Coal Measures at Allan Hills. 6th International Symposium on Antarctic Earth Sciences, Tokyo.

IN PREP:

Woolfe, K. J. (ed)   : Geological data from an ancient alluvial system (Permian) preserved at Allan Hills. Antarctic Data Series . Victoria University of Wellington

Woolfe, K. J.; Arnot, M. J.; Francis, J. E; Barrett, P. J.   : Geology of Allan Hills, southern Victoria Land Antarctica.

PLANNED:

Papers on (with principle author(S)):

Jurassic Glaciation (Francis and Woolfe)
Paleocurrent signatures and preservation bias (Woolfe and Barrett)
Sheet Sandstone facies relationships and interpretation (Smith).
Paleoclimate from tree ring studies (Francis)
Paleosinuosity (Barrett)
Non-avulsive Meandering systems (Woolfe)

5) ENVIRONMENTAL IMPACT

All non-burnable solid wastes (including human) were returned to Scott Base. Burnable solids were incinerated in the field and the remains returned to Scott Base for disposal.

A limited number of geological samples were collected for laboratory study. These were mainly for paleobotanical and paleoclimatology studies at the University of Leeds (Francis).

Three large rock cairns were established at survey control points near the head of Manhaul Bay. A number of small numbered cairns were established on significant outcrops however, these are expected to be dismantled by the wind.

Numerous refuge items left by previous expeditions were recovered and returned to Scott Base for disposal.

6) FUTURE RESEARCH

The 1990-91 field season was the last in the current round of Beacon studies at Victoria University. However, it is clear that further research should be carried out. The excellent exposure and preservation of geological features in the Beacon Supergroup at Allan Hills makes the area ideal for the study of fluvial process. Many exposures documented by this and previous projects should be revisited in order to further our understanding of geological processes.

A number of findings made by the 1990-91 expedition will almost certainly result in further work being undertaken both in Antarctica and elsewhere.

a) Fluvial modelling is expected to produce a new model to explain the deposition of sediment by meandering rivers. Funding has already been secured for additional fieldwork in south Westland and it is anticipated that additional Antarctic field work will be proposed in the next few years.

b) New evidence relating to Gondwana glaciation is likely to generate substantial international interest. It is likely that a proposal to revisit Allan Hills to further investigate Jurassic glaciation, Permian glacio-fluvial interactions and glacially produced bedrock deformation will be prepared.

c) Paleobotanical studies have revealed an unequalled occurrance of high-latitude Permian trees. It is almost certain that additional climatological and botanical studies will be conducted at Allan Hills considering the international significance of the occupance.

In general it is felt that the next round of Beacon studies at Victoria University will involve additional interaction with overseas institutions and will be process orientated. However, although several overseas parties have expressed an interest in working with the universities Beacon program no definite plans for future work have been formulated.

7) MANAGEMENT OF SCIENCE IN THE ROSS DEPENDENCY

The Allan Hills contain a number of geological features of international significance. These include:

a) Abundant trees and logs within the Weller Coal measures. Excellent exposure combined with an abundance of both upright and fall trees makes this locality one of the best fossil Permian forests yet discovered. This is a unique and valuable occurrence containing a well preserved high-latitude flora.

b) Fossil trees and peat rafts in the Feather Conglomerate. This represents the only known occupance well preserved fossil plant material in the Feather Conglomerate, a formation that spans the Permian-Triassic boundary.

c) Excellent exposure of fluvial sediments. Natural processes of wind and glacial erosion have given rise to unequalled exposures of fluvial sediments (Weller Coal Measures).

It is well known that fossil wood is easily collected from Allan Hills. This has led to its collection by scientists and other visitors (including helicopter crews, DVs and the like), and pedestrian traffic has dislodged and dispersed other specimens. These activities have already led to some destruction of irreplaceable and scientifically important specimens. We believe that a management plan needs to be introduced to protect these occurrences from further damage. We therefore formally propose that a Specially Protected Area be established at Allan Hills in due course.

This proposal will likely encompass the area bounded by:

The permanent ice edge of Manhaul Bay from Denes Point to the western side of Fiestmantle Valley.

The ridge line from Denes Point to Balance Peak and Roscollyn Tor.

A line drawn between Roscollyn Tor and Watters Peak.

A line drawn between Watters Peak and Baldrick (GPS site marked by rock cairn on summit).

A line drawn from Baldrick to the edge of the Permanent ice on the western side of Fiestmanle Valley.

It will likely be proposed:

That entry into this area be restricted to protect the geological features contained within it.

That the sampling of in situ fossil wood, leaves and other plant material should be permitted only after adequate scientific justification has been provided.

That every effort should be made not to disturb fossil localities, and that pedestrian traffic should where possible be restricted to areas protected by surfacial deposits (moraine, scree, pavement) or snow.

That the collecting of any fossil plant materials, in situ or otherwise, for other than scientific study should not be permitted.

8) ACKNOWLEDGEMENTS

The success of the 1990-91 field season is a reflection of the efforts and support of numerous people and organisations to all of whom we are grateful. DSIR Antarctic staff provided excellent support and advice in the planning stages and the efforts of Garth Varcoe in co-ordinating the Hut and staging equipment at Cape Roberts warrant special mention.

As usual support from Scott Base staff exceed all reasonable expectations and this was particularly true in the stores department. The USGS-DOSLI survey assistance team are thanked for siting two GPS site within easy walking distance of our campsite. These provided much need control for local surveying carried out during the project.

Alex Pyne (Expedition Manager at VUW) provided much logistic and computing advise during the planning phase of the expedition, and Dan Zwartz (VUW) wrote the paleocurrent software.

Funding for the expedition was provided by the New Zealand Vice Chancellors Committee, Victoria University's Internal Grants Committee and the Australian Geographic Society. The Internal Grants Committee (VUW) also provided funding to develop the software package.

NZARP REPORT No 2
LOGISTIC REPORT TO DSIR ANTARCTIC

BY

K-048
WEST ANTRACTIC VOLCANO EXPLORATION
(WAVE)
October 1990 - January 1991
Participants:
J.A. Gamble (K-048)
W Atkinson (K-048)
J.L. Smellie (K-048)
P. Rose (K048)
W.C. McIntosh (S-081)
K.T. Panter (K-081)

prepared by J.A. Gamble

AIMS

The aim and objectives of the WAVE programme are to understand better the volcanology of the late Cenozoic Volcanic Province of West Antarctica, to document in detail the chronology of individual volcanoes and to elucidate the petrogenesis of the magmas and their sources. In addition, xenoliths carried to the surface by volcanic processes would be used to reconstruct sections through the lithosphere.

PLANNING

Logistic planning for phase two of the WAVE programme had been established in June 1989. Further planning was undertaken at the Tekapo orientation meeting and final details decided at a briefing with VXE-6 in Mc Murdo.

CARGO

Some equipment was transported to Scott Base as a part of the VUWAE shipment. Some equipment from the 1989/90 season had been stored over at Scott Base and in a sealed cage at Mc Murdo (BFC). No excess baggage was carried to or from Scott Base. Some 800lbs of rock samples were returned to New Zealand by Gamble for study at Victoria University.

EVENT PERSONNEL

Members of K-048 for the 1990/1991 field season to West Antarctica (Mount Murphy and Executive Committee Range) were as follows:

1) John Gamble, Dept of Geology, Victoria University of Wellington.
2) Bill Atkinson, Field Leader, 173 McKenzie Drive, Twizel.
3) John Smellie, British Antarctic Survey, Madingley Road, Cambridge, U.K.
4) Paul Rose, Field Leader, British Antarctic Survey, Madingley Road, Cambridge.

This party was augmented by personnel from USAP S-081: W.C. McIntosh and K.T. Panter and P.R. Kyle and N.W. Dunbar (the latter 2 from 2nd January 1991).

PREPARATIONS FOR THE FIELD

The party (including S-081) assembled in Christchurch on 30th October 1990 and after a 24 hour cancellation due to bad weather at McMurdo, departed on 1st November 1990 for the ice. The flight was event free. Field equipment, tents, cooking equipment and provisions were assembled at Scott Base and McMurdo in the period 2nd to 8th November 1990. Recce flights planned on the 4th and 5th November were both cancelled due to poor weather in Marie Byrd Land. Skidoos and several of the sledges were tested during a number of short shake down trips along and over Hut Point Peninsula. Put-in to Mount Murphy was on 10th November 1990.

FIELD TRANSPORT

A detailed report on the effectiveness of the Bombadier Alpine 503 skidoos and sledges for transportation was presented in the 1989/90 WAVE report. Similar transport was used this season but fuel was air-dropped during the recce flight. We can report that our mechanical equipment again performed well and few running repairs were necessary. Further details are included in the Field Leaders report (Appended as Appendix 2).

EVENT DIARY

1st November 1990	WAVE party to Scott Base by C-141 transport.
2-8th November 1990	Event preparation, shake down trips and Recce flight (8th - 9th November).
10th November 1990	Put-in flight to south side of Mount Murphy Volcanic Complex. Travelled 10 km and established Camp 1. Clocks advanced 4.00 hours to MBL time.
11th November 1990	Time spent organising camp, fuel (which had been air dropped during recce flight), provisions, etc. Meteor sighted by JAG at midnight (MBL time) travelling in a W-E trajectory above Mt Murphy.
12th November 1990	Field work on Sechrist Ridge between Sechrist Peak and Bucher Peak. Rose and Atkinson returned to Put-in site to recover additional fuel. Route flagged on return.
13th November 1990	Field work at Petril Nunatak and Turtle Peak. Route flagged. Returned to camp early due to gathering storm.
14th November 1990	Storm all night with winds to 50 knots.
15th November 1990	Field work at Petril Nunatak, returned to camp at 6.00pm in white out and blowing snow.
16 November 1990	Awake to blowing snow after storm night, visibility down to zero.
17th-22nd November	Storm. Time spent in and around camp.
23rd November 1990	Camp move to Camp 2 at Turtle Peak (75^0 27'S, 111^0 15'W), arriving at 9.30pm.
24th November 1990	Petril Peak section with JLS. Rose and Atkinson recce and

flag route to Dorrel Rock.

25th November 1990	Work on Petril Peak on a beautiful day.
26th November 1990	Field work on summit section of Petril Nunatak. W Mc Intosh looses field book down crevasse.
27th November 1990	Mapping and measuring on the Sechrist amphitheatre with Mc Intosh and Panter.
28th November 1990	Mapping and collecting in area south of Sechrist Peak. Xenoliths collected from cone SW of Sechrist Peak.
29th November 1990	Section measuring at Heden Nunatak with JLS. Rose and Atkinson return to Camp 1 to recover fuel and provisions.
30th November 1990	Turtle Peak with McIntosh and Panter.
1st December 1990	Dorrel Rock gabbro with Atkinson, Panter, McIntosh via previously flagged route.
2nd December 1990	Rough night with gusts to 50 knots. Day spent organising gear for camp move tomorrow.
3rd December 1990	Camp move to North Bay and Camp 3, due East of Kay Peak (75^0 14'S, 110^0 50'W).
4th December 1990	Mapping and collecting west of Kay Peak. JLS found plant fossils in basement sediments. We map high grade metamorphics.
5th December 1990	Mapping on ridge south of Kay Peak with McIntosh and Panter. Volcanics overlying basement metamorphics.
6th December 1990	Light snow falling and limited visibility. Tent day.
7th December 1990	Snow continued to fall over night and wind increased ~6.00 to 20 knots. Continued all day. Tent day.
8th December 1990	Wind dropped over night but visibility still v. poor. Wind kept switching direction throughout day.
9th December 1990	Camp move in near white-out conditions to a site near Benedict Peak. Camp 4 (75^0 14'S, 110^0 30'W) at Benedict Peak. Party undertook recon trip to Eisberg Head.
10-17th December 1990	Storm. Gusts up to 70 knots. USAP tent suffers structural damage, NZARP survival tent dissintegrates, several sledges suffer structural damage.
18th December 1990	Heavy snow falling in morning but wind has dropped. Camp move begun pm. Return to Camp 1.

19th December 1990	Arrive at Put-in site at 3.45am and sleep until noon. Awake to a cloudy overcast day and spent time reorganising camp and packing gear and garbage.
20th December 1990	Field work on ridge between Sechrist and Bucher Peak but outcrop entirely snow covered following storm. Walked out all outcrops on ridge in search of xenolith localities. Visited new xenolith locality on Hawkins Peak (pm) discovered earlier by McIntosh and Panter.
21-22nd December 1990	Put-in Camp site awaiting pickup.
23rd December 1990	Camp move to Camp 5 at Calendar Peak (). Party travelled "light" with 4 sledges and 3 skidoos. Fierce wind at Calendar.
24th December 1990	Return to put-in camp amid deteriorating weather conditions.
25 Dec - 2nd Jan 1991	Wind and blowing snow, variable visibility and occasional "holes" in the cloud cover. Tent days.
3rd January 1991	Wind dropped overnight and we were in a clearing "hole" by morning. LC-130 arrived at 8.45 pm and returned party to Byrd Surface Camp. 3 members of party returned to McMurdo and 3 moved to Mt Hampton being joined by 2 from S-081(Kyle and Dunbar).
3rd-4th January 1991	Put-in to Mt Hampton and arrival of BAS Twin Otter from Ford Ranges.
4th-6th January 1991	Mt Hampton and Whitney Peak.
6th January 1991	Gamble, Atkinson and Panter return to NZ from Mc Murdo.
7th January 1991	Kyle and Dunbar to Mt Waesche by Twin Otter. McIntosh, Smellie and Rose to USAS Escarpment.
9th January 1991	Kyle and Dunbar return from Waesche.
11th January 1991	Pick-up by LC-130 and return to Mc Murdo.
12-22nd January 1991	Smellie, Rose join members of S-081 on Mt Erebus.
27th January 1990	Smellie returns ot NZ.
31st January 1990	Rose erturns to NZ.

EVENT MAP

A map is enclosed a Appendix 1 to this report. The map includes details of camp sites in the vicinity of Mount Murphy.

WEATHER

Full details of the weather are contained in the Appendix 3. Weather was again rather fickle and we were only able to work on 35% of the time spent at Mount Murphy. During this time we were blessed with a period of continuous fine weather which lasted 13 days but this intervened storms which lasted 8 days and then 13 days.

ACCIDENTS

No serious accidents occurred during the field season although JAG sustained a bump on the head as a result of some inattentive skidoo driving by an unnamed individual.

FIELD EQUIPMENT

Comments regarding the performance of the field equipment are contained in the report by the NZARP field leader. (Appendix 2).

RADIO COMMUNICATIONS

Radio communicantions used USAP supplied Southcom transmitter-receivers and good communications were enjoyed with S. Pole, Mac Centre and CAZERTZ. Communications with Scott Base were non existent and we used K-051 to relay messages.

The Tait hand held radios performed perfectly as did the solar charging units. The USAP personnel brought Motorola hand helds and we were able to use the same frequency. Hand helds proved much more successful this season than the previous season.

