REPORT NO.2:

LOGISTIC REPORT TO NEW ZEALAND ANTARCTIC PROGRAM

Event K044

Seismic Experiment Ross Ice Shelf - Again

"Seris-A"

November 24th, 1994 to January 6th, 1995

Compiled March 1995 by Ron Hackney

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Introduction

This document serves as a report to the New Zealand Antarctic Program on the logistics of Event K044, a geophysical traverse on the Ross Ice Shelf at latitude ~82°S. The report is broken into sections as requested, though only relevant sections have been dealt with. A summary of the most important issues arising from this trip is included at the end of the report.

1. Aims

The principal objective of this event was to enhance and extend the geophysical image of the sub-surface portion of the Transantarctic Mountain front that was gained from the 1990/91 Seris Expedition on the Ross Ice Shelf.

The 1990/91 seismic work did not locate a graben structure adjacent to the Transantarctic Mountain front, a graben that is believed to have formed as a result of rifting between East and West Antarctica. This expedition extended the Seris traverse a further 100 km north-east onto the Ross Ice Shelf with measurements of gravity, magnetics and ice thickness. With these measurements we will investigate the possibility that the expected graben exists further from the mountain front.

Additionally we aimed to obtain detailed measurements of ice thickness on the Robb Glacier portion of the 1990/91 expedition for reprocessing of seismic data. This information would then provide a clearer picture of the deep structure associated with the East/West Antarctica boundary.

2. Planning

We experienced some form of communication break-down upon arriving in Antarctica. We found at our event briefing at Scott Base that we were working off an Equipment Allocation form dated just prior to Tekapo, whereas NZAP staff were referring to one dated September 19th, 1994, a form which we never received. It appeared also that the September 19th form had not been updated with respect to some equipment and time in the field as agreed at Tekapo. With this in mind, it is likely beneficial for field parties to check with NZAP that both sides have compatible allocation forms.

All requested information (maps, previous reports etc.) were provided quickly by the NZAP library. We obtained previous reports on the 1990/91 Seris Expedition to the same area, and Bill Atkinson obtained an older map of the Ross Ice Shelf that included some geophysical data, a map which we found quite useful.

The Tekapo training course was a very useful precursor to the real thing in that it served to familiarise personal with the program and also the people that would provide support at Scott Base.

As well as learning a great deal, we all thoroughly enjoyed the week. Bill Atkinson did not attend the Tekapo course but we do not believe that this disadvantaged the event in any way.

3. Cargo

Eight small yellow boxes and assorted seismic equipment contained in 3 large boxes weighing in at 420 kg (930 lbs), were forwarded to NZAP as cargo on October 30th. We received notification that the cargo had arrived in Christchurch, and this cargo was waiting for us at Scott Base when we arrived.

In addition, we hand carried small amounts of sensitive equipment to Antarctica. The equipment survived the trip there and back, though continued requests for care by aircrew were necessary.

4. Personnel

The event personnel were as follows:

Ron Hackney	*Science Leader, Masters student*
Tony Haver	*Senior Technician*
Julie Quinn	*Honours student*

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All members of the party integrated well and shared much good humour whilst at the same time working hard and striving to achieve the best for the event.

5. Preparations for the Field

We were well received by the Scott Base staff. Many of the staff willingly worked beyond normal hours to assist us in getting things ready for the field, time for which we are grateful.

Planning for the field went reasonably smoothly, aside from the previously mentioned problems with differing Event Allocation Forms. The staff were happy to modify our dates in the field after consultation with Tim Stern in New Zealand, and we were allocated extra fuel as a backup upon request.

Prior to arrival in Antarctica, three fuel drops were deployed by Twin Otter. We had no difficulty in locating the fuel once in the field. Five 60L fuel drums were positioned at depot Julie (for locations see Event Map, Section 8), three at depot Kilo and nine at depot Lima. Fuel drums were deployed two high and marked with several flags.

All equipment allocated to us was well prepared and in good working order: skidoos ran well, sledges were in good shape, stoves were clean and functional, field gear was complete and clean. We had some problems with availability and standard of radio equipment (refer to later section).

Additions were made to two of the skidoos allocated (AL1 and AL5) to enable mounting of GPS navigation equipment. Modifications involved drilling screw holes into the cowling of AL1 to allow attachment of a GPS receiver mounting bracket. Wiring was added to both skidoos running from the auxiliary battery connector on the dash-panel to an antenna mount attached to the back railing of the skidoo.

The new auxiliary battery connectors on the dash-panel were invaluable for connecting equipment such as GPS receivers, avoiding the need to make direct connections to the skidoo battery. However we would have liked to see a heavier duty system used on the skidoos. Connectors with larger contacts and higher current rating would perhaps be more appropriate. With greater capacity, devices (such as Codan radios) with a higher current draw could also be connected to the system. Rather than wire the connectors through the skidoo ignition system, we would be happier to see a direct fused connection to the battery. This would ensure that equipment could still be operated in the event of failure of the ignition system.

Antarctic Field Training served the purpose of both being a good introduction to the Antarctic environment and also a valuable refresher. The course was well run and in the time allocated everything that was necessary was adequately covered.

For a shakedown, we took a trip out to Cape Royds with our skidoos and sledges. On this trip everything ran smoothly and looked to be in good working order. We did notice that the steering on

AL4 was a little sloppy, perhaps a precursor to the breakage experienced later? (see Section 6). An extra shorter trip was taken toward "Room With a View" for the purpose of testing HF radio equipment. Such a test remote from Scott Base is essential as the "testing" of equipment outside the Scott Base radio room is inadequate (see Section 12). In general, a shakedown trip is an important part of field preparation that should not be left out. Such trips can also be beneficial to "cultural welfare", in our case because we were able to share some time with penguins!

We were delayed 3 days into the field from Scott Base, we believe due to aircraft unavailability. Whilst this delay pushed back our scheduled extraction date from the field, we were given sufficient notice of the delay. It would be useful in the future given such warning of a delay, to also delay the delivery of science and other equipment to McMurdo cargo handling. By being able to hold onto our equipment longer, some time could have been spent close to Scott Base preparing the equipment for the field. Extra time with the equipment could well have saved us some preparation time upon arrival in the field.

Overall, the preparation of equipment was adequate and the allocation of that equipment efficient. This does not apply to radio gear, but this will be dealt with in Section 12.

6. Field Transport

6.1. NZAP Vehicles

The 3 skidoos allocated to this event were well prepared and adequate spares, tools and lubricants were supplied. We were impressed with the Scott Base staff who prepared our machines.

During their time in the field, the skidoos were never subjected to testing terrain. Being on the Ross Ice Shelf, the terrain was flat and mostly smooth. The roughest terrain had hard sastrugi ridges no more than half a metre in height. Aware of the possible consequences of such terrain, we were conscious of the need to adjust travelling speeds to suit the terrain. We were sometimes able to average speeds of 20 km/hr, but on average managed about 15 km/hr. Occasionally progress was as slow as 10 km/hr.

The lack of testing terrain resulted in good fuel consumption. Averaged for the three skidoos used, this consumption was:

4.2 km/litre or *2.38 litres/10km.*

During the time in the field, we used 9 60L drums of 2-stroke, a $^1/_2$ drum of Mogas (generator), and one jerrycan of kerosene. This usage left 16 drums of 2-stroke, $1^1/_2$ drums of Mogas and 2 jerrycans of kerosene. All drums and remaining fuel were flown out of the field.

Mileage of each skidoo is detailed below.

Skidoo	AL1	AL4	AL5
odometer (start)	5733	2840	6204
odometer (end)	6801	3264	7301
Total distance	**1068 km**	**424 km**	**1097 km**

The smaller distance covered by AL4 was due to it being used only during camp moves.

Little maintenance was required on the vehicles. Work that was necessary and damage that did occur is outlined below:

Date	Event	Remedy
21/12	AL5 fuel pump/carburettor icing	Towed to camp and de-iced
21/12	AL4 steering failure	Towed to camp. Later added a make-shift steering system to avoid the need to tow.
24/12	AL4 breaks nose ski	Retrieved next day by mounting nose on sledge and towing.
6/1	AL5 steering failure	On approach to Herc at extraction time.