ENVIRONMENTAL IMPACT

This season all waste apart from human wastes (which was buried) was returned to McMurdo for disposal. Plastics, paper and metallic wastes were sorted at the putin site and packed in cardboard containers.

IMMEDIATE SCIENCE REPORT
K-048: WEST ANTARCTICA VOLCANO EXPLORATION (WAVE)
EXPEDITION TO MOUNT MURPHY & EXECUTIVE COMMITTEE RANGE

October 1990 - January 1991

Event Personnel:
J.A. Gamble
W. Atkinson
J.L. Smellie (BAS)
P.Rose (BAS)
W.C. Mc Intosh (USAP)
K.T. Panter (USAP)

ABSTRACT

Phase two of the WAVE field programme involved detailed mapping and sample collection from the Mount Murphy Volcanic Complex (MMVC) and a return to the Executive Committee Range (ECR) to complete studies at the northern end of this line of volcanoes.

The Mount Murphy Volcanic Complex has been deeply eroded to expose sections through the volcano which range from sub aqueous to sub aerial mode of eruption. The volcanic rocks rest on an eroded metamorphic basement complex of high grade metamorphic rocks cut by granitoid intrusions. A single outcrop of low grade sedimentary rock has yielded plant fossils - some of the first insitu fossil material to be discovered in Marie Byrd Land. Detailed study of continuous sections of volcanics up to 600m thick in the vicinity of Turtle Peak, Petril Nunatak, Heden Nunatak and Seechrist Peak has revealed a transition zone from sub aqueous to sub aerial eruption. These relationships together with high precision dating studies by the $^{40}Ar/^{39}Ar$ method promise to reveal much about the glacial-eruptive history of the volcano and to add to the growing knowledge concerning the level of the West Antarctic ice sheet during the Pliocene. Samples collected in association with this mapping will be used to assess the geochemical and petrological evolution of the volcano. A number of satellite basaltic scoria cones on the flanks of the eroded MMVC have yielded upper and lower crustal and upper mantle xenoliths from which we can reconstruct a stratigraphic section through the lithosphere beneath the volcano.

For the last 10 days of field work the party transferred to Mount Hampton at the northern end of the Executive Committee Range (ECR). Here, sampling was assisted by close support from a BAS Twin Otter aircraft. This enabled some of the party to sample tephra layers from blue ice in the vicinity of Mount Waesche at the southern end of ECR and a visit to scoria cones of the USAS Escarpment. Samples for dating and geochemical study were collected from Mt Hampton, Whitney Peak (on the NW flank of Hampton) and the USAS Escarpment (Mt Aldaz). Lithospheric xenoliths were collected from scoria cones on Whitney Peak (NW Mt Hampton) and the USAS Escarpment.

2/ Proposed Programme

The second field season of the WAVE project aimed to visit several of the major volcanic complexes of the Kohler Range, principally Mount Murphy (Appendix 1) to undertake programmes of mapping and sample collection. Later in the season, it was proposed to move to the north end of the Executive Committee Range (ECR) to complete work from the foreshortened 1989/90 season. For the 1990/1991 season we aimed for a LC-130 put-in at Mount Murphy (75º 22'S, 110º 40'W) and from here to travel by sledge party to Toney Mountain (75º 48'S, 115º 50'W). In the latter part of the season the party would transfer (by LC-130) to Mount Hampton (northern ECR) and from here we planned visits to the USAS Escarpment (76ºS, 124 - 129ºW and Crary Mountains (76º 45'S, 117º 50'W) by a BAS supplied Twin Otter aircraft.

Poor weather at Mount Murphy, which resulted in the loss of roughly 2/3 work time, necessitated a change in plans such that the proposed sledging trip to Toney Mountain was scrapped. Also, due to ski damage, the close support promised by the Twin Otter did not materialise and we were only able to transfer and return a party from Mt Waesche and to pay a brief visit to the USAS Escarpment before that aircraft returned to Rothera.

3/ Scientific Endeavours and Achievements

The two planned field seasons for the WAVE project have now been completed and despite rather poor weather conditions being encountered on both seasons, considerable success can be reported.

Detailed stratigraphic mapping has been undertaken on Mt Sidley, Mt Waesche and Mt Murphy. Sampling for geochemical study has been undertaken on Mt Sidley, Mt Waesche, Mt Cumming and Mt Hampton (ECR), the USAS Escarpment and Mt. Murphy. Suites of lithospheric xenoliths have been collected from numerous localities in ECR, the USAS Escarpment and Mt Murphy.

4/ Publications

Results from the first field seasons work on xenoliths from ECR were presented at the Geological Society of New Zealand Annual Conference in December 1990. (Wysoczanski R.J. & Gamble J.A.: Lower Crustal xenoliths from the Executive Committee Range, West Antarctica.). Abstracts of papers have been submitted to the Organising Committee of the Sixth International Symposium on Antarctic Earth Sciences.

5/ Environmental Impact

Apart from the removal of rock specimens for scientific study the impact on the environment is assessed as negligible. Flags were removed from all flagged access routes on completion of work. All metallic, paper and plastic waste was returned to Mc Murdo for disposal. Human waste was buried at site.

6/ Future Research

Detailed analytical work on the materials collected during the 1989/90 and 1990/91 seasons is now underway. R.J. Wysoczanski has applied to the Royal Society of New Zealand for funding from the Prince and Princess Award Scheme to undertake important isotopic work at Royal Holloway & Bedford New College, University of London. Future work will involve placing the West Antarctic xenoliths into a plate tectonic perspective of the Pacific rim region. In the future it would be valuable to return to the Flood Range, Ames Range, Mt. Flint, Mt Petras, the Crary Mountains and Toney Mountain. Visits to these sites of volcanic activity were in the original scope of the WAVE programme, but they were cancelled due either to the inclement climatic conditions during the two seasons or to the breakdown of the Twin Otter.

7/ Management of Science in the Ross Dependency

The two WAVE field seasons involved seven personnel from three national Antarctic research programmes (NZARP, USAP & BAS). Planning and logistic arrangements proceeded according as anticipated. Our recce flight was delayed by several days but the put-in brought forward such that we were in the field on the designated day. Our pick-up at Mt Murphy was delayed form an anticipated 18 December 1990 until 2 January 1991 - frustrating, but a way of life in Antarctica. We had excellent support and advice from the base staff at Scott Base, but I would make a plea for a few more Macs in the science lab. I was never able to get on to a machine when I wanted to.

8/ Acknowledgements

All WAVE personnel extend their thanks to all Scott Base staff for their assistance prior to and following our field season. Thanks also to our friends from "over the hill" notably Ric Campbell, Jill and the BFC staff and Kirk and Pete in the skidoo shop.

POPULAR SCIENCE REPORT
K-048: WEST ANTARCTICA VOLCANO EXPLORATION (WAVE)
EXPEDITION TO MOUNT MURPHY AND THE EXECUTIVE COMMITTEE RANGE

October 1990 - January 1991

K-048 & S-081: WEST ANTARCTICA VOLCANO EXPLORATION (WAVE)

J.A. Gamble (Victoria University, Wellington), J.L. Smellie (British Antarctic Survey), W,C. McIntosh, K.T. Panter, P.R. Kyle and N.W. Dunbar (New Mexico Institute of Mining and Technology).

The two projected field seasons of the WAVE programme for research into the Intraplate volcanoes of West Antarctica have been completed. Detailed volcanological mapping and sampling was undertaken on Mounts Sidley, Waesche and Murphy and additional collections made at Mount Cumming, Dorrel Rock and the USAS Escarpment. Planned visits to Toney Mountain, the Crary Mountains, Mount Petras and Mount Flint were cancelled due to a combination of bad weather and aircraft breakdown.

The mapping programme confirmed that the majority of rocks forming Mounts Sidley and Waesche were erupted sub aerially while on Mount Murphy a transition from sub aqueous eruptions (perhaps sub glacial) at the base of the volcano to sub aerial at higher altitudes has been documented. In addition, sub aerial lavas can be demonstrated to have erupted onto glacially striated surfaces and occasional till horizons separate lava flow units - these sedimentary layers may yield microfossils which will be important paleoclimatic indicators. Other fossil material, which we believe to be the first insitu material from Marie Byrd Land, was found in sedimentary rocks forming the basement to Mount Murphy. High precision $^{40}Ar/^{39}Ar$ dating studies will be undertaken on samples collected across the transition zone. Detailed analysis of this data together with the stratigraphic information may yield important information as to the permanance of the West Antarctic ice sheet during late Cenozoic times.

Geochemical study of the volcanic rocks are being undertaken in order to understand the geochemical evolution of the magmas and their sources. Xenoliths (rock fragments entrained in the lavas and which were plucked from the lithospheric wall rocks as the magmas moved towards the surface) have been collected from parasitic scoria cones in all the centres visited. They range from shallow crustal rocks (either subvolcanic intrusions or immediate basement) to lower crustal (mafic and felsic granulites) to mantle peridotite in composition. The xenoliths promise to give unique information on the crust and lithosphere of the earth in a region where only the tops of the volcanoes peek through the ice cap.

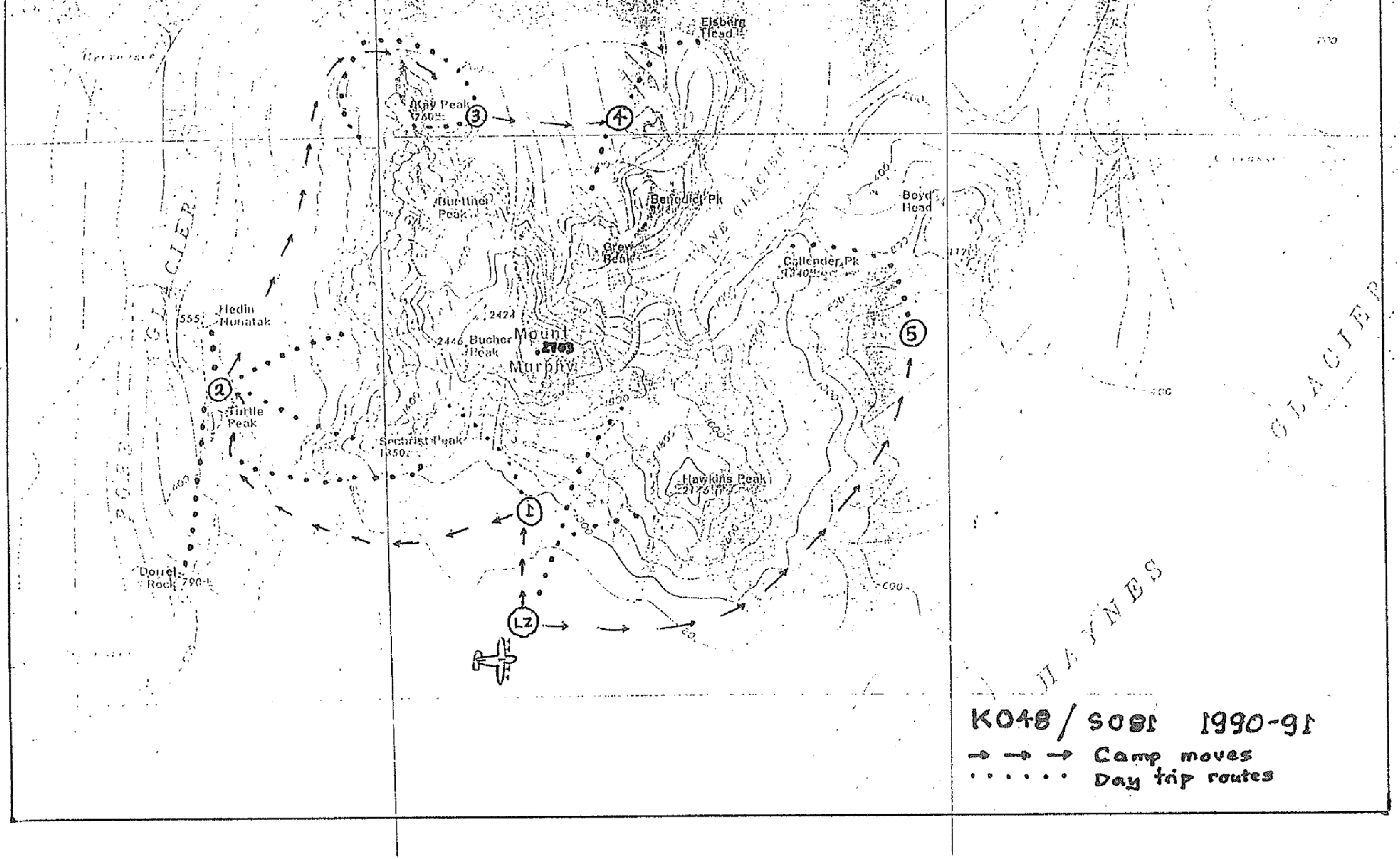
At present two PhD projects are being undertaken in conjunction with the WAVE project and a number of papers have been submitted for presentation at the forthcoming Sixth International Symposium on Antarctic Earth Sciences.

APPENDIX 1

LOCATION MAP AND CAMPS IN VICINITY OF MOUNT MURPHY VOLCANIC COMPLEX

(K-048)

Appendix 1



K048 / S081 1990-91

→ → → Camp moves

· · · · · · Day trip routes

APPENDIX 2

REPORT OF NZARP FIELD LEADER

W. ATKINSON

FIELD REPORT K048

MARIE BYRD LAND 1990/91

Report :

This report is concerned only with the equipment, logistics, and safety aspects of the Event. The scientific program will not be discussed here.

Locality :

The Event worked on and around Mt Murphy, western Marie Byrd Land. See appendix 1 (map detail), and the Mt Murphy sheet of the USGS Antarctica 1:250,000 Reconnaisance series SS 10 - 12/16 1977. Mt Murphy is at 75- 23'S, 110. 45'W.

Personnel :

Bill McIntosh	(Principal Investigator)	USA
Kurt Panter	(Geologist)	USA
John Smellie	(Geologist)	UK
Paul Rose	(Polar Guide)	UK
John Gamble	(Geologist)	NZ
Bill Atkinson	(Field Leader)	NZ

Personnel Selection :

McIntosh and Panter, both from New Mexico Tech, came through the USAP, while Smellie and Rose were employed by the British Antarctic Survey (BAS) in the UK. Gamble is a Senior Lecturer from Victoria University, Wellington. Atkinson, a Mountain Guide based in Twizel, was employed by DSIR Antarctic. All except Rose were on the 1989/90 Event.

Timetable :

The Event reconnaisance flight and airdrop was delayed from 4 November til 8 November, but the put-in at Mt Murphy LZ was accomplished on schedule on 10 November 1990. The lift-out date of 20 December was missed, and the group returned to Byrd Station on 2 January 1991. Panter, Gamble and Atkinson went on to Scott Base/McMurdo, while McIntosh, Smellie and Rose were joined by Phil Kyle and Nelia Dunbar at Mt Hampton. Flights out of Antarctica to New Zealand were further delayed in January.

Tekapo Training :

Gamble and Atkinson attended at Tekapo for 3 days in August 1990 to finalise Event planning details.

Pre-Event Organisation :

Delays on the reconnaisance flight made it necessary to hold the team close to Scott/McMurdo from 4 - 9 November. The food/fuel/equipment were made ready for the put-in flight on 10 November, but the usual shakedown trip/survival training had to be abandoned. As the Event members were, with one exception, on the WAVE program last year, this proved to be acceptable.

Field Equipment / Store :

Much of the equipment was provided by the Berg Field Center (BFC) at McMurdo. This included major items such as ski-doos (snowmobiles), 17 empty jerrycans, 8 x 200 liter full mogas fuel drums, 3 drum frames, two-stroke oil at 1:50 ratio, tools, 8 Optimus 111B stoves, 36 x 1 gal (US) full Coleman stove fuel cans, 8 Nansen sledges, 2 HF field radios, 3 VHF hand-held radios, rock boxes, packaging, and airdrop materials.

The Scott Base Field store and DSIR provided 2 VHF radios and solar chargers, 2 First Aid kits, the personal equipment and clothing for the two NZ and UK staff, and also the camping gear, excepting stoves.

The group all used white gas (Coleman fuel) stoves this year. NZ practice has been to use kerosene with a solid or spirits primer. This experiment with a more volatile fuel was successful. Coleman fuel is conveniently packaged, requires no primer, and burns more cleanly in the tent. The whit gas stoves will easily burn mogas, as proved necessary this season, with the flight out of the field being 12 days late.

Just under 6 x 200 liter barrels of mogas were used by 4 ski-doos, for approx 8 kpl, and an average of 700 km travelled by each machine. 36 cans of Coleman fuel lasted 6 persons (3 tents) approx 45 days, with the last few days on unmixed mogas.

The bulk of the food came through the BFC, with the emergency supply from Scott Base.

Snowmobiles :

The Event used 4 Bombadier Alpine 503 machines, three of which were used t WAVE last year (1989/90). These were equipped with ice cleats, rock boxes, jerrycan frames, and ice axe holders. Emergency tentage was shockcorded to the nose frame for the season. Seat backs were not taken or needed.

The routine maintenance schedule included checking spark plugs, steering linkages, ski bolts, bogie wheel shafts and bolts, transmission belt, trac tension, and transmission oil.

Recorded problems were few, and are listed for each machine.
#1721 : ice-clogged fuel pump induction line; added six new ice cleats.

#1794 : 1 set broken bogie springs; loose steering bolts; loose bolts at top of ski leg, and through spring; replaced spring locking plate; popped front axle seals and lost oil, replaced; front axle bearings and splines a little worn; small track tear at ice cleat.

#1791 : replaced cracked transmission belt; broken brake handle pin.

#1728 : possibly broken lead wire in igniter, replaced.

Our thanks to Kirk Kiyota and Pete, mechanics at McMurdo's ski-doo garage, and to Bill McIntosh, for preparation and care of the machines.

Logistics :

Transport to Antarctica was by C141 at the beginning of November. This happened on schedule, and no equipment was lost. The placing of the reconnaisance on November 4, and its subsequent postponement through to th 8th, displaced the time available for the usual shakedown trip and surviva training at Scott.

The recconaisance flight put one fuel pallet at Mt Toney and three at Mt Murphy, all as requested. Some other items went with the airdrop, and everything at Murphy was recovered intact. The Toney dump was not retrieve due to weather, but was observed to be in place.

The put-in flight was on schedule on 10 November at Mt Murphy.

The lift-out flight was on 2 January 1991, 12 days after the planned date of 20 December 1990. Mt Murphy, and Marie Byrd Land in general, have only narrow 'windows' of flyable conditions. Several of these were missed between 20 December and 2 January.

Communications :

In 1989/90 radio traffic was best achieved on 5400kHz from the Mt Sidley area to Scott Base. This season 5400kHz and 4770kHz to Scott from Mt Murph were ineffective.

Best communications were with McMurdo on 11553kHz, and often to Byrd Surface Camp or Pole Station on 11553kHz or 8997kHz. We reached SPRITE, also in MBL, early in the season, and occasionally a group in the Ruppert mountains, MBL.

Direct contact was never made with Scott Base.

Message transfer from Mt Murphy to Scott via US Navy radio was necessarily indirect, often frustrating, and usually a waste of time. The system improved to some extent when Phil Kyle and Nelia Dunbar arrived in McMurdo, and were able to assist Rick Campbell with the radio traffic. Our thanks to all three.

The field radios used were :

One Southcom 130 HF, able to handle any frequency between 2000kHz and 12000kHz. There were no problems with this set.

One Southcom 120 HF. This radio had a low output, and the locked crystals did not include 11553kHz.

Auxillary equipment included two braided wire aerials (the alternative steel tape aerial breaks a lot, and has no plug connectors), a wooden radio box, and solar charger panels. The US solar panels have weak wire connexions, but the NZ panels were strong and efficient.

Communications within the 6-person Event were made with VHF hand-held radios, on Channel 1, which is the McMurdo industrial (I) net. No other combination of the available 6 NZ and 10 US channels was found to work, other than Channel 1 on both Tait and Motorola radios.

Weather :

Photocopy of daily weather records included as appendix 2.

To draw some generalisations from the experience of 1989/90 and this seaso
1990/91 :

The sky is often cloudy in MBL. Inside a cloud it is snowing. Cloud breaks that allow a C-130 landing are brief, usually 12 - 24 hours.

A zero or very shallow pressure gradient means no wind, or only light winds. A steep pressure gradient, up or down, beginning or ending at any point on the line, means lots of wind, and/or strong winds.

The windward quarter was NE to SE.

The US Navy now (1989/91) requires the Event to radio weather informatic
at hourly intervals in the day before a scheduled pick-up in the field. They currently want, in this order :

Sky	(cloud in octas) and ceiling (in feet).
Visibility	(in miles).
Temperature	(in degrees F).
Grid wind	(in degrees, with your east longitude as north eg our 110 W becomes 250 E, subtract 250 from the local true map bearing to get grid wind direction).
Station pressure	(will accept hPa/mb, but prefer inches of mercury).
Altimeter	(sea level equivalent - requires analogue altimeter).
Definition	(ground and horizon; poor, fair, or good).
Remarks	(anything relevant).

Miscellaneous :

There are various comments to be made concerning equipment, logistics and safety :

* A motorcycle helmet (3/4 face) was worn for several days while travelling, but was found to be restrictive, and didn't seal well with the issue goggles.

* The polarpile neck ruff requires stretch stitching thread.

* A new pair of ASICS mukluks leaked blue-green dye all season.

* A re-design of the salopette straps would make the garmet more versatile for toileting purposes cf.the Patagnia polarpile salopettes.

* The new DSIR carrybag develops a leak where the clear plastic covers the nametag slot. Otherwise, a good bag.

* Tent prusik cords need to be longer than current issue, and around 7mm diameter, to be effective.

* One pyramid tent (not old, but faded, and possibly used on Erebus) ripped out cloth at a guy point.

* A VE 24-clone dome tent was collapsed and broken by winds gusting over 70 kts, despite heavy poles. Try pre-curved poles to prevent canopy damage.

* Fertiliser sacks make great field gear/food containers, where rigid protection is not required. The weight of a sack compares favourably with the 18lb of a food box.

* The US full-length sledge tank is faster and easier to use than the NZ short version. However, you may want to carry a short plywood floor for the tent. Also, the sledge, if left with the US tank unloaded in gusty wind, will attempt to emulate a C-130 field take off.

* Earmuffs should be available for sound protection on snowmobiles, though not all operators will wear them.

* The US teflon frypan is superior to the NZ version.

* A coffee pot makes a good substitute for one of the NZ billies, as it has a pouring spout and a handle.

* The NZ milkshaker has still won no friends in MBL.

* The supplied clothes pegs are ineffective, and soon break.

* The NZ toaster frames are better than the US type, but need rivetting on the corners for durability.

* The weights and measures in the Field Manual need revision. Liquid volumes (eg fuel drums) should be in US or metric. The use of Imperial is confusing.

Documentation :

I have been helped a lot in the preparation and writing up of the Event by access to computer facilities at Scott Base and DSIR Antarctic in Christchurch. Particularly useful was the Apple Mac at Scott. My thanks to Malcolm Macfarlane for generous technical assistance, and information on the Mac and various word processing programs.

Conclusion :

As well as the persons already mentioned in the text, I would like to thank Eric Saxby, for support in Christchurch; Sherelle King, for help with word processing systems; also Dave Geddes, Barry Were, and particularly John Alexander, for direction and assistance at Scott Base.

In addition, my regards to the other members of K048 / S081 and DSIR Antarctic, for good company and a good field season.

W. P. Atkinson

Bill Atkinson
Mountain Guide Scott Base 5 January 1991

APPENDIX 3

WEATHER DETAILS FROM WAVE 1990/91

K048
1990-91
MARIE BYRD LAND
Appendix 2

Station M U R P H Y 1 Observer

Date 9 0 (YR) | 1 1 (MON) | 1 1 (DAY) Time (24 hr) 2 1 (HRS) | 0 0 (MIN)

wind direction	wind speed[1]	cloud above station[2]	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			7 Hail	
8 N			8 Sleet	
9 Variable			9 Thunderstorm[3]	

[1] Note wind gust speeds in remarks if equipped with anemometer
[2] Note cloud below station in remarks
[3] Note precip. type in remarks.

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

weight new snow . gm
water mm
density kg/m

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

Thermograph °C ☐ trend
Hygrograph %

snow cm
total
new
snow cm
interval
storm

foot penetration 2 cm
surface ice

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

high level wind dir speed Beaufort

Barograph 8 9 0 hPa trend

REMARKS:
10 ~ 20 kts wind continues

Arrival from Scott Base/McMurdo via Byrd + C130
LZ → Murphy Ⓕ camp

Station M U R P H Y Observer

Date 9 0 (YR) | 1 1 (MON) | 1 2 (DAY) Time (24 hr) 0 7 (HRS) | 0 0 (MIN)

wind direction	wind speed[1]	cloud above station[2]	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			7 Hail	
8 N			8 Sleet	
9 Variable			9 Thunderstorm[3]	

[1] Note wind gust speeds in remarks if equipped with anemometer.
[2] Note cloud below station in remarks.
[3] Note precip. type in remarks.

+/− 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
snow cm
interval
storm

foot penetration 2 cm
surface ice

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

high level wind dir speed Beaufort

Barograph 8 8 7 hPa trend ↘

REMARKS:
Wind increasing during day, 8mb pressure drop

Geologists on Sechrist ridge. Return day trip to
LZ for equipment + fuel

Station MURPHY I Observer

Date 90 11 13 (YR MON DAY) Time (24 hr) 00 00 (HRS MIN)

wind direction	wind speed[1]	cloud above station[2]	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			7 Hail	
8 N			8 Sleet	
9 Variable			9 Thunderstorm[3]	

[1] Note wind gust speeds in remarks if equipped with anemometer

[2] Note cloud below station in remarks

[3] 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

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/m

windrun km: present, previous morning (MORNING ONLY)

run (24 hr)

foot penetration 2 cm surface icc

high level wind: dir, speed, Beaufort

Barograph 881 hPa trend ↘

REMARKS:

Cloud increasing, strong wind at ground

Flagged to Turtle Pk. Saw many snow petrels.

Station MURPHY I Observer

Date 90 11 14 (YR MON DAY) Time (24 hr) 07 00 (HRS MIN)

wind direction	wind speed[1]	cloud above station[2]	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			7 Hail	
8 N			8 Sleet	
9 Variable			9 Thunderstorm[3]	

[1] Note wind gust speeds in remarks if equipped with anemometer.

[2] Note cloud below station in remarks.

[3] 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

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/m

windrun km: present, previous morning (MORNING ONLY)

run (24 hr)

foot penetration 2 cm surface icc

high level wind: dir, speed, Beaufort

Barograph 880 hPa trend →

REMARKS:

Winds to 40 kts night of 13/14. Wind 20 kts on 14th.

4 persons to Petrel nunatak (not on map) near Turtle Pk.
2 persons at Murphy I.

800 m

Station MURPHY I Observer

Date 90 11 15 (YR MON DAY) Time (24 hr) 07 00 (HRS MIN)

wind direction	wind speed[1]	cloud above station[2]	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			7 Hail	
8 N			8 Sleet	
9 Variable			9 Thunderstorm[3]	

[1] Note wind gust speeds in remarks if equipped with anemometer.
[2] Note cloud below station in remarks.
[3] 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

interval, storm: snow cm

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 (MORNING ONLY): present, previous morning, run (24 hr)

foot penetration 2 cm

surface ice

high level wind: dir, speed, Beaufort

Barograph 880 hPa trend →

REMARKS:

Heavy cloud to E + SE becoming total cover.
Light snow, winds to 30 kts, poor viz.

'Petrel' nunatak day trip

---

800 m

Station MURPHY I Observer

Date 90 11 16 (YR MON DAY) Time (24 hr) 07 00 (HRS MIN)

wind direction	wind speed[1]	cloud above station[2]	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			7 Hail	
8 N			8 Sleet	
9 Variable			9 Thunderstorm[3]	

[1] Note wind gust speeds in remarks if equipped with anemometer.
[2] Note cloud below station in remarks.
[3] 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

interval, storm: snow cm

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 (MORNING ONLY): present, previous morning, run (24 hr)

foot penetration 2 cm

surface ice

high level wind: dir, speed, Beaufort

Barograph 876 hPa trend ↘

REMARKS:

Broken → overcast. Strong wind all night. Drifting
snow. 20 - 30 kts all day.

Camp day.

800m

Station MURPHY I Observer

Date 90 11 17 (YR MON DAY) Time (24 hr) 07 00 (HRS MIN)

wind direction	wind speed[1]	cloud above station[2]	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			7 Hail	
8 N			8 Sleet	
9 Variable			9 Thunderstorm[3]	

[1] Note wind gust speeds in remarks if equipped with anemometer.
[2] Note cloud below station in remarks.
[3] 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
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 (MORNING ONLY): present, previous morning, run (24 hr)

foot penetration 2 cm surface ice

high level wind: dir, speed Beaufort

Barograph 874 hPa trend ↘

REMARKS:

Wind 20 kts all day

Camp day.

800m

Station MURPHY I Observer

Date 90 11 18 (YR MON DAY) Time (24 hr) 07 00 (HRS MIN)

wind direction	wind speed[1]	cloud above station[2]	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			7 Hail	
8 N			8 Sleet	
9 Variable			9 Thunderstorm[3]	

[1] Note wind gust speeds in remarks if equipped with anemometer.
[2] Note cloud below station in remarks.
[3] 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
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 (MORNING ONLY): present, previous morning, run (24 hr)

foot penetration 2 cm surface ice

high level wind: dir, speed Beaufort

Barograph 880 hPa trend ↗

REMARKS:

Wind all day. Black clouds.