6.2. Aircraft Operations

The event was deployed to the field with VXE-6 Hercules aircraft, one flight each to and from the field. Deployment and pick-up was at depot Lima (see Section 8 for map).

Cargo was delivered to McMurdo almost 5 days before the flight to the field. We did not experience any difficulties getting our cargo through the system at McMurdo and we found that the personnel on this side of things at McMurdo were helpful.

The weights carried on our flights were close to the maximum load possible for a Hercules landing in the field. These weights were:

To the Field:	4220 kg	(9300 lbs)
From the Field:	3670 kg	(8100 lbs)

The majority of our cargo (food and kitchen boxes, science boxes etc) were strapped to a large pallet. Extra 60L fuel drums were carried on a small pallet. Sledges were carried separately in the hold unloaded, though one sledge carried checked personal luggage. We drove the skidoos to the Ice Runway ourselves about 24 hours prior to the scheduled departure time and insisted on loading them onto the aircraft at departure time ourselves. We would recommend to others transporting skidoos on Hercules *not* to rely on the loading crew to get the vehicles on the plane without damage.

Given that we had only one flight each way, no special arrangements were made for hazardous cargo (fuel, skidoos etc) other than the usual labelling arrangements and a waiver was arranged by McMurdo Cargo Handling to allow passengers to ride with cargo considered hazardous.

All our cargo arrived with us in the field safe and well.

Pre-planning of flights to the field went quite smoothly. We were given plenty of notice of our delay, and on the rescheduled day of departure, we were away only a few hours late.

Extraction from the field was a little more eventful. Our scheduled removal was December 27th, we were not picked up until the early hours of January 6th. Reasons for this were: the weather (3 days of the waiting period were stormed out); mechanical problems with aircraft; and "higher priority" flights elsewhere. Whilst we understand that there are many factors that control flights in the Antarctic, we felt at times that more could have been done at Scott Base to push the Americans to get a plane to us. We were critically low on food (for reasons discussed in Section 11.3) and our impression from communication with Scott Base was that the Americans were not totally aware of how critical our situation was. A 4 or 5 day storm at the time of extraction would have left us with no food. Regretfully it seemed that more effort was made only after persistent insistence from us.

Landing sites in the field were adequate and locations are shown on the attached map. At field put-in time, 3 ski drags were made by the plane before landing on the fourth pass. The landing felt reasonably smooth and no complaints were heard from the aircrew. The landing site was flat, crevasse free, lacked substantial sastrugi ridges and was covered in 10 to 15 cm of soft snow.

At pull-out time, the drag lines had been covered over by blowing snow and new ridges and sastrugi had formed. The site still appeared suitable for a landing and the plane that picked us up landed on the first approach without any test drags. Loading the aircraft took roughly $1\frac{1}{2}$ hours, including packing the camp. The loading crew were very efficient, patient and helpful. Take-off from the site was noticeably rougher, but still not critically so, though we understand that some damage was done to the nose-ski of the plane during take-off.

We were impressed with the aircrew (and grateful) on this extraction flight as they landed under conditions of very flat light and low cloud ceiling, conditions under which we hadn't expected a landing to be attempted. The ski-way where the drags were initially put was marked with flags separated by 200m over a length of 2000m. These markings may have assisted the aircrew with their decision to land.

The only other aircraft support was the Twin Otter flight in late November to deploy the fuel depots. These depots were deployed as requested and were not drifted in to any great extent.

7. In the Field

7.1. Event Diary

Following is a summary of our day to day events whilst at Scott Base and in the field.

Nov 22nd: - Bill Atkinson arrives in Antarctica.
Nov 23rd: - travel Wellington to Christchurch, accommodation Windsor Hotel.
Nov 24th: - flight check in 0400, departure to Antarctica 2315.
Nov 25th: - arrive Scott Base 0630, briefing and sleep.
Nov 26th: - Event briefing, Field Training in afternoon.
Nov 27th: - Field Training continued, preparation for shakedown trip.
Nov 28th: - shakedown trip to Cape Royds.
Nov 29th: - packing of cargo.
Nov 30th: - cargo taken to McMurdo.
Dec 1st: - gravity measurements at McMurdo and Scott Base.
Dec 2nd: - skidoo driving practise and HF radio testing towards "Room With a View".
Dec 3rd: - skidoo practise and discussion on GPS with Perry Gilbert (NZAP) and McMurdo USGS surveyors Larry Hotham and Barbara Littell.
Dec 4th: - skidoos delivered to ice runway, bag drag in evening.
Dec 5th: - to ice runway at ~1930, supervised loading of LC130, take-off at ~2045. Touch-down in the field at Camp Lima (refer map) at ~2300.
Dec 6th: - day spent organising equipment.
Dec 7th: - measurements and testing at Lima measurement site (km-190).
Dec 8th: - measurements km-190 (Lima) to km-160.
Dec 9th: - camp move to km-130.
Dec 10th: - measurements km-150 to km-110.
Dec 11th: - no progress due to bad weather (wind and poor definition).
Dec 12th: - camp move to km-70 (in poor weather conditions).
Dec 13th: - no progress due to bad weather (wind, snow, poor visibility).
Dec 14th: - no progress due to bad weather (wind, snow, poor visibility).
Dec 15th: - no progress due to bad weather (wind, snow, poor visibility).
Dec 16th: - measurements km-100 (Kilo) to km-90.
Dec 17th: - measurements km-90 to km-70.
Dec 18th: - measurements km-46 to km-70.
Dec 19th: - camp move to km-22.
Dec 20th: - measurements km-44 to km-22.
Dec 21st: - measurements km-0 (Julie) to km-22.
Dec 22nd: - no progress due to skidoo repairs and battery charging.
Dec 23rd: - return travel km-22 to km-100.

Dec 24th: - return travel km-100 to km-190 (Lima).

Dec 25th: - travel to km-160 and back to retrieve damaged skidoo (AL4).

Dec 26th: - packing of equipment in preparation for scheduled pull-out, also attempted measurements with seismograph.

Dec 27th: - flight postponed.

Dec 28th: - tent bound due to storm.

Dec 29th: - tent bound due to storm.

Dec 30th: - tent bound due to storm.

Dec 31st: - storm cleared, but no flight scheduled. Dug sleds etc out of snow drifts.

Jan 1st: - no flight scheduled. Food drop requested from Scott Base.

Jan 2nd: - flight scheduled for 2300, then postponed and postponed some more....

Jan 3rd: - plane arrives ~0300 but doesn't land due to poor surface definition. With little warning, at 0500 plane arrives and drops US Navy "Survival" rations. Pick-up rescheduled for next day.

Jan 4th: - two planes develop mechanical troubles en-route to pick us up, one of which we believe carried the requested NZAP food drop.

Jan 5th: - Flight travelling via Byrd eventually arrives on schedule at ~0100. In poor conditions (low cloud and poor surface definition) plane lands. Loading completed in $1\frac{1}{2}$ hours. Arrive back at Ross Island ~0500, emergency landing due to damaged nose ski.

- day spent packing science cargo for return to NZ.
- board flight back to Christchurch at 2200.

Jan 6th: - arrive Christchurch 0630, returned to Wellington by 0930.

A summary of the time in the field is as follows:

total days making measurements	=	8
total days lost to weather/repairs	=	6
total days for camp movement	=	5
total days for put-in/pull-out	=	2
total days delay from field	=	10
TOTAL DAYS IN FIELD	=	**31**

7.2. Method

In brief, a typical day involved working from camp about 20 to 25 km in either direction on successive days making measurements, then returning to camp. This removed the need to continually go through the time consuming process of setting up and pulling down camp every day. It also allowed us to travel lightly whilst making measurements; we only carried the science equipment and emergency survival equipment that included 2 Dome tents. A more detailed account of method is contained in the Immediate Science Report for the event.

It is worth mentioning here the method used to navigate the traverse line. We used GPS equipment loaned from Alex Pyne (Victoria University). A *Trimble Pathfinder Basic Plus* unit was mounted onto a skidoo cowling with its antenna attached to the back railing (see Section 5). Navigation with such a set-up is accurate to around ±100m. Such accuracy seemed adequate for our navigation purposes, since we had no difficulties finding fuel depots deployed earlier by the Twin Otter. For scientific reasons, more accurate positioning was required at measurement sites and this was achieved using additional *Trimble Pathfinder* equipment set recording for approximately 15 minutes at each site, eventually to be differentially corrected to a continuously logging base station GPS back at camp. The base station data will in turn be differentially corrected with data provided by USGS surveyors at McMurdo. With this method, we should be able to determine measurement positions to within about a metre.

Whilst GPS is a convenient and relatively simple means of navigation and position finding, we found that discussions and advice from Dosli surveyor Perry Gilbert invaluable. In this sense, we believe that whilst it may appear GPS removes the need to supply survey assistance to science events, the need to have access to someone familiar with surveying techniques (both conventional and GPS) is still vital.

8. Event Map

The Event Map is attached at the end of this report.

9. Weather

Weather during the time in the field was quite variable. For the first week it remained clear and sunny with light winds. After this time conditions deteriorated to low cloud, variable visibility and poor surface definition. On the odd day snow fell, occasionally quite heavily. Heavy snow days combined with the relatively warm temperatures, led to problems with wet clothing. A storm with up to 40 knot winds and heavy blowing snow was encountered over a three day period toward the end of the trip. This storm did not help pull-out procedures.

Despite the lack of perfect conditions for the majority of the trip, the weather did not greatly hinder progress. Six days were lost to weather as a result of strong wind and/or very poor visibility. It is worth noting that work only continued due to the fact that we were travelling on the relatively safe terrain of the Ross Ice Shelf. In many other parts of Antarctica travel would have been unwise.

Temperatures in the field averaged around -5 to -7°C, the coldest being about -17°C and the warmest +1°C. Again, the mild temperatures at times caused problems with wet clothing.

A more detailed account of weather has been submitted to the Scott Base science technicians in the "Met Book".

10. Accidents, Incidents or Hazards

No accidents or incidents occurred that resulted in significant injury. Perhaps our biggest safety concern was the manner in which the steering system failed on skidoo AL4 (Section 6.1). Fortunately this failure occurred just prior to commencing travel. Had the failure occurred during normal travel speeds (maximum 20 km/hr), potential for injury would be high. Given the failure of AL5 in a similar manner, and also with the failure of another skidoo (AL3) on the polar plateau during the previous season in mind, it may be necessary to consider a closer examination of the steering mechanism on skidoos in order to strengthen the system.

11. Field Equipment

11.1. Clothing

Clothing performed quite well. Relatively mild temperatures meant that feeling cold was not too much of a problem, though toward the end of the trip when food was becoming low, the quicker onset of cold was noticeable by all members of the party. The only major problem we had with the clothing was wetness when travelling in conditions with falling or blowing snow. This problem was overcome by wearing the waterproof oversuits supplied to us. These oversuits were good for this purpose, but we still believe that they would be difficult to use for their intended purpose as a suit to go over survival clothing. If the suits were to become regular issue as a waterproof garment, then modifications to make them similar to other issued clothing would be needed.

11.2. Tents

Our team trialed a modification on the standard polar tent design involving split poles to fold the tent to a more compact size. We experienced no great difficulties with the system of slotting poles together, though we would be suspicious of using the system in extreme conditions of cold or wind. Some form of lubricant where the poles join together would improve the ease with which the join could be made and also pulled apart.

We carried with us two dome tents as emergency back-up. We also found these tents useful as a mobile "laboratory" in which batteries could be charged more efficiently due to the warmer environment. In future we would consider taking an extra tent of this type solely for the purpose of "laboratory", thus avoiding the necessity to disassemble the tent before a days travel from base camp.

11.3. Food Boxes

We experienced many short falls with the Food Boxes. We quickly ran out of items such as spreads, leaving us with a large excess of crackers that we could either not eat or eat dry. Muesli bars were way in excess; we brought back the equivalent of about 10 muesli bars for each member of the party, and would have brought back more had other food not run out.

We were concerned with the used by dates on many items in the boxes. Muesli bars were often up to 3 years out of date and showing it. Tinned fish is an especially dodgy product when in date, let alone out of date. Thought should perhaps be given to replacing these and other items (eg. milk powder). We wonder whether it is worth risking food poisoning for deep field parties that are perhaps days away from assistance?

We found that with all the food allocated as per NZAP guidelines, we ran short of food by the end of the trip. The result of this was that instead of having the required 14 days per person extra food, we only had at most 7 days. This equates to the food boxes having the equivalent of 16 person days of food as opposed to the stated 20.

Items that we believe should be given a greater emphasis in boxes include:

* frozen meat and vegetables (an extra 4 person days per box)
* pasta and rice (an extra packet of each would make a difference)
* spreads (jam, honey, vegemite etc)
* margarine (vanished quickly because needed for cooking)

Less emphasis should be put on:

* tinned fish (especially out of date)
* muesli bars (reduce or replace some with extra cookies)

We would also have liked to see some cooking oil included in the food boxes as we frequently used the teflon frypan for meals.

Maybe it is worth considering a system by which field parties can select their own food, thereby allowing them knowledge of exactly what they have in the field and enabling some degree of selection of preferred items.

11.4. Other Equipment

Technical climbing equipment, whilst not used to any great extent, appeared to be of suitable standard.

Sledges worked well and no problems were experienced. When moving camp, we carried loads that pushed the maximum capacity of the sledges, but no damage occurred under normal use.

The contents of the kitchen boxes were adequate, though inclusion of a sealable milk-shaker would be more useful. The teflon frypans are a definite plus.

Stoves all worked well and were clean and in good working order when we got hold of them. The only field maintenance required was the replacement of the burner nipple on one primus and the tightening of the nipple on another.

We had no problems with the generator supplied other than the lack of a 12V DC charger that we had expected. We were impressed with the ease at which the generator started and its persistence even when partly covered by blowing snow. We were grateful for the wooden box made at Scott Base to shelter and transport the box. Such boxes should be considered standard issue with all generators.

All equipment was returned to Scott Base in working order. One sledge was returned with a broken deck rail as a result of improvising to retrieve AL4, the skidoo that severed a nose ski. Regretfully, a lot of the equipment was returned uncleaned, but due to our rapid transit through Scott Base this was unavoidable. We are apologetic and grateful to the staff at Scott Base with whom this gear was left.

Overall, we found the field equipment supplied of a suitable standard and the service in providing this equipment of an equivalent standard. We would however suggest some major thinking on the food boxes and hope that some of our other minor suggestions above will be considered.

12. Radio Communications

We were in the fortunate position to have an experienced radio technician as part of the team (Tony Haver). Regretfully, we believe that there are a number of problems with the current communications set-up.

We were issued with two older Codan radios from Scott Base, one of which worked well, the other having a deficiency in power output. We had been expected to be issued with the new Codan X2 radios but apparently these were unavailable. As far as we could see, at least one X2 spent our field time sitting in a broken down Hagglund. Whilst we managed good communications with the radios we had (and this is not a result of the radios alone), we had difficulty understanding why one new radio could not have been made available to the only deep field party this season.

Our HF radios were tested approximately 15 km from Scott Base toward "Room With a View". Testing of radio equipment any closer to Scott Base is not a true test of the system. As testimony to this, we called the radio room from the hanger by transmitting from our lower power radio as it was in its box, no aerials attached. The perfect communications resulting from this indicate the importance of taking HF radio gear away from base. We would consider the absolute minimum distance for such a test as 5 km from Scott Base.

For safety reasons whilst travelling on glaciers, we had also requested the use of a HF vertical whip aerial and were on the understanding that one would be available (otherwise we would have brought our own). Contrary to the experience of our technician, we were informed that such a whip aerial would not work and consequently we were not even given the chance to trial the set-up. We consider a system that avoids unwinding the conventional dipole aerial in a crevassed area a definite necessity from a safety perspective, and believe that developing a system for adaptation to skidoos something that NZAP should seriously consider.

Batteries supplied with the radios whilst serving their purpose for brief radio conversation, were not adequate for the extended conversation periods that we found necessary. However, we acquired a spare 12V skidoo battery to overcome this problem. We believe that the batteries supplied in the green wooden boxes should be modified slightly to include, as all our own batteries did, a fuse. Given that these batteries are charged from unregulated solar panels, a simple short or overload could result in a fire. Fusing the batteries is a cheap and simple safety precaution.