Camp day

Scott

Station MURPHY I Observer

Date 90 11 19 (YR MON DAY) Time (24 hr) 07 00 (HRS MIN)

wind direction	wind speed[1]	cloud above station[2]	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			7 Hail	
8 N			8 Sleet	
9 Variable			9 Thunderstorm[3]	

[1] Note wind gust speeds in remarks if equipped with anemometer.
[2] Note cloud below station in remarks
[3] 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
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 2 cm surface ice

high level wind: dir, speed, Beaufort

Barograph 878 hPa trend →

REMARKS:

Winds 30 kts + all day + night

Camp day

Scott

Station MURPHY I Observer

Date 90 11 20 (YR MON DAY) Time (24 hr) 07 00 (HRS MIN)

wind direction	wind speed[1]	cloud above station[2]	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			7 Hail	
8 N			8 Sleet	
9 Variable			9 Thunderstorm[3]	

[1] Note wind gust speeds in remarks if equipped with anemometer.
[2] Note cloud below station in remarks
[3] 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
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 2 cm surface ice

high level wind: dir, speed, Beaufort

Barograph 581 hPa trend ↗

REMARKS:

Wind + cloud all night, partial clearing in morning only.

Camp day

800 m

Station MURPHYS Observer

Date 90 | 1 | 21 (YR MON DAY) Time (24 hr) 07 | 30 (HRS MIN)

wind direction	wind speed[1]	cloud above station[2]	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			7 Hail	
8 N			8 Sleet	
9 Variable			9 Thunderstorm[3]	

[1] Note wind gust speeds in remarks if equipped with anemometer.
[2] Note cloud below station in remarks
[3] Note precip. type in remarks.

+/− 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

+/−
Thermograph °C trend
Hygrograph %

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

snow cm
total
new
interval
storm
snow cm

foot penetration 2 cm surface ice

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

high level wind dir speed Beaufort

Barograph 878 hPa trend →

REMARKS:

Gusty wind all night, viz 50 m.

Camp day.

---

800 m

Station MURPHYS Observer

Date 90 | 1 | 22 (YR MON DAY) Time (24 hr) 07 | 00 (HRS MIN)

wind direction	wind speed[1]	cloud above station[2]	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			7 Hail	
8 N			8 Sleet	
9 Variable			9 Thunderstorm[3]	

[1] Note wind gust speeds in remarks if equipped with anemometer.
[2] Note cloud below station in remarks
[3] Note precip. type in remarks.

+/− 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

+/−
Thermograph °C trend
Hygrograph %

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

snow cm
total
new
interval
storm
snow cm

foot penetration 2 cm surface ice

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

high level wind dir speed Beaufort

Barograph 884 hPa trend ↗

REMARKS:

Wind all night + day.

Camp day.

800m

Station MURPHY I Observer

Date 90 | 11 | 23 Time (24 hr) 07 | 00
YR MON DAY HRS MIN

wind direction	wind speed[1]	cloud above station[2]	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			7 Hail	
8 N			8 Sleet	
9 Variable			9 Thunderstorm[3]	

[1] Note wind gust speeds in remarks if equipped with anemometer
[2] Note cloud below station in remarks
[3] 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 %

weight new snow . gm
water mm
density kg/m³

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

snow cm
total
new
interval snow cm
storm

foot penetration 2 cm surface ice

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

high level wind dir speed Beaufort

Barograph 885 hPa trend →

REMARKS:

Morning drop in windspeed. Possibly snowing as well as blowing snow.

Moved from Murphy I to Murphy 2 camp in 4½ hrs. Flagged to Demel Pk.

400m North side of the Pk.

Station MURPHY 2 Observer

Date 90 | 11 | 24 Time (24 hr) 07 | 00
YR MON DAY HRS MIN

wind direction	wind speed[1]	cloud above station[2]	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			7 Hail	
8 N			8 Sleet	
9 Variable			9 Thunderstorm[3]	

[1] Note wind gust speeds in remarks if equipped with anemometer
[2] Note cloud below station in remarks.
[3] 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 %

weight new snow . gm
water mm
density kg/m³

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

snow cm
total
new
interval snow cm
storm

foot penetration 10 cm surface ØD

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

high level wind dir speed Beaufort

Barograph 943 hPa trend ☐

REMARKS:

Clear above camp. Light SW in afternoon

400m

Station M U R P H Y 2 Observer

Date 9 0 (YR) 1 1 (MON) 25 (DAY) Time (24 hr) 0 7 (HRS) 0 0 (MIN)

wind direction	wind speed[1]	cloud above station[2]	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			7 Hail	
8 N			8 Sleet	
9 Variable			9 Thunderstorm[3]	

[1] Note wind gust speeds in remarks if equipped with anemometer

[2] Note cloud below station in remarks

[3] Note precip. type in remarks

+/− temperature

dry . °C

wet . °C

max . °C

min . °C

Reset max and min in morning only

weight new snow . gm

water mm

density kg/m

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 ØD

Rain gauge (enter directly) or Precip. gauge mm

MORNING ONLY ↓

now

before (morning)

precip. (24 hr) . mm ◄

high level wind dir speed Beaufort

Barograph 9 5 0 hPa trend ↗

REMARKS:

< 5 kts W during day.

Observed 2 skuas at Turtle Pk, many snow petrels at Turtle Pk + Sechrist Pk.

Climbed Turtle Pk, travelled to Sechrist Pk day trip

400m

Station M U R P H Y 2 Observer

Date 9 0 (YR) 1 1 (MON) 26 (DAY) Time (24 hr) 0 7 (HRS) 0 0 (MIN)

wind direction	wind speed[1]	cloud above station[2]	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			7 Hail	
8 N			8 Sleet	
9 Variable			9 Thunderstorm[3]	

[1] Note wind gust speeds in remarks if equipped with anemometer

[2] Note cloud below station in remarks.

[3] Note precip. type in remarks.

+/− 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

snow cm

interval

storm

foot penetration 1,0 cm

surface ØD

Rain gauge (enter directly) or Precip. gauge mm

MORNING ONLY ↓

now

before (morning)

precip. (24 hr) . mm ◄

high level wind dir speed Beaufort

Barograph 9 5 5 hPa trend ↗

REMARKS:

Thin stratus on horizon, no development all day.

Wind on Turtle Pk 20kts E.

Day trip Petrel nunatak, Turtle + Sechrist Pks

400m

Station MURPHY 2 Observer

Date 9 0 | 1 1 | 27 (YR MON DAY) Time (24 hr) 07 | 00 (HRS MIN)

wind direction	wind speed[1]	cloud above station[2]	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			7 Hail	
8 N			8 Sleet	
9 Variable			9 Thunderstorm[3]	

[1] Note wind gust speeds in remarks if equipped with anemometer
[2] Note cloud below station in remarks
[3] Note precip. type in remarks

+/− 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 — MORNING ONLY
present
previous morning
run (24 hr)

Thermograph °C trend
Hygrograph %

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

foot penetration 1,0 cm surface ØD

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

high level wind dir speed Beaufort

Barograph 952 hPa trend ↘

REMARKS:
E wind gusts overnight.

Daytrip to Hedin nunatak.

400m

Station MURPHY 2 Observer

Date 9 0 | 1 1 | 28 (YR MON DAY) Time (24 hr) 07 | 00 (HRS MIN)

wind direction	wind speed[1]	cloud above station[2]	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			7 Hail	
8 N			8 Sleet	
9 Variable			9 Thunderstorm[3]	

[1] Note wind gust speeds in remarks if equipped with anemometer.
[2] Note cloud below station in remarks.
[3] Note precip. type in remarks.

+/− 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 — MORNING ONLY
present
previous morning
run (24 hr)

+/−
Thermograph °C trend
Hygrograph %

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

foot penetration 1,0 cm surface ØD

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

high level wind dir speed Beaufort

Barograph 950 hPa trend ↘

REMARKS:
NE gusty, very little cloud.

400m

Station M U R P H Y 2 Observer

Date 9 0 | 1 1 | 29 Time (24 hr) 097 | 0 0
YR MON DAY HRS MIN

wind direction	wind speed[1]	cloud above station[2]	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			7 Hail	
8 N			8 Sleet	
9 Variable			9 Thunderstorm[3]	

[1] Note wind gust speeds in remarks if equipped with anemometer.
[2] Note cloud below station in remarks.
[3] 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
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 1 0 cm surface Ø D

high level wind dir speed Beaufort

Barograph 9 5 0 hPa trend →

REMARKS:

Increasing E cirrus. Fine weather.

Daytrip logistics to LZ via Murphy I.

400m

Station M U R P H Y 2 Observer

Date 9 0 | 1 1 | 3 0 Time (24 hr) 0 7 | 0 0
YR MON DAY HRS MIN

wind direction	wind speed[1]	cloud above station[2]	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			7 Hail	
8 N			8 Sleet	
9 Variable			9 Thunderstorm[3]	

[1] Note wind gust speeds in remarks if equipped with anemometer.
[2] Note cloud below station in remarks.
[3] 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
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 1 0 cm surface Ø D

high level wind dir speed Beaufort

Barograph 9 5 0 hPa trend →

REMARKS:

E cirrus around horizon. Low cloud on Murphy

400m

Station MURPHY 2 Observer

Date 90 12 01 (YR MON DAY) Time (24 hr) 07 00 (HRS MIN)

wind direction	wind speed[1]	cloud above station[2]	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			7 Hail	
8 N			8 Sleet	
9 Variable			9 Thunderstorm[3]	

[1] Note wind gust speeds in remarks if equipped with anemometer
[2] Note cloud below station in remarks
[3] 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
interval, storm snow cm

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 MORNING ONLY
present
previous morning
run (24 hr)

foot penetration 10 cm surface ØD

high level wind dir speed Beaufort

Barograph 954 hPa trend ↗

REMARKS:

E in morning, clear skies. NE blowing snow in afternoon.
Daytrips to Ross Glacier, Turtle Pk, Dorrel Rock.

400m

Station MURPHY 2 Observer

Date 90 12 02 (YR MON DAY) Time (24 hr) 07 00 (HRS MIN)

wind direction	wind speed[1]	cloud above station[2]	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			7 Hail	
8 N			8 Sleet	
9 Variable			9 Thunderstorm[3]	

[1] Note wind gust speeds in remarks if equipped with anemometer
[2] Note cloud below station in remarks.
[3] 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
interval, storm snow cm

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 MORNING ONLY
present
previous morning
run (24 hr)

foot penetration 10 cm surface ØD

high level wind dir speed Beaufort

Barograph 959 hPa trend ↗

REMARKS:

Gusty NE overnight.

400

Station MURPHY 2 Observer

Date 9 0 | 1 2 | 0 3 (YR MON DAY) Time (24 hr) 0 7 | 0 0 (HRS MIN)

wind direction	wind speed[1]	cloud above station[2]	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			7 Hail	
8 N			8 Sleet	
9 Variable			9 Thunderstorm[3]	

[1] Note wind gust speeds in remarks if equipped with anemometer.
[2] Note cloud below station in remarks.
[3] 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; 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 (MORNING ONLY): present, previous morning, run (24 hr)

foot penetration 1 0 cm surface Ø D

high level wind: dir, speed, Beaufort

Barograph 9 5 8 hPa trend →

REMARKS:
Very strong E/NE wind gusts overnight. Large buildup of stratus from SW, then NE, persisting into 3rd.
Travel to Murphy 3 in 1½ hours with 5 sledges

330m East of Kay Pk, at 45'14S 110'30 E

Station MURPHY 3 Observer

Date 9 0 | 1 2 | 0 4 (YR MON DAY) Time (24 hr) 0 7 | 0 0 (HRS MIN)

wind direction	wind speed[1]	cloud above station[2]	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			7 Hail	
8 N			8 Sleet	
9 Variable			9 Thunderstorm[3]	

[1] Note wind gust speeds in remarks if equipped with anemometer.
[2] Note cloud below station in remarks.
[3] 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; 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 (MORNING ONLY): present, previous morning, run (24 hr)

foot penetration 5 cm surface Ø D

high level wind: dir, speed, Beaufort

Barograph 9 6 8 hPa trend

REMARKS:
Hazy bright, poor horizon definition to west. Buildup of stratus, from NW.
2 skuas, no snow petrels. McIntosh + Panter
Daytrip to Kay Pk 690 m first ascent

Station MURPHY 3 Observer

Date 90 YR 12 MON 05 DAY

Time (24 hr) 07 HRS 00 MIN

wind direction	wind speed[1]	cloud above station[2]	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			7 Hail	
8 N			8 Sleet	
9 Variable			9 Thunderstorm[3]	

[1] Note wind gust speeds in remarks if equipped with anemometer

[2] Note cloud below station in remarks

[3] Note precip. type in remarks

+/– temperature

dry . °C

wet . °C

max . °C

min . °C

Reset max and min in morning only

weight new snow . gm

water mm

density kg/m

windrun km

present

previous morning

MORNING ONLY

run (24 hr)

Thermograph °C trend

Hygrograph %

snow cm

total

new

interval

storm

snow cm

foot penetration 5 cm

surface 0 D

Rain gauge (enter directly)

or Precip. gauge mm

now

MORNING ONLY ↓

before (morning)

precip. (24 hr) . mm ◄

high level wind dir speed Beaufort

Barograph 972 hPa

trend ↗

REMARKS:

E high scattered stratus. Increasing westerly cloud during day. Flat light, overcast by 1800 hrs. Poor viz, light snowfall by 2030 hrs.

Station MURPHY 3 Observer

Date 90 YR 12 MON 06 DAY

Time (24 hr) 07 HRS 00 MIN

wind direction	wind speed[1]	cloud above station[2]	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			7 Hail	
8 N			8 Sleet	
9 Variable			9 Thunderstorm[3]	

[1] Note wind gust speeds in remarks if equipped with anemometer.

[2] Note cloud below station in remarks.

[3] Note precip. type in remarks.

+/– 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

interval

storm

snow cm

foot penetration 7 cm

surface 0 D

Rain gauge (enter directly)

or Precip. gauge mm

now

MORNING ONLY ↓

before (morning)

precip. (24 hr) . mm ◄

high level wind dir speed Beaufort

Barograph hPa

trend

REMARKS:

Light snow all night.

Camp day.

550m

Station MURPHY 3 Observer

Date 9 0 | 1 2 | 0 7 (YR MON DAY) Time (24 hr) 0 7 | 0 0 (HRS MIN)

wind direction	wind speed[1]	cloud above station[2]	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			7 Hail	
8 N			8 Sleet	
9 Variable			9 Thunderstorm[3]	

[1] Note wind gust speeds in remarks if equipped with anemometer
[2] Note cloud below station in remarks
[3] 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 .2
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/m

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

foot penetration 9 cm
surface Ø D

high level wind dir speed Beaufort

Barograph 9 6 3 hPa trend ↓

REMARKS:

Low cloud, poor viz overnight. Wind NE 20kts +
from 0600 all day. Pressure drop 10mb 0700/1900hs
Total 20mb in 36 hours. Blowing wet snow
accumulating in drifts.