We did not use the issued NZAP dipole aerials and brought our own, along with 3m length poles upon which to mount the aerials. The raising of the aerials above the ground in combination with the use of an aerial tuning unit was likely the major factor contributing to our good communications with Scott Base. These communications were interrupted only by failures at Scott Base and rarely by unfavourable atmospheric conditions.

We found that the radios had no settings to American frequencies currently in use. This leaves a field party in dire straits should a problem occur at a time when Scott Base is off line. We experienced such a time when Scott Base was off line and the only way we could communicate was through the gratefulness of South Pole who tuned off their standard frequency (now 8998 MHz) to talk to us on 8997 MHz. We believe that it is essential for NZAP to look at getting some American frequencies set on the radios immediately, especially the modification of the 8997 MHz band to the 8998 MHz band.

As mentioned above communications with Scott Base were excellent. We also found that we were frequently relaying for other field parties closer to Scott Base than ourselves. One particular party experienced a fault with their Compak radio and were unable to contact Scott Base with the back-up. It was fortunate that we were listening at the time, and also fortunate that we were delayed from the

field, otherwise they could have been in the field with no means of communication for a period of about a week.

We found the radio sked timing to be suitably flexible. Radio operators were friendly and helpful. Weather reports were provided on request and messages were passed to and from New Zealand efficiently. Information on flights and resupply was slow in coming through, though certainly not through any fault of the radio operators. We often had to request information about flights, but generally found it quicker to get information regarding flight schedules direct from South Pole. We requested a food package be prepared and air dropped to us, a drop that never arrived, we hope due solely to aircraft troubles.

VHF radio's along with high gain aerials were also supplied to us for inter-party communications. We found that the high gain aerials were ineffective when the party was further than about 10 km apart.

In the future we would plan to bring our own radio communication and eventually satellite communication equipment. This way we can be sure of the standard of the equipment and know that we will always be able to communicate with Scott Base and the outside world.

13. Scott Base Lab Facilities

Lab space used by us was mainly for the purpose of storing electronic equipment and charging batteries. We used a spare room in the Hatherton Lab to set-up GPS and computer equipment, and some bench space upstairs in Q-Hut to keep the gravity meter on power.

Suggestions that we could make for the new lab facilities include:

* space, perhaps partitioned, for specific events to set-up equipment (in our case, computers, gravity meter etc). Space away from the garage environment is essential as the dirt associated with garages is not a good mix with sensitive scientific equipment.
* equipment that would be useful in such areas could include a soldering iron, battery chargers appropriate for charging up to 20Ahr 12V sealed led acid batteries, such charger(s) should have a current output of 2 - 5 Amps.
* a basic set of tooling would be useful, perhaps a set of the tools most commonly borrowed from the garage and workshops? We found that bringing a complete set of tools for ourselves was much more practical than relying on what is already at Scott Base.

15. Environmental Impact

The relevant form has been completed and attached to this report.

We found no sign of impact from the previous 1990/91 Seris Expedition in the same area.

In terms of wildlife, we had visits at various times from roughly half a dozen different skua's, usually individually, but once in a pair. The skua's would generally only spend a few minutes sitting on the ground around the camp and then would fly away to the north. One other type of bird was sighted on one occasion. This bird had a white underside, grey top and grey wing leading edge. Its wings were pointed and its beak dark in colour. We thought this might have been an Australian Plover, which we understand are found in colonies in Marie Byrd Land.

18. Management of Science in the Ross Dependency

In general, it would seem that NZAP can adequately cater for work such as ours. We experienced some inconveniences that have been outlined in this report. There a few things that we believe need looking at, and attention to these issues can only improve the standard of support provided by NZAP.

At Scott Base we had a lot of support and mostly gained equipment of suitable standard. Exceptions were the radio equipment and food boxes. We hope that the comments above will contribute to resolving these problems.

Though we realise that there are many factors controlling aircraft allocation in the Antarctic, we feel that NZAP could provide more support to their own field parties by perhaps being a little less reserved when it comes to asking things of the US program or making them aware of situations in the field. This is especially the case for situations such as our own in which time and particularly amount of food were becoming critical.

In light of our need for a quick air drop of food, it may be worth considering having a pre-packaged emergency food supply stored at Scott Base for immediate dispatch on any aircraft in the hours rather than days before a plane is scheduled to depart. Such a package should include standard food items necessary for normal food consumption and should be already packaged in a state fit for an air-drop. Such a package stored ready for immediate dispatch could avoid the dangerous situation of a field party being stranded without food. Such a package could also save a field party from the demoralising experience of living on US Navy "Survival Rations".

This event involved no guest scientists and no senior scientists. Two students were involved, a Masters student as Science Leader and an Honours student. We do not believe that this

disadvantaged the event in any way. The presence of a more senior scientist would have made little difference to the amount of progress made. All that is required on such trips is someone familiar with maintaining the equipment (the technician), someone familiar with the scientific objectives of the trip (the Science Leader, who in this case was given a thorough briefing in New Zealand and through his own work is familiar with the problems being addressed), people familiar with using the equipment (technician and students) and someone with the ability to make on the spot judgements with regard to data being collected (students and technician).

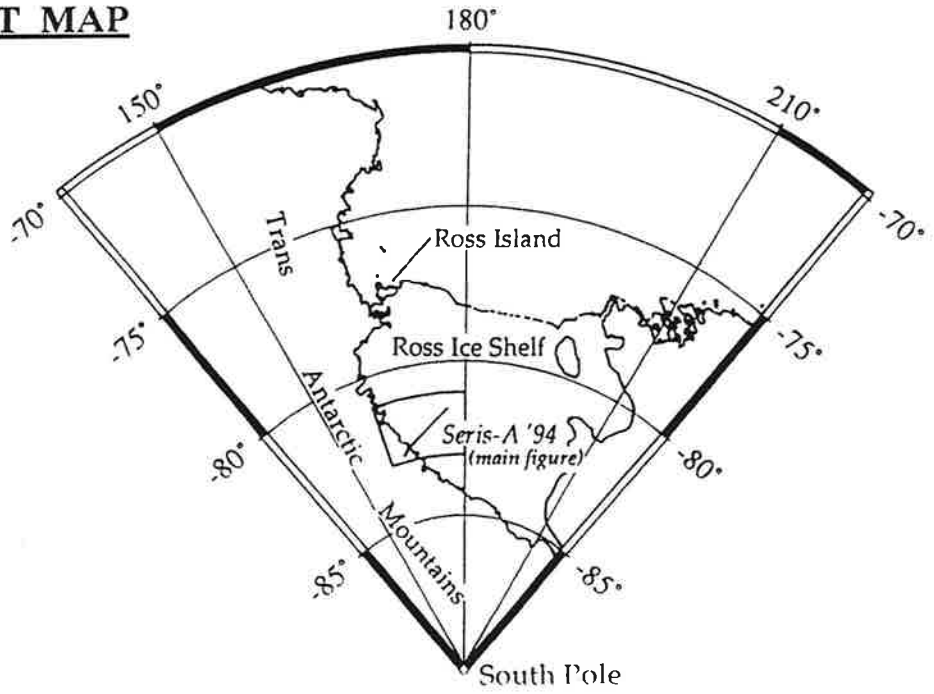
SUMMARY

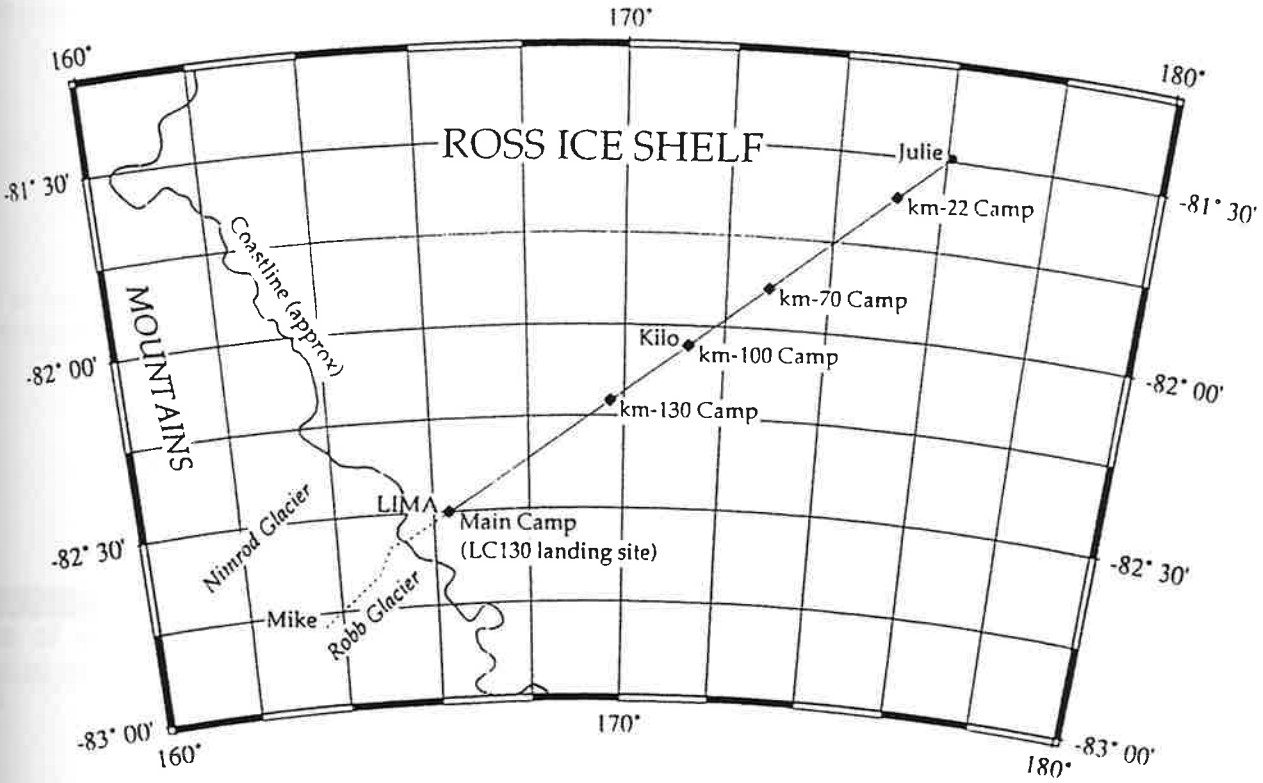
There are several things highlighted in this report that we believe require attention for the benefit of field teams that follow us. In outline these are:

* the problems of food box contents. We would suggest a review of the contents and a "clean-out" of over date food items (Section 11.3).
* the provision of an emergency food supply for *rapid* deployment to the deep field (Section 11.3).
* the problems and inefficiencies with radio communications (Section 12), especially testing of HF radios further from base, the need to develop a compact aerial unit for use on crevassed terrain, and work towards providing compatible frequencies with the US program.
* the need for greater communication between Scott Base operations and McMurdo operations with regard to deep field parties (Section 6.2).
* the possible need for a close examination of the skidoo nose-ski system in order to strengthen the system, thereby reducing the risk of injury (Section 10).
* the advantages of providing boxes for transporting and sheltering generators (Section 11.4), perhaps looking at greater use of solar energy in place of generators.

We would be more than happy to provide further information and consult further with NZAP on these issues if it were considered necessary.

EVENT MAP





Top: Map showing the region around the "Seris-A" Traverse in relation to Ross Island and the Ross Ice Shelf. *Bottom:* Location Map of the traverse showing camp sites and put-in/pull-out location. Travel was from Lima to Julie, returning to Lima. Fuel depots were positioned by Twin Otter at Lima, Kilo and Julie (see Section 5). Dotted line represents the portion of the traverse on the Robb Glacier not covered.

NZAP ENVIRONMENTAL RETURN
1994-95 SEASON

Office use only

Complete all relevant sections and include in both Immediate Science And Logistics Reports

Event No. K044

Permit No. _____

Use of chemicals including radionucleides in Antarctica.

Complete the following for each chemical and radionucleide taken to Antarctica

Chemical form	Locations used (long, lat)	Quantity (μ Curies where applicable)

Were all chemicals returned to New Zealand..... ❑ Yes ❑ No

If NO detail why, location, quantities of material released or stored

Did the use of the radionucleide(s) comply with permit..... ❑ Yes ❑ No

If NO detail why non-compliance

Use of explosives.

Detail any use of explosives.

Date	Location (long, lat)	Explosive type	Size of charge kg	Number exploded

Importation of animal, plant (includes seeds), microorganism or soil.

Detail each species and quantities taken to Antarctica

Species | Quantity | Location (long, lat)

Were all these returned to New Zealand ..... ❑ Yes ❑ No

If NO detail why, locations (long, lat) and quantities released

Did importation comply with permit ..... ❑ Yes ❑ No

If NO, detail why non-compliance

Collection, tagging, killing, restraining or handling any terrestrial, freshwater or marine plant or animal ,or collection of geological material

For each major location eg Scott Base, Cape Evans, Cape Bird etc detail each species handled in any way, or material collected

		Numbers or amounts in each category				
Species or geological specimen type	Location (long, lat)	Caught or collected	Tagged or banded	Killed	Restrained	Differ from permit Y/N
eg Adelie Penguin	Cape Bird	25	25	0	25	N
eg Ventifacts	SE Bull Pass	2				N

If collection etc differed from any permit issued in accordance with the work, please state how:

Details of entry to Protected Areas.

List any protected area, Specially Protected Area (SPA) or Site of Special Scientific Interest (SSSI) or Specially Reserved Area (SRA), you entered.

Name of SSSI, or SRA	Date Visited	Party size	Total person-days in Area

Did your activity in the Area differ from that stated in your permit ❑ Yes ❑ No

If NO detail why non-compliance

Details of equipment left in the field

Include any equipment, markers, stakes, cairns, human waste or fuel (including spills)

Item	Size, Number, Quantity	Location (long.lat)	Reason
Human Waste	1 'pit' per camp	Camp sites	
Flags	40	Depot Lima (82°30·25/166°18·5E)	Used to mark landing strip at pull-out. Pilot insisted they be left.

Other impacts (e.g. disturbance by sampling, trampling, camp operations, installation of equipment, buildings, cumulative impacts)

Detail any other environment impacts from your activity. In particular detail those impacts which differed from those stated in your pre-season environmental evaluation.

Summary of locations occupied

Complete the following for each site occupied by your event

	Sites Occupied or visited	Field Camp Location For field camps give longitude and latitude or map reference.			Dates Occupied		Total Days	Number of people	Total person-days at location	Previously used camp site Yes/No
		Latitude	Longitude	Map and Ref	From	To				
1.	Scott Base	77°51.0S	166°46E							
2.	Vanda Station	77°31.4S	161°40.4E							
3.	Cape Bird	77°14.0S	166°28.0E							
4.	DEPOT LIMA	82°30·2 S	166°18·5 E		Dec 5,94	Dec 9	4	4	16	Yes
5.	km-130 Camp	82°12·6 S	169°42·8 E		Dec 9	Dec 12	3	4	12	No
6.	km-70 Camp	81°53·4 S	172°49·5 E		Dec 12	Dec 19	6	4	24	No
7.	km-22 Camp	81°36·8 S	175°08·5 E		Dec 19	Dec 23	4	4	16	No
8.	km-100 Camp	82°03·3 S	171°17·9 E		Dec 23	Dec 24	1	4	4	No
9.	DEPOT LIMA	82°30·2 S	166°18·5 E		Dec 24	Jan 5,95	13	4	52	Yes
10										
11.										
12.										

Notes:

REPORT NO.1:

IMMEDIATE SCIENTIFIC REPORT TO NEW ZEALAND ANTARCTIC PROGRAM

Event K044

Seismic Experiment Ross Ice Shelf - Again

"Seris-A"

November 24th, 1994 to January 6th, 1995

Compiled March 1995 by Ron Hackney

Institute of Geophysics

Victoria University Of Wellington

1. Summary

The Transantarctic Mountains form one the highest and longest mountain chains in the world. Mechanisms for forming the mountains are debated, though it is believed that the mountains are a result of rifting between East and West Antarctica. The boundary between East and West Antarctica is marked by where the mountains meet the Ross Ice Shelf/Ross Sea. The occurrence of rifting suggests that at the mountain front a depression, or graben, should exist in the West Antarctic crust.