550m

Station MURPHY 3 Observer

Date 9 0 | 1 2 | 0 8 (YR MON DAY) Time (24 hr) 0 7 | 0 0 (HRS MIN)

wind direction	wind speed[1]	cloud above station[2]	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			7 Hail	
8 N			8 Sleet	
9 Variable			9 Thunderstorm[3]	

[1] Note wind gust speeds in remarks if equipped with anemometer.
[2] Note cloud below station in remarks.
[3] 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
snow cm
interval
storm 1.0

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 20 cm
surface Ø D

high level wind dir speed Beaufort

Barograph 9 5 1 hPa trend →

REMARKS:

Overnight pressure drop slowed to 2mb (953/951)
wind change 180° and slowing. Poor viz +
definition. Low snow cloud. Clearing from 1300.

Station MURPHY 3 Observer

Date 90 12 09 (YR MON DAY) Time (24 hr) 07 00 (HRS MIN)

wind direction	wind speed[1]	cloud above station[2]	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			7 Hail	
8 N			8 Sleet	
9 Variable			9 Thunderstorm[3]	

[1] Note wind gust speeds in remarks if equipped with anemometer
[2] Note cloud below station in remarks
[3] 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 %

weight new snow gm
water mm
density kg/m

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

snow cm
total
new
interval
storm
snow cm

foot penetration 20 cm
surface Ø D

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

high level wind dir speed Beaufort

Barograph 953 hPa trend →

REMARKS:
Snowblend around horizon, flat light, no wind.

Moved to Murphy A.

Station MURPHY 4 Observer

Date 90 12 10 (YR MON DAY) Time (24 hr) 03 00 (HRS MIN)

wind direction	wind speed[1]	cloud above station[2]	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			7 Hail	
8 N			8 Sleet	
9 Variable			9 Thunderstorm[3]	

[1] Note wind gust speeds in remarks if equipped with anemometer.
[2] Note cloud below station in remarks.
[3] 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 %

weight new snow gm
water mm
density kg/m³

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

snow cm
total
new
interval
storm
snow cm

foot penetration 20 cm
surface Ø D

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

high level wind dir speed Beaufort

Barograph 957 hPa trend

REMARKS:
Overnight pressure drop 7mb, very strong wind gusts. Strong wind 20-30kts all day.

Station MURPHY 14 Observer

Date 90 12 11 (YR MON DAY) Time (24 hr) 08 00 (HRS MIN)

wind direction	wind speed[1]	cloud above station[2]	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			7 Hail	
8 N			8 Sleet	
9 Variable			9 Thunderstorm[3]	

[1] Note wind gust speeds in remarks if equipped with anemometer

[2] Note cloud below station in remarks

[3] 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 %

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

tool penetration 20 cm; surface Ø

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

high level wind: dir; speed; Beaufort

Barograph 962 hPa trend ↗

REMARKS:

Wind gusts 40 kts+ all night. Pressure rise 12mb 0800 - 2000 hrs. Slight clearing during day.

Station MURPHY 4 Observer

Date 90 12 12 (YR MON DAY) Time (24 hr) 07 00 (HRS MIN)

wind direction	wind speed[1]	cloud above station[2]	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			7 Hail	
8 N			8 Sleet	
9 Variable			9 Thunderstorm[3]	

[1] Note wind gust speeds in remarks if equipped with anemometer.

[2] Note cloud below station in remarks.

[3] 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 %

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

tool penetration 2,0 cm; surface Ø D

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

high level wind: dir; speed; Beaufort

Barograph 982 hPa trend ↑

REMARKS:

Poor visibility, snowing all night

Station MURPHY 4 Observer

Date 90 12 13 YR MON DAY Time (24 hr) 07 00 HRS MIN

wind direction	wind speed[1]	cloud above station[2]	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			7 Hail	
8 N			8 Sleet	
9 Variable			9 Thunderstorm[3]	

[1] Note wind gust speeds in remarks if equipped with anemometer.
[2] Note cloud below station in remarks.
[3] 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
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 20 cm surface ØD

high level wind: dir, speed, Beaufort

Barograph 976 hPa trend ↘

REMARKS:
Poor visibility, snowing all night. Gusts to 50kts
same all day.

2 sledges broken in wind roll-overs.

Station MURPHY 4 Observer

Date 90 12 14 YR MON DAY Time (24 hr) 07 00 HRS MIN

wind direction	wind speed[1]	cloud above station[2]	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			7 Hail	
8 N			8 Sleet	
9 Variable			9 Thunderstorm[3]	

[1] Note wind gust speeds in remarks if equipped with anemometer.
[2] Note cloud below station in remarks.
[3] 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
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 20 cm surface ØD

high level wind: dir, speed, Beaufort

Barograph 982 hPa trend ↗

REMARKS:
Poor visibility, snowing all night. Gusts to 45kts.
Wet snow all day. Gusts to 50kts. Afternoon
clearance.

Station M U R P H Y | 4 Observer

Date 9 0 | 1 2 | 15 (YR MON DAY) Time (24 hr) 0 7 | 0 0 (HRS MIN)

wind direction	wind speed[1]	cloud above station[2]	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			7 Hail	
8 N			8 Sleet	
9 Variable			9 Thunderstorm[3]	

[1] Note wind gust speeds in remarks if equipped with anemometer.
[2] Note cloud below station in remarks.
[3] Note precip. type in remarks

+/– 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 (MORNING ONLY)
present
previous morning
run (24 hr)

+/–
Thermograph °C trend
Hygrograph %

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

foot penetration 20 cm surface Ø D

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

high level wind dir speed Beaufort

Barograph 987 hPa trend ↗

REMARKS:

Moderate visibility, winds to 50 kts+ day + night.
Clearing to 7/8 cloud, high wind 1900
2 to Eisberg Head, 2 to Green Pk.
Sledge relieve with 3 full jerrycans on tank.

Station M U R P H Y | 4 Observer

Date 9 0 | 1 2 | 16 (YR MON DAY) Time (24 hr) 0 7 | 0 0 (HRS MIN)

wind direction	wind speed[1]	cloud above station[2]	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			7 Hail	
8 N			8 Sleet	
9 Variable			9 Thunderstorm[3]	

[1] Note wind gust speeds in remarks if equipped with anemometer.
[2] Note cloud below station in remarks.
[3] Note precip. type in remarks.

+/– 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 (MORNING ONLY)
present
previous morning
run (24 hr)

+/–
Thermograph °C trend
Hygrograph %

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

foot penetration 20 cm surface Ø D

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

high level wind dir speed Beaufort

Barograph 993 hPa trend ↗

REMARKS:

Good viz, acceptable surface definition, light
snow 0200 hrs. Steady deterioration to wet
heavy snow + wind.

Station M.U.R.P.H.T 4 Observer

Date 9 0 | 1 2 | 17 (YR MON DAY) Time (24 hr) 0 7 | 0 0 (HRS MIN)

wind direction	wind speed¹	cloud above station²	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			7 Hail	
8 N			8 Sleet	
9 Variable			9 Thunderstorm³	

¹ Note wind gust speeds in remarks if equipped with anemometer.
² Note cloud below station in remarks
³ 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
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 MORNING ONLY
present
previous morning
run (24 hr)

foot penetration 3 5 cm surface Ø D

high level wind dir speed Beaufort

Barograph 9 9 3 hPa trend →

REMARKS:
Poor visibility, poor definition, snowing all night, wind to 20 kts, no gusts, snowing all day.

Station M.U.R.P.H.Y 4 Observer

Date 9 0 | 1 2 | 18 (YR MON DAY) Time (24 hr) 0 7 | 0 0 (HRS MIN)

wind direction	wind speed¹	cloud above station²	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			7 Hail	
8 N			8 Sleet	
9 Variable			9 Thunderstorm³	

¹ Note wind gust speeds in remarks if equipped with anemometer.
² Note cloud below station in remarks
³ 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
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 MORNING ONLY
present
previous morning
run (24 hr)

foot penetration 5 0 cm surface Ø D

high level wind dir speed Beaufort

Barograph 9 9 6 hPa trend ↗

REMARKS:
Poor viz, poor definition, snowing all night, deep drifts, winds up to 20 kts, mostly less, no gusts,

Left 1830 for LZ.

Station MURPHY LZ Observer

Date 90 12 19 (YR MON DAY) Time (24 hr) 07 00 (HRS MIN)

wind direction	wind speed[1]	cloud above station[2]	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			7 Hail	
8 N			8 Sleet	
9 Variable			9 Thunderstorm[3]	

[1] Note wind gust speeds in remarks if equipped with anemometer
[2] Note cloud below station in remarks
[3] 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
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 1 0 cm; surface Ø D

high level wind: dir, speed, Beaufort

Barograph 9 1 1 8 hPa; trend

REMARKS:

Soft snow, slow clearing

Arrived 0400 from Murphy 4, 85 km

Station MURPHY LZ Observer

Date 90 12 20 (YR MON DAY) Time (24 hr) 07 00 (HRS MIN)

wind direction	wind speed[1]	cloud above station[2]	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			7 Hail	
8 N			8 Sleet	
9 Variable			9 Thunderstorm[3]	

[1] Note wind gust speeds in remarks if equipped with anemometer.
[2] Note cloud below station in remarks
[3] 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
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 1 0 cm; surface Ø D

high level wind: dir, speed, Beaufort

Barograph 9 1 1 8 hPa; trend →

REMARKS:

Slowly increasing cloud cover.

Day trip Sechrist + Murphy.

Station MURPHY LZ Observer

Date 90 12 21 (YR MON DAY) Time (24 hr) 07 00 (HRS MIN)

wind direction	wind speed[1]	cloud above station[2]	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			7 Hail	
8 N			8 Sleet	
9 Variable			9 Thunderstorm[3]	

[1] Note wind gust speeds in remarks if equipped with anemometer.
[2] Note cloud below station in remarks.
[3] Note precip. type in remarks

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

weight new snow . gm
water mm
density kg/m

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

Thermograph °C trend
Hygrograph %

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

tool penetration 10 cm
surface Ø D

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

high level wind: dir, speed, Beaufort

Barograph 920 hPa trend →

REMARKS:

Thin ground fog burning off. Fine + calm all day

4 on Mt Murphy day trip.

Station MURPHY LZ Observer

Date 90 12 22 (YR MON DAY) Time (24 hr) 07 00 (HRS MIN)

wind direction	wind speed[1]	cloud above station[2]	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			7 Hail	
8 N			8 Sleet	
9 Variable			9 Thunderstorm[3]	

[1] Note wind gust speeds in remarks if equipped with anemometer.
[2] Note cloud below station in remarks.
[3] Note precip. type in remarks

+/− 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 (MORNING ONLY)
present
previous morning
run (24 hr)

+/−
Thermograph °C trend
Hygrograph %

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

tool penetration 10 cm
surface Ø D

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

high level wind: dir, speed, Beaufort

Barograph 919 hPa trend →

REMARKS:

Thin overcast, 15 kts.

2 to highest exposure on Hawkins.

Station M,U,R,P,H,Y | LZ Observer

Date 9,0 | 1,2 | 23 (YR MON DAY) Time (24 hr) 0,7 | 0,0 (HRS MIN)

wind direction	wind speed[1]	cloud above station[2]	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			7 Hail	
8 N			8 Sleet	
9 Variable			9 Thunderstorm[3]	

[1] Note wind gust speeds in remarks if equipped with anemometer
[2] Note cloud below station in remarks
[3] 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
interval, storm snow cm

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 1,0 cm surface Ø D

high level wind dir speed Beaufort

Barograph 9,1,5 hPa trend ↘

REMARKS:

Overnight to Callendes Pk.

Station M,U,R,P,H,Y | S Observer

Date 9,0 | 1,2 | 24 (YR MON DAY) Time (24 hr) (HRS MIN)

wind direction	wind speed[1]	cloud above station[2]	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			7 Hail	
[✓ 8] N			8 Sleet	
9 Variable			9 Thunderstorm[3]	

[1] Note wind gust speeds in remarks if equipped with anemometer.
[2] Note cloud below station in remarks.
[3] 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
interval, storm snow cm

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 2,0 cm surface Ø D

high level wind dir speed Beaufort

Barograph 9,3,0 hPa trend

REMARKS:

Fine, bright

All to Callendes Pk north ridge.

Station MURPHY LZ Observer

Date 90 12 25 (YR MON DAY) Time (24 hr) 07 00 (HRS MIN)

wind direction	wind speed[1]	cloud above station[2]	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			7 Hail	
8 N			8 Sleet	
9 Variable			9 Thunderstorm[3]	

[1] Note wind gust speeds in remarks if equipped with anemometer

[2] Note cloud below station in remarks

[3] 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

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/m

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

foot penetration 10 cm surface Ø D

high level wind: dir, speed, Beaufort

Barograph 903 hPa trend ↘

REMARKS:

Fine, bright

Station MURPHY LZ Observer

Date 90 12 26 (YR MON DAY) Time (24 hr) 07 00 (HRS MIN)

wind direction	wind speed[1]	cloud above station[2]	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			7 Hail	
8 N			8 Sleet	
9 Variable			9 Thunderstorm[3]	

[1] Note wind gust speeds in remarks if equipped with anemometer.

[2] Note cloud below station in remarks.

[3] 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

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, run (24 hr) — MORNING ONLY

foot penetration 15 cm surface Ø D

high level wind: dir, speed, Beaufort

Barograph 906 hPa trend ↗

REMARKS:

Poor visibility

Station M.U.R.P.H.Y LZ Observer

Date 90 12 27 (YR MON DAY) Time (24 hr) 07 00 (HRS MIN)

wind direction	wind speed[1]	cloud above station[2]	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			7 Hail	
8 N			8 Sleet	
9 Variable			9 Thunderstorm[3]	

[1] Note wind gust speeds in remarks if equipped with anemometer.
[2] Note cloud below station in remarks.
[3] Note precip. type in remarks.

+/- 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

snow cm: interval, storm

foot penetration 20 cm

surface Ø D

Rain gauge (enter directly) or Precip. gauge mm

MORNING ONLY ↓ now

before (morning)

precip (24 hr) . mm ←

high level wind dir speed Beaufort

Barograph 910 hPa trend ↗

REMARKS:

Poor visibility

Station M.U.R.P.H.Y LZ Observer

Date 90 12 28 (YR MON DAY) Time (24 hr) 07 00 (HRS MIN)

wind direction	wind speed[1]	cloud above station[2]	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			7 Hail	
8 N			8 Sleet	
9 Variable			9 Thunderstorm[3]	

[1] Note wind gust speeds in remarks if equipped with anemometer.
[2] Note cloud below station in remarks.
[3] Note precip. type in remarks.

+/- 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

snow cm: interval, storm

foot penetration 20 cm

surface Ø D

Rain gauge (enter directly) or Precip. gauge mm

MORNING ONLY ↓ now

before (morning)

precip (24 hr) . mm ←

high level wind dir speed Beaufort

Barograph 910 hPa trend →

REMARKS:

Visibility improving, clearing from NE quarter.