During December 1994, the K044 geophysical traverse collected data on the Ross Ice Shelf intended to enhance and extend the image of the crustal structure of the boundary between East and West Antarctica that resulted from the 1990/91 Seismic Experiment on the Ross Ice Shelf ("Seris", see ten Brink et al, 1993). The traverse at ~82°S covered a total distance of almost 200 km, starting at the edge of the Transantarctic Mountains and moving north-east onto the Ross Ice Shelf.

Data collected included GPS data for navigation and position finding, gravity data, magnetic data and radio echo sounding measurements of ice thickness.

The gravity data collected confirms earlier data and has initially shown some interesting features on the new portion of the traverse, though at this stage it is unclear what these variations represent. It is possible that the variations seen could be associated with the graben that was not imaged during the 1990/91 work closer to the mountain front.

Measurements of the Earth's magnetic field were made over the length of the traverse, such data were not collected on the earlier traverse. Once effects from the daily variation in the magnetic field and the general shape of the background field have been removed, we expect to see magnetic anomalies relating to the transition between West and East Antarctic crust.

Measurements of ice thickness made with an ice penetrating radar suggest that the Ross Ice Shelf becomes thinner away from the mountains, a result that would be expected given that further from the mountains, ice is further from its source. The main purpose of the radar measurements was to make ice thickness measurements up the Robb Glacier. Such measurements would have been used in reprocessing of seismic data from the 1990/91 traverse. However poor weather and time constraints meant that this part of the event was not carried out.

Future work may involve making the ice thickness measurements not achieved this year on the Robb Glacier, along with magnetic measurements. It is also feasible that a larger seismic expedition could be carried out should results from the Seris-A traverse suggest this is warranted. Such an expedition could easily be extended still further across the Ross Ice Shelf.

2. Proposed Program

The principal objective of this event was to enhance and extend the geophysical image of the sub-surface portion of the Transantarctic Mountain front that was gained from the 1990/91 Seris Expedition on the Ross Ice Shelf.

The 1990/91 seismic work did not locate a graben structure adjacent to the Transantarctic Mountain front, a graben that is believed to have formed as a result of rifting between East and West Antarctica. This expedition extended the Seris traverse a further 100 km north-east onto the Ross Ice Shelf with measurements of gravity, magnetics and ice thickness. With these measurements we will investigate the possibility that the expected graben exists further away from the mountain front.

Additionally we aimed to obtain detailed measurements of ice thickness on the Robb Glacier portion of the 1990/91 expedition for reprocessing of seismic data. This information would then provide a clearer picture of the deep structure of the East/West Antarctica boundary.

3. Scientific Endeavours and Achievements

Navigation along the 200 km "Seris-Again" (Seris-A) traverse route utilised the satellite based Global Positioning System (GPS). Approximate co-ordinates of desired measurement sites were pre-determined in New Zealand and then stored in a GPS receiver as "way points". Navigation to a way point when in the field is achieved by following the bearing indicated by the GPS unit. Navigation in this manner was accurate to about ±100 m.

A typical day of making measurements involved travel of up to 50 km on skidoo. We opted to operate up to 25 km either side of a base camp on successive days, making measurements and then returning to camp, thereby avoiding the need to set and break camp every day. Such a method was fuel efficient in that only light loads of science and survival equipment were carried on a single sledge behind each of two skidoos. Roughly every third day, it became necessary to shift camp. Whole days were dedicated to this task. Camp was moved at most 60 km in a day.

Measurements of the Earth's gravity and magnetic fields were made at 2 km intervals along the 200 km traverse. In addition to use in navigation, co-ordinates of measurement sites were also determined using GPS. We hope to obtain positions and elevations with accuracy's of the order ±2m. To achieve this accuracy, we logged data from satellites for approximately 15 minutes at each site. This data will be corrected to a continuously logging base station GPS left at camp, and this base station will in turn be corrected to data logged at McMurdo Station by the USGS.

Images of the crustal structure of the Transantarctic Mountain front obtained from the Seris traverse of 1990/91, did not locate any graben structure adjacent to the mountains. The absence of this graben can suggest that the age of the mountain uplift is older than thought (ten Brink et al, 1993). However, there is a possibility that the graben formed further from the mountain front. In search of this graben, the K044 team extended the 1990/91 traverse a further 100 km north-east onto the Ross Ice Shelf.

Preliminary indications from gravity data suggest that interesting features lie below the ice and sea water under the new portion of the traverse. Closer to the mountains the gravity data are flat, reflecting the presence of flat lying sediments in this region, as imaged in the seismic data from the Seris traverse (ten Brink et al, 1993). The new data indicates that the gravity profile does not remain flat further out from the mountains, perhaps indicating structures associated with deformation occurring in the West Antarctic crust at the same time as mountain uplift. At this stage it is unclear exactly what the data indicate and further processing is necessary.

Soundings of ice thickness were made over the full length of the Seris-A traverse at 4 km intervals. Such measurements involved laying out antenna arrays onto the snow surface and recording reflections of electromagnetic waves from an ice-water or ice-rock interface. Given that the whole traverse was carried out on the Ross Ice Shelf, we only expect to have reflections from an ice-water interface. It is unclear at this stage how the signals from such an interface behave. Despite this, field examination of the data seemed to suggest that the ice was becoming thinner away from the Transantarctic Mountains, perhaps reducing from about 400 m to 200 m. This observation appears to be consistent with other work on the Ross Ice Shelf (USGS, 1972).

In order to reprocess seismic reflection data and improve an image of the deep crustal structure of the mountain front, it was planned to continue the traverse up the Robb Glacier with the priority being to obtain detailed ice thickness measurements. Such measurements would be a valuable "static correction" for use in reprocessing of the Seris seismic data. Poor weather and time constraints meant that this part of the expedition was not possible.

It had also been hoped to obtain magnetic data up the Robb Glacier. A significant magnetic anomaly is expected to be present at the mountain front as the cross is made between the very different crusts of West and East Antarctica. Despite the Robb Glacier portion of the traverse not eventuating, magnetic data collected on the portion of the traverse covered may have been close enough to the mountain front to begin to see this anomaly.

For the future, given the desire to obtain the detailed ice thickness measurements from radio echo sounding on the Robb Glacier, an expedition may eventually be proposed to cover the portion of the Seris-A traverse not covered this season. At the same time magnetic data would be recorded in

search of any magnetic anomaly associated with the boundary between East and West Antarctica. Such work would probably involve a similar time period and logistical effort to this years traverse.

With seismic reflection and refraction sounding, a more detailed examination of the geology underneath the Ross Ice Shelf can be achieved. Should the results of the Seris-A work suggest the existence of the extensional graben expected to be present, then the traverse can form the basis of a logistically larger seismic expedition to further probe the area examined this year. Such a traverse could easily be extended still further north-east across the Ross Ice Shelf.

Making geophysical measurements requires sensitive and fragile instruments, and making the measurements in Antarctica is made more difficult by the harshness of the Antarctic environment. In an effort to improve the chances of survival of this equipment in Antarctica, methods have been devised at Victoria University to protect the instruments. Many of these modifications are based on experience from earlier designs used on the polar plateau during the East Antarctic Seismic Traverse of 1993 (Bannister, 1994).

Perhaps the most sensitive instrument used was the gravity meter. This meter requires operation at a fixed temperature of 48°C, and it is extremely susceptible to damage from even the smallest of bumps. With the traverse being undertaken using skidoos towing sledges, it was necessary to consider the roughness to be experienced by the gravity meter whilst riding over sastrugi'd terrain on the sledges.

In order to keep the gravity meter warm and safe from bumping, a large box was made in which to house the meter. The meter itself (with rough dimensions 15x20x30 cm) was enclosed, for warmth, by a perspex housing insulated with closed cell foam. Based on past experience, closed cell foam is necessary as the moisture held in open cell foams tends to freeze, thereby expanding the foam and misshaping it. The housing was designed to allow normal operation of the meter without the need to continually remove the housing. A battery used to keep the meter's internal heater operating was also contained within the box, thereby making it a self contained unit. The battery only needed to be removed for charging. Future versions are planned to include a built in solar panel to maintain the battery at operational capacity.

To protect the meter from jarring while riding on the sledges, a spring loaded suspension platform was built into the box upon which the meter rested during transport. The platform absorbed the shock that occurs from travelling over bumpy ground.

Other insulated boxes were constructed to house the magnetometer and barometers, and a separate box to hold computers. Space was allowed to include bottles of hot water with the computers, and by doing so, we were able to maintain temperatures in the computer box above zero for the duration of a days work.

These adaptations were given a rigorous test whilst in the field, the result being that the equipment endured the field season successfully.

Much of the equipment used on the traverse, as in any geophysical project, requires the use of battery power. In the cold environment of Antarctica, batteries tend to discharge quicker and recharge less efficiently. We made substantial use of solar energy for battery recharging. With a solar panel we found that use of a generator was only required after prolonged periods of poorer sunlight conditions. By avoiding the use of a generator, we also avoid the tedious task of refuelling in the cold.

4. Publications

Results from the traverse will be processed and analysed during 1995 and presented as a Bachelor of Science (Honours) thesis by Julie Quinn at Victoria University.

A publication for an international journal is likely to be prepared towards the end of 1995. Such a publication will present the results from the traverse to a wider audience interested in the implications derived from our results.

A presentation will be made at the upcoming 7th International Symposium on Antarctic Earth Sciences in Siena Italy, in September 1995. The presentation will aim to expose to a wider audience some of the methods developed for protecting sensitive geophysical instruments in Antarctica. At Scott Base prior to our traverse, other scientists expressed interest in these methods. Hence we see it as worthwhile to make the methods known in the hope that it can be of use to others.

5. Acknowledgments

Event K044 would like to thank the staff at Scott Base for their part in making the "Seris-A" traverse a success. Alex Pyne of the Antarctic Research Centre at Victoria University loaned the event GPS equipment and generously gave up his own time to introduce us to the system. Discussions on GPS techniques with Perry Gilbert (Dosli) were invaluable and we thank Barbara Littel and Larry Hotham of the USGS for providing GPS data from McMurdo. The Seris-A expedition was initiated and organised by Tim Stern at Victoria University, and it was he who arranged the financial support of the Internal Grants Committee, Victoria University. Ron Hackney's study in New Zealand is made possible by support through the New Zealand government Commonwealth Scholarship and Fellowship Plan. Eric Broughton and Workshop staff at Victoria University provided much assistance in preparing the scientific equipment for the field. Thanks to Ed Waddington from the University of Washington for the loan of a radar transmitter.

6. References

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K045
1994/95

LOGISTIC REPORT TO NEW ZEALAND ANTARCTIC PROGRAMME

K045 : Polar Wander of Gondwanaland

New Zealand Antarctic Programme 1994/95

Event Personnel: D.A. Christoffel (Scientific Leader)
A. Wooler (Scientist, Gondwanaland Programme)
Nerida Bleakley (Scientist and Principal Investigator, Sirius Programme)

November-December 1994

EVENT K045: REPORT NO 2 : LOGISTIC REPORT

1 Aims

The aims of this event were twofold:

i) Determine the polar wander path for Gondwanaland, by collecting oriented core samples from the Devonian Aztec section outcropping at Mt Crean, Portal Mt and Mt Kempe, with investigators David A Christoffel and Adam Wooler;

ii) determine the climate of Antarctica 3 My ago by mapping and collecting samples from the Sirius glacial sediments at Table Mountain and Mt Feather; investigator Nerida Bleakley.

2 Planning

i) RDRC proposals. Proposal for item (i) presented little difficulty as it was the follow on from the reconnaissance expeditions in the 78-79 and 80-81 seasons. There was no direct interaction with RDRC but we clearly had fair treatment. For item (ii), Nerida Bleakley was awarded an RDRC Scholarship.

ii) with NZAP staff members. This largely took place at Tekapo. We were able to clear up issues such as supply of antifreeze and transport of mogas in helicopters. Nerida had special dietary requirements and was able to arrange for suitable food to be supplied.

iii) Maps and aerial photos were largely obtained from DOSLI in Wellington, but our discussions with NZAP librarian showed that if we had been unsuccessful, they could probably have satisfied our needs. In particular, we were able to obtain copies of maps prepared from the mapping flights undertaken during the 93-94 season but could probably also have got them from NZAP library or ICAIR. Such a speedy service is remarkable and commendable for all concerned.

iv) I have attended many Tekapo training courses. They have always been well conducted, but I believe fine tuning has brought about an even better programme. Most of the topics covered were pertinent but the most important aspect was meeting the season's personnel. The overnight campout was a good opportunity for our party to become acquainted under field conditions. In retrospect it would have been desirable to have had hands - on experience with the Antarctic clothing. Many items were new to me and we would probably have chosen different items after trialing.

v) The medical requirements were thorough. There was some possibly unnecessary discrimination in my having to undergo a stress ECG purely through age. One would have thought the requirement could have been determined from the general medical examination, which was quite thorough.

3 Cargo

Our forwarded cargo consisted of the following items:

1	Rock drills packed separately	boxes	2
2	Orienting equipment	box	1
3	Magnetically shielded container for samples	box	1
4	Equipment for collecting Sirius samples	box	1

All items were packed in a single bin.

4 Personnel

Adam Wooler, Rotary Scholar and PhD student
Research School of Earth Sciences
Victoria Univ of Wellington
PO Box 600
Wellington

Adam has had previous polar experience on a Canadian ice island in the Arctic Ocean.
He is prominent in the British lifesaving organisation and is a keen outdoors person.
He is making palaeomagnetic studies of Gondwanaland and the samples collected on this Event are an important part of his research.

Nerida L Bleakley, RDRC Scholar and MSc student
Department of Geology
Victoria Univ of Wellington

Nerida is commencing a project to determine the origin of the Sirius moraine deposits.

David A Christoffel, Senior Research Fellow
Institute of Geophysics
Research School of Earth Sciences
Victoria Univ of Wellington

Has undertaken 17 expeditions to Antarctica since 1958.

5 Preparations for the Field

i) Reception: On landing at 0430, Tues 16 Nov, we had the usual friendly welcome (by Scotty), a cuppa and assignment to Q Hut.

At 1100 we had the Base briefing by the Base Services manager (Graham). He took us through the Base services and protocols.

At 1400 we had our operations meeting with Alan Wilson. This was particularly useful as we discovered our requirements for 2 stroke fuel and antifreeze had been omitted from their list.

We were also able to rearrange our helicopter moves to a more efficient schedule and replaced our Mt Kempe with a Portal Mountain site.

The tour of the Base at 1500 was particularly useful as it had been almost completely rebuilt since my last visit in 1981. We also had the opportunity of meeting cargo handler Robert Mataroa (Mat) and the field support officer, Tom Hopkins.

Our AFT was confirmed for the following day (Wed 17th) and our briefing was given by the Field Training Leader, Warren Herrick.

ii) Field equipment. The bin containing our shipped equipment was found safely stored in a container. We were able to obtain our mogas in sealed gallon containers from McMurdo and the engineering services manager, John Williams, assisted us with our antifreeze requirements. Nerida's special non-cereal rations could not be found and Tom gave us great assistance in locating and substituting in our food boxes, suitable items from the general store.

iii) Antarctic Field Training. This took place Wed 17th and Thurs 18th Nov. We found this enjoyable and useful. Adam and I had previous survival training but it was good to have a refresher. The rope training came in useful during our field work (see later). One particularly good aspect of the AFT was that it was generally tailored to party requirements.

iv) Delays at Scott Base. There were none. After returning from AFT pm on the 18th we flew out at midday, Fri 19th. We had to work hard to prepare our equipment in time but we did not mind that.

6 Field Transport

i) Helicopter Operations.

Helicopters were our sole means of transport. We experienced problems and delays with every move except the first, either through poor weather conditions or mechanical problems. The crews must have heaved sighs of relief when our event finished. We were underweight but our cargo was bulky, which caused some cramped moves. A further problem was that in most cases we were near maximum helicopter range, which left little scope for reconnaissance. Our basic cargo is shown in Table 1. Modifications between moves arose through resupplies of food, antifreeze and fuel and samples, which were retroed after each move.

7 Event Diary

Fri 18 Nov: Departed SB aboard Gentle 11, 1235. Landed McMurdo for a fuel top up. Flew up S side of Ferrar Gl and landed on a snow patch on Table Mountain at 77°58'S, 160°E. Set up camp and reconnoitred to almost immediately find the Sirius moraine deposits. To get communications via VHF we had to climb a slope above the camp. HF reception was poor.