Station MURPHY LZ Observer

Date 90 12 29 Time (24 hr) 07 00
YR MON DAY HRS MIN

wind direction	wind speed[1]	cloud above station[2]	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	Remarks:
6 W	6 Gusty		6 Snow	
7 NW			7 Hail	
8 N			8 Sleet	
9 Variable			9 Thunderstorm[3]	

[1] Note wind gust speeds in remarks if equipped with anemometer
[2] Note cloud below station in remarks
[3] Note precip. type in remarks.

+/− 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
run (24 hr)
MORNING ONLY

Thermograph °C trend
Hygrograph %

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

foot penetration 20 cm
surface 0 0

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

high level wind: dir, speed, Beaufort

Barograph 905 hPa trend ↘

REMARKS:
Large hole in clouds over station, visibility to mt murphy.

Station MURPHY LZ Observer

Date 90 12 30 Time (24 hr) 07 00
YR MON DAY HRS MIN

wind direction	wind speed[1]	cloud above station[2]	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	Remarks:
6 W	6 Gusty		6 Snow	
7 NW			7 Hail	
8 N			8 Sleet	
9 Variable			9 Thunderstorm[3]	

[1] Note wind gust speeds in remarks if equipped with anemometer.
[2] Note cloud below station in remarks.
[3] Note precip. type in remarks.

+/− 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
run (24 hr)
MORNING ONLY

+/−
Thermograph °C trend
Hygrograph %

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

foot penetration 20 cm
surface 0 0

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

high level wind: dir, speed, Beaufort

Barograph 899 hPa trend ↘

REMARKS:
Large hole in clouds over station.

Station MURPHY LZ Observer

Date 90 | 12 | 31
YR MON DAY

Time (24 hr) 07 | 00
HRS MIN

wind direction	wind speed[1]	cloud above station[2]	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			7 Hail	
8 N			8 Sleet	
9 Variable			9 Thunderstorm[3]	

[1] Note wind gust speeds in remarks if equipped with anemometer

[2] Note cloud below station in remarks

[3] 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

interval

storm

snow cm 5.0

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 25 cm

surface ∅ D

high level wind dir speed Beaufort

Barograph 908 hPa

trend ↗

REMARKS:

Whiteout

Station MURPHY LZ Observer

Date 91 | 01 | 01
YR MON DAY

Time (24 hr) 07 | 00
HRS MIN

wind direction	wind speed[1]	cloud above station[2]	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			7 Hail	
8 N			8 Sleet	
9 Variable			9 Thunderstorm[3]	

[1] Note wind gust speeds in remarks if equipped with anemometer.

[2] Note cloud below station in remarks.

[3] 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

interval

storm

snow cm

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 25 cm

surface ∅ D

high level wind dir speed Beaufort

Barograph 908 hPa

trend →

REMARKS:

Some large holes in cloud cover

Station MURPHY LZ Observer

Date 91 | 01 | 02 (YR MON DAY) Time (24 hr) 07 | 00 (HRS MIN)

wind direction	wind speed[1]	cloud above station[2]	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			7 Hail	
8 N			8 Sleet	
9 Variable			9 Thunderstorm[3]	

[1] Note wind gust speeds in remarks if equipped with anemometer.
[2] Note cloud below station in remarks.
[3] Note precip. type in remarks.

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

weight new snow . gm
water mm
density kg/m

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

Thermograph °C ☐ trend
Hygrograph %

snow cm
total
new

snow cm
interval
storm 1,00

foot penetration 25 cm
surface Ø D

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

high level wind dir speed Beaufort

Barograph hPa trend

REMARKS:

Scattered cloud, good weather.

3 to Scott Base/McMurdo; 3 to Hampton.
K045 return to Byrd via C130.

Station Observer

Date (YR MON DAY) Time (24 hr) (HRS MIN)

wind direction	wind speed[1]	cloud above station[2]	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			7 Hail	
8 N			8 Sleet	
9 Variable			9 Thunderstorm[3]	

[1] Note wind gust speeds in remarks if equipped with anemometer.
[2] Note cloud below station in remarks.
[3] Note precip. type in remarks.

+/- 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
run (24 hr)
MORNING ONLY

+/-
Thermograph °C ☐ trend
Hygrograph %

snow cm
total
new

snow cm
interval
storm

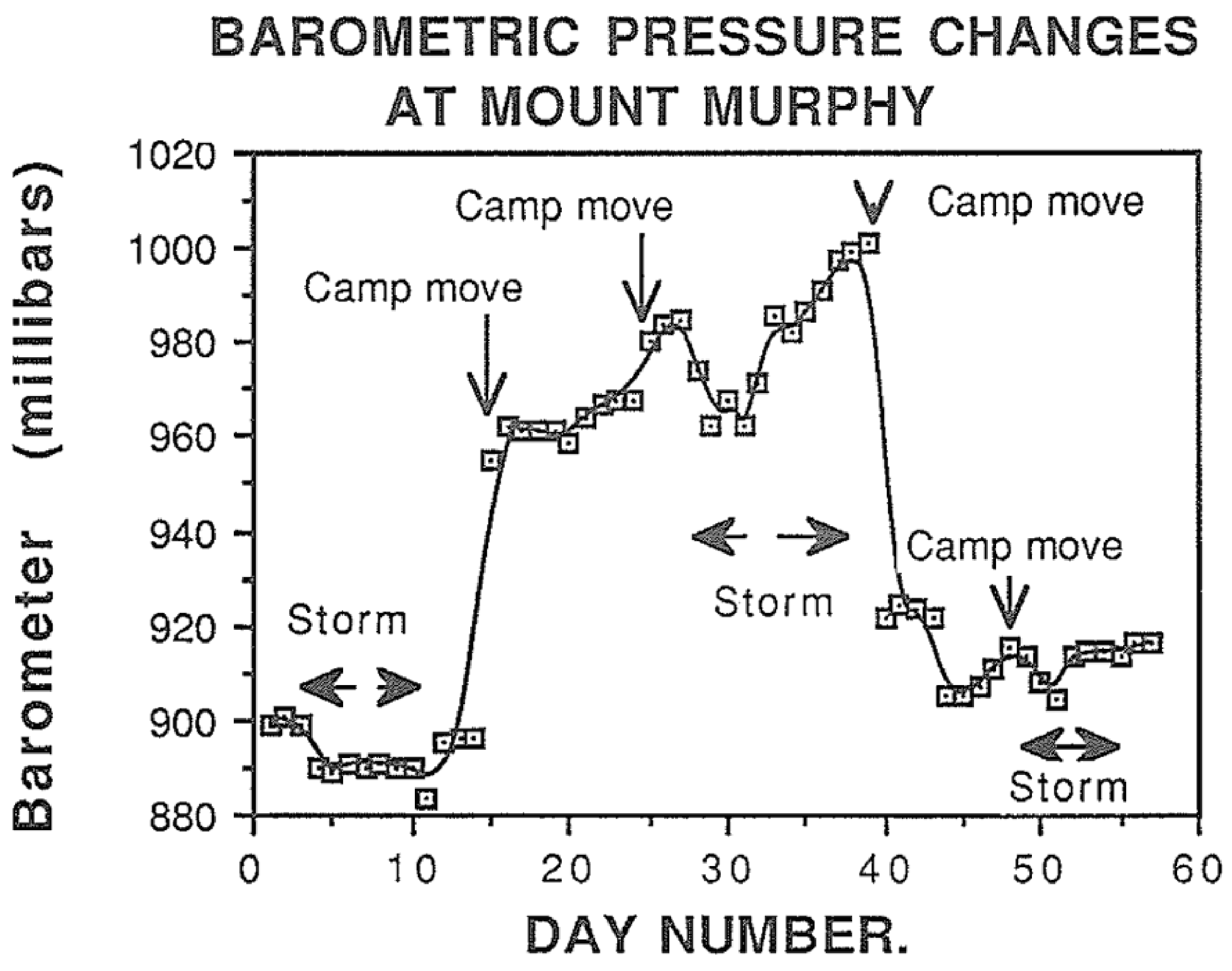
foot penetration cm
surface

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

high level wind dir speed Beaufort

Barograph hPa trend

REMARKS:


BAROMETRIC PRESSURE CHANGES
AT MOUNT MURPHY
Barometer (millibars)
1020
1000
980
960
940
920
900
880
0
10
20
30
40
50
60
DAY NUMBER.
Camp move
Camp move
Camp move
Camp move
Storm
Storm
Storm

CCM175

LOGISTICS REPORT

K132 : Optical Properties of Sea Ice

New Zealand Antarctic Research Programme 1990/91

Event Personnel: R G Buckley
H J Trodahl
J Southon
V Homewood

October-November 1990

1 AIMS OF EXPEDITION

The aim of Event K132 "Optical Properties of Sea Ice" was to monitor the changing optical properties of sea ice as the spring warming occurs. This was accomplished using two optical techniques. Firstly, we employed a technique developed by ourselves over recent years that measures the spatial spreading of light in sea ice, and thus determines, among other things, the transparency of sea ice to visible and UV light. Secondly, we employed a laser that emits a very short light pulse (3 nano sec long) to measure the temporal spreading of light in sea ice. This result gives us the distribution of path lengths for light in sea ice and allows us to predict the value of the backscattered and transmitted radiation fields. Because of the observed strong dependence of the optical properties on ice structure and its time dependence, it was important to be on the ice as early as possible.

2 PLANNING

The New Zealand pre-Antarctic planning phase of our expedition went well. At all times Antarctic Division staff were very helpful, in particular, the "sea ice" meeting in the Antarctic Division office at Christchurch before Tekapo was useful.

3 CARGO

All our cargo arrived at Scott Base on time. Some of the boxes were damaged although the equipment they contained was in good condition.

4 PERSONNEL

R G Buckley, H J Trodahl, J Southon, V Homewood

5 PREPARATIONS FOR THE FIELD

We were met on arrival (October 12) at the ice runway by John Alexander and shortly after arriving at Scott Base had an event briefing with him. This was a useful and to the point working meeting that sorted out all our uncertainties. We also got a brief report on the ice conditions in the region in which we intended to work. We spent October 13 and 14 preparing to go into the field, testing equipment and being issued with field gear and food. On October 15 all members undertook the sea ice travel course, with V Homewood completing the full survival course (October 16 and October 17). R G Buckley, J H Trodahl and J Southon travelled by toboggan to the experimental site on October 16 and V Homewood on October 18. We were able to complete our initial optical measurements the night we arrived, October 16, which was one of the major achievements of this year's event. John Alexander and Eric Saxby were helpful in getting us away. Due to ice conditions at the transition in front of Scott Base, we had problems leaving the Base and had to travel via the ice shelf and Willy's field road.

6 FIELD TRANSPORT

(i) Toboggan - worked well when required, issued with a box sledge and Tamworth sledge to take our gear out to experimental sites from the wannigan. Due to the length of our equipment, it has proved vital to have a Tamworth to transport it on the ice. The fixed bar on the Tamworth was also essential.

(ii) Helicopter - the helicopter trip of 29 October was very successful. The weather was very good, sunny with no wind, and we were able to visit 3 different sites in McMurdo Sound. Two sites were similar to each other and a third near the ice edge on thin ice was somewhat different. We had no problems, the crew were very helpful and we got all that we intended done.

7 EVENT DIARY

See Appendix A.

8 EVENT MAP

We were camped for the entire time of our event near Inaccessible Island.

9 WEATHER

We had very good weather for the first 10 days of our field programme which allowed us to obtain data very early in the season, ie on October 16. This is the earliest date on which we have ever collected data. After that there were a number of days where we were restricted to the wannigan.

10 FIELD EQUIPMENT

(i) All field clothing was found to be of a high standard. We also found that it is important that field personnel are issued with the older heavy jackets.

(ii) In general, field equipment was of a high standard. Although we were issued with 2 box sledges it was not possible with them alone to transport our equipment to the experimental site. For this we required, and were issued with, a Tamworth and a box sledge. The Tamworth, due to its length, is essential for transporting our equipment between experimental sites in the vicinity of the wannigan.

(iii) The members of the event felt that in general the Scott Base diet contained too much meat, although in all other respects the base and the field diet is good.

(iv) We had two wannigans issued to us this year, NZ3 and NZ8. These proved to be essential for the success of this year's event. This is particularly true for NZ8. The experiment we undertook was technically demanding in that it required the operation in the field of a dye laser, high speed optical detector, oscilloscope and a computer. Without access to the dry warm atmosphere of NZ8 this experiment would not have been the success it was. We are grateful for the use of NZ8. I would like to point out the importance of not only the extra room, but also the access to a warm and dry space that is incompatible with NZ3 where we sleep and cook. NZ3 tends to be too wet to operate electronic equipment in.

11 RADIO COMMUNICATIONS

(i) In general radio communications with Scott Base were good. However, we did have some problems with both of the radios issued. It would appear that the contact to the battery pack is failing and for reliable communications the battery had to be held up against the radio at all times, with some inconvenience.

(ii) Radio sked times were set in a flexible way to suit both ourselves and Scott Base. However, Scott Base was not reliable in keeping the evening sked nor at times the morning one.

12 ENVIRONMENTAL IMPACT

All waste was separated into burnable and non-burnable and returned to Scott Base. Human waste was disposed of in the sea ice as in earlier years.

13 ACKNOWLEDGEMENTS

We would like to thank DSIR Antarctic for logistic support, in particular John Alexander, Eric Saxby and Ron Rogers. Also we are grateful for support from the technical staff of DSIR Physical Sciences and Victoria University of Wellington.

APPENDIX A

EVENT DIARY - K132, October 1990

October 11 Thursday	Fly from Wellington to Christchurch, stay at Windsor Hotel
October 12 Friday	Fly to Scott Base from Christchurch, check that all the boxes have arrived in Antarctic.
October 13 Saturday	Begin to have issued field gear, check it and begin packing.
October 14 Sunday	Continue with checking of gear and issue of field gear.
October 15 Monday	Sea ice travel course. Continue packing in the evening.
October 16 Tuesday	Travel to experimental site and set up tents. Had a number of problems in getting away due to pressure ridges around Scott Base. Had to go across the ice shelf. Camp set up between Tent and Inaccessible Islands. Perform transmission and backscattering measurements - a good data set collected in very good conditions during the evening. Site named 90A. Ice had about 30 mm of snow and was 1.9 m thick. Freeze in thermistor array. Some thermistors were found to be not working. Full survival course for Vanessa.
October 17 Wednesday	Weather not so good, no travel. Main part of camp arrived at midday, spent rest of the afternoon and evening setting up camp - no experiments. Slept in NZ8.
October 18 Thursday	Transmission and backscattering experiments at 90A. Took a salinity ice core and temperature profile. Slept in NZ3. Vanessa arrived, general celebration throughout camp.
October 19 Friday	Try time resolved experiment, measure salinity. Time resolved experiment indicates that the sensitivity is on the low side and will have to look at short separations only. Can improve things however. Made measurements at two separations and spectra look different. There is a pick up problem from the RF of the laser. This varies from scan to scan. Need to do more careful experiments in good weather. Getting windy towards the end of the experiment. Did the first density experiment - gear worked well.
October 20 Saturday	Very windy but sunny. Filled in top of array with salt water/ice and undertook a calibration of the visible source. 5204 lock-in failed! Finished with 220. Did a salinity and temperature core. Greenpeace and Helo called, both with fresh bread! Problems getting ice core out. Still windy and thus cold.

October 21 Sunday	Cold wind. Measured transmission and backscattering at 90A in the morning. Measured density at 90A, reduced background in time experiment - detector out of box, used slower detector and covered it with aluminium foil to reduce pickup. This produced a 100-fold improvement.
October 22 Monday	Repeat salinity density and temperature measurements at 90B. A very good day, no wind. Tried the time resolved experiment with the new setup at 2 sites, 90B and 90C. 90B was a very milky site that had overflowed from the ice edge/crack. 90C was a snow free site of "normal" columnar ice in appearance. The experiment worked very well. The S/N was much better than on the October 19 RF pickup down and signal up - the big improvement. Detector was placed in a plastic bag. The data collected was very good. Observed a shift in the position of the peak to longer times with increasing separation. No change in tail. Greenpeace and surveyors came over in the evening. New loo hole cut and shifted into place.
October 23 Tuesday	Transmission at 90A both through snow and without on the wide detector. Clear that wide detector was used on October 21. Backscattering at both sites 90B and 90C. Vanessa and Joe went to Cape Evans/Scotts Hut. Seems clear that we do not have enough petrol to last the full time - 60 litre is about ½ our requirements. We will need more by the weekend. Should have enough 50:1 however.
October 24 Wednesday	Time resolved experiment at site 90C, looking at long collection times. Did salinity and density of full cores at 90C. Having trouble getting core up - still cold and windy -17°C.
October 25 Thursday	Did transmission and backscattering at site 90A and density and salinity at 90A. Did transmission at 90B also. JS made a really neat saw handle!
October 26 Friday	No work, snow and wind, wind drop in afternoon. Greenpeace leave for their trip. No work.
October 27 Saturday	Blowing snow all night, cold -14°C and 18 knots. Little chance of work.
October 28 Sunday	Still blowing snow, although not first time -15°C and 16 knots from the south at 11am.
October 29 Monday	Clear sky, temp -19°C. Very little wind. Helo trip on at 2pm. New loo hole. Helo trip went very well. Measured temp. salinity and ice depth at 3 sites in McMurdo Sound. Two in sound, and one near the ice edge. Very sunny.

October 30 Tuesday	Overcast -15°C. Time resolved experiment at 90C. Density and salinity at 90A. Blowing snow and colder in mid-afternoon. Halo and glory appeared.
October 31 Wednesday	Blowing snow again as yesterday afternoon, -18°C good visibility however. Confirm that Joe T goes. Markus is expected for tea. Forecast is for no change in weather for a while. David B now expected on normal date.
November 1 Thursday	Transmission at site 90A. Time resolved at 90C. Salinity measured on core taken on 31 October at 90C. Joe T left at 7pm in ASV, party of four came out! Mechanic tried to fix 15 kVA generator. Talked to Malcolm. Journalist from NZ Herald. Very good time resolved data including backgrounds. Joe S undertaking subtractions on time resolved data. Mail came. Restarted array measurements.
November 2 Friday	-18.5°C but 5 knots blowing. Ice crystals in sky so halo/glory was visible again. At least as good, if not better than on 30/10. Made a density measurement at 90A but core gave problems again poles to get it up. Penguin seen sliding on its belly moving slowly into a strong wind. Also took a salinity core. Analyse the density results. Site 90A appears to be changing but not 90C? Ice appears to be getting thicker and less dense at the surface - not apparent at C, could be understood in terms of growth at top with snow/ice. Site 90A has a lot of snow on it, could be as much as 80 mm and growing. Site C has snow on it but a lot less than 90A and it has not increased by the same fraction. Joe got subtractions going, looks very good. Continuing with array measurements again - a lot of snow on top. Measured density and salinity at 90A.
November 3 Saturday	Clear sky again -19°C, no wind, sunny, measured conductivity of samples collected 2 November. Set up time resolved experiment site 90C 2 hr scans and background (1) 400 mm; (2) 600 mm - should be able to look more closely at the tail; (3) 200 mm for 1.25 hrs only. Did salinity and density at 90C. Had time resolved system going from 9am-8pm. Climb Inaccessible Island after tea. Malcolm called to say we may need to leave Wednesday. Voltage on Victoria generator max at 220 V.
November 4 Sunday	Blowing snow -15°C, 15 knots. No work outside. Measured conductivity of core taken 3/11. Subtract files. Backscattering 90C. Tea with Markus, very nice. Recalculated all salinity with new standard.

November 5 Monday	Time resolved at C all day, looking at small separations with high voltage resolutions. Transmission at 90A for last time. 12 volt supply gave out! Continued with battery. Used almost all the fuel for generators, ie, 2 x 60ℓ, should get 3 x 60ℓ in future. Temperatures on array continue to decrease. Ross and Ken arrived by ski-doo, David and Grant at 7pm. Did density and salinity at 90A. Need new saw.
November 6 Tuesday	Ken and Ross leave, day starts clear, but by midday wind and blowing snow. Did not work, packed up gear. Joe worked on data. Tim and Chris arrived. Stopped reading the array. Need screw drivers, hack-saws, longer metal files, ring spanners, more computers - generators to run in boxes.
November 7 Wednesday	Finished packing up last items. Weather deteriorated but John, Dave etc came out at about 3 and picked us up. Drove back to Scott Base in blowing snow and very poor visibility. Called Liz. Organising to leave. Talked to Ken and Ross about their experiment.
November 8 Thursday	Weather began poorly, but by 11am had come right. Nevertheless flight cancelled! Still preparing to go. Using Macintosh SE - very good - analyse some transmission data.
November 9 Friday	Bags to Hill Cargo. More analysis of transmission data - can see transmission decreasing. Fly to Christchurch, leave at 8.30pm.
November 10 Saturday	Arrive in Christchurch at 3.30am. Fly to Wellington at 10.45am.

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IMMEDIATE SCIENCE REPORT

K132 : Optical Properties of Sea Ice

New Zealand Antarctic Research
Programme 1990/91

Event Personnel:

R G Buckley
H J Trodahl
J Southon
V Homewood

October-November 1990

1 ABSTRACT

A series of optical experiments were performed on sea ice in McMurdo Sound between 16 October and 8 November 1990. These included both a measurement of the spatial spreading of light introduced at a point on the surface and the temporal spreading of a brief pulse of light injected at a point. These experiments will further clarify the details of the interaction of light with this turbid natural material. A number of thermal and physical measurements were also performed on the ice in order to relate the optical behaviour to the physical structure of the ice.

2 PROPOSED PROGRAMME

The behaviour of the optical properties of sea ice is of interest, both for its impact on polar ecosystems and for the information it gives about the physical structure of the ice. It is a field which is rather little studied, principally because definitive *in situ* measurements are not easily performed on this inhomogeneous, anisotropic, and changing material. In the 1985 season, we tested a new measurement geometry which has permitted us to relate more fully than ever before, the optical behaviour of sea ice to its physical structure, and following experiments performed in the 1985, 1986, and 1989 spring seasons we published a number of papers on the subject[1-8]. The most striking result is that the surface layer of the ice is much more transparent early in the spring than it is later, which has implications for under-ice life[4,6-8].

Our objectives during the 1990 spring were twofold: (i) to extend our measurements to as early in the spring as possible, and (ii) to test an entirely new optical experiment intended to complement the one we have performed to date. This second experiment is a technologically demanding one, for it involves running a very fast pulsed dye laser, fast detection equipment and a computer in a harsh environment.

3 SCIENTIFIC ENDEAVOURS AND ACHIEVEMENTS

In this section we describe the two major optical experiments performed, followed by a brief description of various auxiliary experiments intended to monitor the physical condition of the ice.

The experiment developed in 1985 consists of a monochromatic source which introduces light into a spot on the surface of the ice and detectors that measure the light emerging from the top and bottom surfaces. Since sea ice is a very turbid medium, light emerges over a large area centred on the source, and it is the intensity profile of this spot that is measured in our experiment. These profiles can be interpreted in terms of the light scattering properties at various depths. The apparatus, methods, and interpretation scheme were developed entirely by this research group. This year's use of the equipment has permitted us to extend our measurements to about two weeks earlier in the season than we had managed previously, and has confirmed that the ice is even clearer in early October than we had predicted based on our measurements of 1986 and 1989. This experiment was performed as often as convenient over the entire period in the field, 16 October - 8 November.

The second major experiment was a measurement of the distribution of path lengths taken by light as it scatters randomly through sea ice. For this purpose we introduce a very short (3×10^{-9} sec) burst of light into the surface, and measure the straggling in the emergent pulse at some distance (100-500 mm) from the source. This very demanding experiment was deployed for the first time on 22 October, and we collected many spectra then and on a number of later dates until our departure from the field. We can clearly see the effects of straggling in the pulse shape, although it still remains to be seen how well they can be interpreted. A number of items used in this experiment had to be kept above 0°C and during measurements we kept them in carefully insulated and heated boxes. At other times we had to keep them in a dry heated wannigan, and for this purpose the oil heated wannigan NZ8 was invaluable.

In addition to the two primary experiments, we continuously monitored the ice with measurements of the salinity, density, and temperature at various depths. These experiments were all operated successfully as they have been in earlier seasons. Changes in these quantities, particularly near the surface, correlate with changes in the optical behaviour.

4 PUBLICATIONS

It will take some months to analyse and interpret the data collected in the 1990 spring season. We have plans to complete that aspect of the work, in collaboration with Esther Haines (DSIR Physical Sciences) and submit a substantial paper to the international polar literature by about the middle of 1991.

5 ENVIRONMENTAL IMPACT

The entire operation was centred on a site on the sea ice about 500 m from Inaccessible island, and the disturbance to the environment was essentially nil. All waste products were returned to Scott Base.

6 FUTURE RESEARCH

We have requested to return to McMurdo Sound, primarily to carry on with the time resolved (pulsed laser) optical experiment. Although this experiment ran as well as expected, we can make further improvements in shielding the detectors from rf noise generated by the laser and so intend to return for a further season.

7 MANAGEMENT OF SCIENCE IN THE ROSS DEPENDENCY

The planning and execution of the support for our research was the best we have yet experienced. We were particularly pleased to be able to get out onto the sea ice within 4 days of our arrival at Scott Base, which permitted us to get the very early measurements that were of special importance. The campsite facilities, particularly the living and laboratory wannigans NZ3 and NZ8, were excellent and contributed to the success and efficiency of the entire programme.

8 ACKNOWLEDGEMENTS

We acknowledge the excellent logistic support of DSIR Antarctic and particularly the assistance of John Alexander, Eric Saxby and Ron Rogers. The work received the financial support of DSIR Physical Sciences, FoRST, and Victoria University.

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IMMEDIATE LOGISTICS REPORT

K136: UV IN THE ANTARCTIC AND EFFECTS ON SEA ICE ALGAE

New Zealand Antarctic Research Programme 1990/91

Event personnel: D.Beaglehole,VUW
G.Carter
K.Ryan, PEL
R.Exley

October 22-November 17 1990

Aims:
There has been considerable speculation on the effects of the enhanced UV resulting from the ozone hole during the Antarctic spring. It has been suggested that the sea ice algae which grow rapidly during the spring would be particulary vulnerable to this radiation. The algae grow on the bottom surface of the sea ice. The transmission of ultraviolet and visible light through the sea ice using an artificial light source has been the study of K132-Buckley/Trodahl during the last three years, who have shown that not more than a few percent of incident ultraviolet radiation passes through the ice, being scattered by brine inclusions, and absorbed by the sea ice algae at the bottom of the ice.

Our programme has two parts. The first is to characterise the amount of UV and visible radiation falling onto the sea ice - the spectrum, the intensity, where it comes from in the sky, and the polarisation of the radiation. The second is to study the effects of enhanced UV radiation on sea ice algae under radiation levels both visible and ultraviolet which are typical of those encountered insitu.

Cargo:
The scientific equipment was shipped in 10 boxes. One box went astray on the way down and this caused some anguish. On return the procedure for shipping to Wellington seemed uncertain.

Personnel:
Department of Physics, Victoria University of Wellington
Professor D.Beaglehole, Grant Carter
DSIR/Physical Sciences, Lower Hutt
Dr. Ken Ryan, Ross Exley

Preparations for the field:
All personel were very helpful.

Field Transport:

We had continuous use of ALP1 toboggan. Transport to Tent Island was by way of the Haglung, return by Toyota. All vehicles worked well.

Event Diary:
The study of the Antarctic skies in general required clear skys, although some overcast days were useful in calibrating the instruments. 4 days at Tent Island were unsuitable, but these were followed by 2 perfect days and allowed the completion of the measurements. A larger proportion of clear days were had at Scott Base. Algal studies were based at Scott Base with daily excursions to the sea ice beneath Arrival Heights to collect samples. Towards the end of our event several trips were made by toboggan to collect algae from the Tent Island camp site. Good weather during most of our stay meant that samples could be collected whenever they were needed.

Scott Base Laboratory Facilities:
The Geoscience Laboratory provided an excellent environment for study of data and repair of equipment (along with the mechanical workshop facilities). In particular we used the Mac computers to analyse data regularly. It would be helpful to have a good printer in the lab. It would also be helpful to have available prior to the trip an information paper describing the computing and other equipment/facilities at Scott Base. The Biolab in Q-Hutt is not deemed worthy of the name, and the facilities for biological research are poor. The provision of wannigans as laboratories was essential. Perhaps A-Hut could be converted into a proper Biological laboratory with wet facilities, bench space and balance and microiscope benches.

IMMEDIATE SCIENTIFIC REPORT

K136: UV IN THE ANTARCTIC AND EFFECTS ON SEA ICE ALGAE

New Zealand Antarctic Research Programme 1990/91

Event personnel : D.Beaglehole, VUW
G.Carter
K.Ryan, PEL
R.Exley

October 22-November 17 1990

Abstract:

The programme had two parts. The first part characterised the sun and sky light in Antarctic, in particular determining the spectrum and the intensity and polarisation distributions around the sky, and the trends in the UV radiation during the period of the programme. The sky light distribution was found to be that of a strongly multiple-scattering atmosphere, while a clear inverse correlation in the UV with ozone abundance was observed. The second part studied the effects of UV radiation on sea ice algae collected from two sites, under Arrival Heights and at Tent Island. Preliminary results suggest sensitivity at low levels of radiation, but not an accumulating effect with increased dosage.

Programme:

There has been considerable speculation on the effects of the enhanced UV resulting from the ozone hole during the Antarctic spring. It has been suggested that the sea ice algae which grow rapidly during the spring would be particularly vulnerable to this radiation. The algae grow on the bottom surface of the sea ice. The transmission of ultraviolet and visible light through the sea ice using an artificial light source has been the study of K132-Buckley / Trodahl during the last three years, who have shown that not more than a few percent of incident radiation passes through the ice in the ultraviolet, being scattered by brine inclusions in the ice, and absorbed by the sea ice algae at the bottom.

Our programme has two parts. The first is to characterise the amount of UV and visible radiation falling onto the sea ice - the spectrum, the intensity, where it comes from in the sky, and the polarisation of the radiation. The second is to study the effects of enhanced UV radiation on sea ice algae under radiation levels both visible and ultraviolet which are typical of those encountered insitu.

Scientific endeavours and achievements:

UV radiation:

About 10 days were spent at Scott Base, checking our instrumentation and then making measurements. This was followed by a week at Tent Island. The first four days there were snowing. However the next 2 days were perfect and we were able to obtain full measurements in that time.

We used two instruments. The first was a monitor which recorded the total radiatron falling onto a flat surface in three bands UV,Violet and Blue. A shadow plate allowed the separation of the direct sun and the sky light, and an auxiliary filter separated UVA from UVB. This monitor was used to determine the variation of the radiation during the complete 24 hour day at Scott Base and at Tent Island, and to monitor the maximum intensity at about noon over the period of the project. The radiation in comparison with Wellington is dominated by the indirect skylight. The UV shows an inverse correlation with the ozone abundances determined at Arrival Heights.

The second instrument was a polarisation spectrometer, which was used to determine the sun's spectrum directly with a resolution of 1nm, and was fitted with a 5° field of view telescope, and used to determine the intensity and polarisation of skylight around the sky. These measurements were made at both Scott Base and Tent Island. The maximum polarisation which occurs at 90° to the sun, was about 0.5, which is considerably smaller than the value in New Zealand, and indicates a strongly multiple-scattering atmosphere. This instrument was also used to measure the absorption spectrum of a chlorophyl extract from the sea ice algae, and a transmission spectrum of the algae.

Sea ice algae:

Samples of sea ice algae were collected from 2 sites, under Arrival Heights and near Tent Island. Samples were obtained using an 8 inch Finn auger to cut a 1.5m deep hole in the ice, followed by a Cipre auger to obtain a core of ice from the last 0.5m. The core was shaded from direct light during removal and a sample of algae taken for return to Scott Base. Sub samples of algae were cultured in the presence of ^{14}C at -1.5°C under an artificial light source containing both UV and visible light at irradiances typical of under ice conditions. The visible light was maintained at approximately 5μmol/m^{2}s, while the UV irradiance was varied from experiment to experiment over a wide range. Growth rates of the algae were estimated by measuring the uptake of ^{14}C over time using a beta spectrometer.

Publications:

We are currently analysing the data and preparing reports for publication.

Environmental impact:

Negligible. The only possible source of environmental hazard is through the use of ^{14}C. All material which came into contact with this low activity isotope was collected and returned to New Zealand, including all glassware, algal samples, sea water and rinse water.

Future research:

UV: 1) The strongly multiple scattering environment around Scott Base and Tent Island is probably mainly the result of the highly reflecting snow and ice surface cover (high albedo). It would therefore be of some interest to measure the intensity distributions at other sites were the albedo may be different. We have already proposed measurements at the South Pole, and again at Lake Vanda in a dry valley.

2) The transmission of the sea ice is very strongly affected by the snow cover, and it

would be of considerable interest to measure the transmission and scattering properties of snow cover of varying thicknesses.

3) Measuring the colours of sea ice algae requires not a transmission measurement but a diffuse scattering measurement, using probably an integrating sphere. It will be of interest to see if any changes to the colour spectrum can be correlated with the enhanced radiation.

Sea-ice algae: 1) Recent studies have demonstrated that UVA radiation may also be injurious to plant growth, both in concert with UVB and in its own right. Future research could examine the relationship of these two bands of radiation to growth rates of sea ice algae.

2) The algae at Tent Island was thicker than at Arrival Heights, and therefore there is the potential for algae closer to the surface to shade those lower down. The response to UV radiation of algae at different layers in the ice could also be studied.

Management of Science:

We found the support from DSIR/Antarctic to be excellent. The facilities for physical science research were excellent, but the "Biolab" was poorly equipped particularly in space allocated, and in the facilities provided. A much larger area remote from the accomodation area is sorely needed, properly established for biological research.

Acknowledgements:

We are indeed grateful to all those in their different areas of responsibilty who made our work enjoyable, and who kept their cool under our deluge of pressure: Barry Were, John Alexander, Malcolm Macfarlane, Pat Nolan, Ross McDonald, Jack Jenniskens, Helen Phillips and Paul Woodgate.

K193 1990/91

IMMEDIATE LOGISTIC REPORT

K193 CAPE ROBERTS TIDE GAUGE

by A.R. Pyne

NEW ZEALAND ANTARCTIC RESEARCH PROGRAMME 1990/91

EVENT PERSONNEL: A.R. Pyne (Antarctic Research Centre, Vic. Uni.)
G. Varcoe (DSIR, Antarctic)
P. Woodgate (DSIR, Antarctic)
R. Bensemann (N.Z. Army)

November 1990

K193 (Cape Roberts)
1990/91

Introduction

The purpose of this project was to install a permanent tide gauge at Cape Roberts. In November 1988 a tide gauge pressure transducer was installed at Cape Roberts within a steel pipe bolted to the coastal rock. This installation was subsequently lost when the coastal ice foot broke off in February 1989. The transducer site we had choosen was the best available because it had deep freely circulating water under the ice foot close to shore but it was clear that a permanent installation required greater protection. I believed this could be achieved by installing the transducer in a hole drilled at an angle through the rock to exit into free water beneath the ice foot.

Planning

K193 (Cape Roberts) was undertaken as a DOSLI event this season but is jointly sponsored by the Antarctic Research Centre @ VUW, the N.Z. Meteorological office and the Department of Survey and Land Information (DOSLI).

This programe was approved later than most other programmes and was dependent on logistic support being made available from the NZARP programme. Previous consultation between A. Pyne and G. Varcoe ensured that the proposed field activity was understood if late approval was given. No significant problems cocurred subsequently in the final planning stage.

Personnel: A.R. Pyne; Antarctic Research Centre, Victoria University
G. Varcoe; Technical Services, DSIR Antarctic
P. Woodgate; Staff Section, DSIR Antarctic
R. Bensemann; Plant Operatorm, Scott Base N.Z. Army.

Preparation for the Field

This programme was closely associated with the D5 cargo train to Cape Roberts. Much of the preparation for the cargo train organised by G. Varcoe was underway by the time Pyne & Woodgate arrived at Scott Base. This season the briefing at Scott Base was well managed and the red tape minimised by the operations staff.

Field Equipment

i) This event was either based at the Cape Roberts facility or with a mobile Wanigan (N.Z.1). It is less appropriate in this situation to rely solely on the NZARP 20 man day ration box system and would have been more efficient to draw on some Scott Base food stocks in a similar way to Vanda Station and Cape Bird facility. This would be efficient if some Scott Base supplies were in smaller packages rather than the bulk supplies at present or if suitable containers were available for repacking.

ii) The Winkie Drill worked well for this programme and proved its portability and flexibility to drill the 12.8m long 45^0 angled hole for the tide gauge transducer. The problems we had where minor and did not prevent the successful drilling of the hole. If a programme in the future required the drill for several holes it would be worthwhile returning all the drill equipment to N.Z. for complete checking and maintenance. The Winkie drill is an invaluable asset of DSIR Antarctic field equipment and worth keeping in good repair.

A Mate powerhead was also used to drill the ice foot with a 10 inch VUW ice auger. This also worked well but was the newest powerhead at Scott Base and the only one in good condition as of November 1990.

Acknowledgements

The other members of this event, Garth Varcoe, Paul Woodgate and "Ben" Bensemann require special mention for their efforts in drilling the hole for the transducer installation at Cape Roberts. Also at Cape Roberts members of the survey event K192 helped with this programme. Peter Isaac provided valuable advice and encouragement from Britina Island while setting up and programming the instrumentation. John Alexander (Operations Manager) and other members of the Scott Base staff provided invaluable support. At Victoria University; Eric Broughton, Jimmy Millar and the Mechanical Workshop helped with the preparation and checking of equipment. Finally Charlie Thurgood of Scott Technical Instruments Ltd. provided an excellent service to replace a faulty transducer for the programme.

K193 Itinerary

5 Nov.Pyne, Woodgate to Scott Base. Varcoe, Bensemann already at Scott Base with other events.

6 Nov.Loading cargo train for Cape Roberts. Winkie drill and K193 equipment. K192 and USGS survey and field equipment K047 fuel & LPG. Woodgate on overnite survival course.

7 Nov.Completed cargo loading with 2 "seal" bladders (JP8) for helo refueling at Cape Roberts.

8 Nov.Poor weather with intermittant clear periods. Left at 1030 hrs from Willies field road transition. Travelled 6 hours until visibility deteriorated, stopped east of Butter Pt. Party personnel: G. Varcoe, A. Pyne, P. Woodgate, R. Bensemann, G. Falloon (K192), and L. Skinner (K192).

9 Nov.Continued to Cape Roberts in clearing weather, arrived approx 2200 hrs. Off loaded fuel & LPG for Vanda at Marble Pt. enroute.

10 Nov. Drilled ice foot (5 holes) at the previous tide gauge siet to determine best site and attitude for transducer drillhole. Ice foot was significantly thicker than 2 previous seasons with pressure ice blocks incorporated into the ice foot.

11 Nov. Set up Winkie drill and ran casing to 0.5m.

12 Nov. Drilled 6.5m. Lost circulation at times in jointed rock above ice foot (approx high tide).

13 Nov. Continued drilling and broke through into free water at 12.8m. Attemped to flush hole with sea water during the night but freezing in hole occurred about 24200 hrs.

14 Nov. Overdrilled casing to 2.6m while hole was frozen (0300-0500 hrs). 3m of ABS pipe (1" bore) from Scott Base to add to LDPE liner pipe. Redrilled ice out of hole and installed liner pipe and transducer. Disassembled drill rig and equipment, repacked cargo sledges.

15 Nov. Cargo train (Varcoe, Woodgate, Bensemann) left for New Harbour 1200 hrs. Pyne remained at Cape Roberts. Removed data logger box from Met. mast and rewired for new instruments.

16 Nov. Fitting new transducer to datalogger system. Found faulty resistor in transducer to datalogger interface (AVW1).

17 Nov. Continued testing transducer with modified constant temperature programme. Decided to recheck transducer installation - poured 5 l of isopropal alcohol in liner pipe to unfreeze transducer.

18 Nov. Removed checked and reinstalled transducer. Reprogramming datalogger and renewed wind speed and director instruments.

19 Nov. Testing datalogger programmes and instruments.

20 Nov. Checking equipment. Brent George (K191) flew to Cape Roberts for familiarisation and surveying of the installation. Pyne, George return to Scott Base 2300 hrs by helo.

21 Nov. Packing equipment in early morning. Pyne return to New Zealand.

K193 1990/91

IMMEDIATE SCIENCE REPORT

K193 CAPE ROBERTS TIDE GAUGE

by A.R. Pyne

NEW ZEALAND ANTARCTIC RESEARCH PROGRAMME 1990/91

EVENT PERSONNEL:	A.R. Pyne (Antarctic Research Centre, Vic. Uni.)
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The purpose of this project was to install a permanent tide gauge at Cape Roberts. In November 1988 a tide gauge pressure transducer was installed at Cape Roberts within a steel pipe bolted to the coastal rock. This installation was subsequently lost when the coastal ice foot broke off in February 1989. The transducer site we had choosen was the best available because it had deep freely circulating water under the ice foot close to shore but it was clear that a permanent installation required greater protection. I believed this could be achieved by installing the transducer in a hole drilled at an angle through the rock to exit into free water beneath the ice foot.

Scientific Endeavours & Achievements.

The first stage of this seasons field programme was to drill a hole in the coastal rock using the "portable" Winkie diamond coring drill belonging to DSIR Antarctic. This season the ice foot (above free water) was thicker than usual (5.5m) and a large amount of ice had been pushed against the shore and incorporated into the overthickened ice foot. These unusual ice conditions prevented the use of video camera modified to work under the ice which we intended to use to establish the best site for the transducer hole. Instead five holes were drilled in the ice foot to establish the ice thickness and where free water occcurred. The site choosen for drilling was within 5m of the previous tide gauge site and required a hole to be drilled 45^0 from the verticle. This was accomplished succesfully in 2 days of drilling with breakthrough occurring at approximately 12.8m. Sea water with a small quantity of Calcium chloride (50kg) was used for drilling fluid and will have no lasting effect on the near shore environment. All equipment was removed after drilling leaving only the transducer cable protected in a polyethylene pipe and steel support cable anchored at the hole.

The transducer is located in a cage at the end of a 32mm low denisty polyethylene pipe lining the drilled hole. The transducer cable became frozen within the hole as expected within a few hours. Two days later the transducer was removed and rechecked by unfreezing the cable with about 5l of isopropal alcohol poured into the plastic liner pipe. This shows that it will be possible to remove the transducer for replacement if it becomes faulty in the future and it should also be possible to adjust the liner pipe and transducer cage at a later date by unfreezing the liner pipe with a submersible heating element.

The water level transducer in connected via a 32m suspended cable to the data logger/meteorological instrumentation on a rock promintory at the eastern end of Cape Roberts. New gell cell batteries were installed and the met. instruments replaced and checked this season. The system is currently programmed to record a 10 minute average of water depth each hour with hourly averages of wind speed and direction, air temperature and solar radiation. Memory storage has been increased so that data can be recorded for a full year.

In the 1991/92 season it will be necessary to accurately relevel, and recalibrate the water depth transducer for connection to the tidegauge bench mark and to Cape Roberts trig. Installation and operation of the tide gauge/met. instrumentation at Cape Roberts has been jointly sponsored by the Antarctic Research Centre, Victoria University of Wellington, the N.Z. Meteorological Service and the Department of Survey and Land Information (DOSLI). This seasons programme was carried out as DOSLI event # K193 and DSIR Antarctic provided logistic support, drill equipment and drilling expertise for the transducer installation.

Conclusion

The success of this seasons programme has shown that it is now possible to establish similar remote tide gauge systems on other parts of the Antarctic coastline. Sites would be on rocky capes or promintories where sea ice breakout occurrs regularly with deep water close to shore and rock suitable for drilling and setting up the drill rig.

Acknowledgements

The other members of this event, Garth Varcoe, Paul Woodgate and "Ben" Bensemann require special mention for their efforts in drilling the hole for the transducer installation at Cape Roberts. Also at Cape Roberts members of the survey event K192 helped with this programme. Peter Isaac provided valuable advice and encouragement from Britina Island while setting up and programming the instrumentation. John Alexander (Operations Manager) and other members of the Scott Base staff provided invaluable support. At Victoria University; Eric Broughton, Jimmy Millar and the Mechanical Workshop helped with the preparation and checking of equipment. Finally Charlie Thurgood of Scott Technical Instruments Ltd. provided an excellent service to replace a faulty transducer for the programme.