Sat 19 Nov: It had snowed overnight and visibility was down to 100 m. Nerida started surveying her section. Adam and I traversed an extensive snowfield making prominent marks and communicating frequently with Nerida. We found outcrops of New Mountain Sandstone - one of our targeted sections, about one hour from camp, in a gully about one hour away with awkward access. Returned to camp and decided to spend our time here assisting Nerida. In the evening, cloud cleared and we surveyed the Sirius deposits. They extend for almost two km.

Sun 20 Nov: Fine and clear with temp <-20°. We spent the day surveying the Sirius moraine deposits. At our 2000 schedule we arranged for Rachel Brown to join our party on our move to Mt Feather. She could get some field experience and also assist Nerida.

Mon 21 Nov: Snowing and visibility < 100 m. Helped Nerida chisel out 9 bags of soil from a site just above camp. Temp -22° and snowing. In the afternoon we flagged the route down to the bottom of the section (about 2 km). Nerida recorded stone orientations to find flow directions. Adam and I sampled soils. Deposits were very hard and sampling was difficult. Conditions made it very hard on the hands. Reception for 8 pm schedule poor but our move confirmed for the morrow. Nerida melted and filtered a second sample of snow. The programme for this location is now complete.

Tues 22 Nov: Overnight snow. Clear and temp -27°. We confirmed that Kiwi 03 was due at 1400. The rocks were covered in snow and there was insufficient time for more sampling. By 1600 Kiwi 03 still had not appeared. Gentle 15 was assigned and appeared about 1630. Further snow had fallen and cloud was building. Helo had returned to Marble Pt to refuel. They reappeared producing contrails and landed at 1830. Rachel Brown had come to assist Nerida but they also carried an additional crew member. Conditions deteriorated and with extra crew we would have been overloaded under the conditions. Gentle 15 finally left at 2000 without us.

Wed 23 Nov: A fine day with small tufts of low cloud. No flight had been scheduled for us but Alan finally arranged for Gentle 11 who arrived at 1245. Time had prevented them from being fully briefed and they were not fully fuelled. We were in line of site with Mt Feather and were able to show our destination. They decided to move us in two loads. At 1305 they departed with Adam and Rachel, leaving Nerida and me with two tents and survival gear. They arrived back at 1530, with cloud closing in and contrails appearing. We set down at Mt Feather at 1630, also with cloud closing in. At an altitude of 2600 m we had VHF contact through Ch 3 on Mt Erebus. We established camp with wind increasing, blowing snow and temperature of -25°.

Thurs 24 Nov: Wind got up at 0100. At 0900 temperature was -25° and wind speed measured off scale at 50 knots from the south. This gave a wind chill factor of -60°. Driving snow reduced visibility to nil. Checked that all guys were secure and moved the loo to some shelter behind the tent. Both parties stayed inside except for essential duties which were reduced to a minimum by drinking sparingly.

Fri 25 Nov: Wind had died down. We were up early, cleared snow out of our tent and returned the loo to its previous commanding site overlooking the Ferrar Gl. In the morning we reconnoitred to the south to determine the extent of the Sirius deposits and to locate any Aztec section. A likely Aztec outcrop was spotted on the east face some distance away. It was capped by a dolerite sill, which would have rendered it of doubtful use as the heat from the sill would have altered the magnetic properties of the rock. It also appeared difficult of access so we decided against checking it out. Instead we located the boundaries of the Sirius deposits and then reconnoitred to the north, along the prominent N ridge. The boundary of the Sirius was again prominent. Descending the ridge below the Sirius, we located Weller coal measures - not our prime target for sampling, but useful to supplement our sparse samples from previous Events. Further down the ridge, a buttress blocked access to the Aztec beds. We returned to camp to collect our sampling equipment. Adam, Rachel and I commenced coring and sampling the Weller coal measures, while Nerida worked on the Sirius deposits just above us. We made good progress until a cold wind curtailed our sampling at 1800. Back at camp, Nerida melted snow for her diatom sampling while we prepared a meal.

Sat 26 Nov: Weather was clear with temperature -21° and an 8 knot northerly wind. Shortly after Adam and I commenced sampling the Weller coal measures (WCM) while Nerida and Rachel sampled the Sirius, cloud rolled in and it commenced snowing. After initial problems with the pump for the antifreeze, we made good progress, obtaining 19 cores. However, coring was then curtailed a little early as snow covered our rocks, making it difficult to locate suitable sampling sites and it became very cold. On returning to camp, we found Nerida had flagged the route. Rachel was in bed with the 'flu.

Sun 27 Nov: A fine clear morning with temperature -27°. Rachel was much improved. Adam and I returned to the WCM, while Nerida and Rachel continued sampling the Sirius. The snow had cleared and we were able to locate our next sampling site, awkwardly placed under an overhang. Cloud rolled in from the valley to the north and by 1100, visibility was down to a few m. We obtained 9 cores from under the overhang. On the next bench down we collected 8 samples. Further down near the bottom of the section we took 6 cores in a narrow coal seam. By 1700 we had completed a pretty representative sampling of the Weller section. Nerida and Rachel had enjoyed a good sampling session. Conditions were still very cold (-27°), and visibility about 50 m.

We had been having some problems with our radio communication. Cloudy conditions and blown snow had rendered our solar chargers ineffective. In addition we were having problems with the connector for our booster antenna. The main problem was with the coax cable becoming stiff and breaking. We had quite good HF communications with other field stations but not with SB. At our 2000 schedule, we confirmed our move to Mt Crean for Tuesday 29th, requesting an am shift for preference as on all but one of our days, cloud had closed in before midday.

Mon 28 Nov: Dawned clear. After placing our resupply order, which included a signal mirror and more HF batteries we commenced surveying a section through the Sirius deposits. By 1100 the cloud had closed in with visibility <50 m. We finished the survey at about midday. This completed our programme for Mt Feather. At 1530, Rachel, Adam and I set off to climb Mt Feather. The objects were to check our altimeter at the summit trig point and to see if we could spot a possible campsite on Mt Crean, about 25 km distant. It was clear on top so we were able to fulfil our objectives. The summit provided a good viewpoint. We could see down both the Ferrar and Taylor Glaciers , out to the Royal Society Range and over The Portal to the Polar Plateau. We were back at camp at about 1900.

Tues 29 Nov: A fine, clear morning with temperature -24°. At 0800, Alan informed us Kiwi 03 would move us, setting off at 0830. They would make two trips to the airstrip and then come to us. We packed the emergency tent and one Polar tent and readied everything at the landing strip. At 1030 we heard Kiwi 03 at Marble Point. We radioed them to hurry as the usual mist was starting to close in. They later radioed that they left at 1140 and would arrive at 1205. We spotted them briefly through the cloud before they disappeared up the Ferrar Gl. S.B. said they had landed and were waiting. At 1500 heard them fly past but by then visibility was 50 m. Later S.B. explained they had engine trouble. We re-erected the Polar tents and set about preparing a meal. At the 2030 sched Alan said he would do his best to get an early flight on the morrow. We had good communications on HF with K061 in the Renish Gl. region.

Wed 30 Nov: Another clear, cold morning. At 0800, Alan informed us Gentle 12 was leaving at 0830 to move us. They arrived at 1020 with extra fuel tanks to move us in two loads. The mist was just starting to come up from the valley. Adam and I went first. We were able to direct them to a small snow patch on the S ridge of Mt Crean close to the southern face at 77°55'S 159°32'E. We realised it would almost certainly be windy but had no option if we were to be reasonably close to our section. We established communication with Gentle 12 but not with S.B. Gentle 12 returned to Mt Feather while we set up the HF equipment. They arrived at Mt Feather at 1130 and were only just in time to pick up Nerida and Rachel with the remaining gear before the cloud completely closed in. They returned at 1140. We farewelled Rachel who had been a great help at Mt Feather while we were simultaneously undertaking both our projects. We established poor communication with S.B. through our HF system. We established camp on our chosen snow patch with the entrances away from what we gathered would be a persistent wind from the Polar Plateau. We discovered the boxes containing our full fuel had been retroed in error for our empty fuel. With difficulty we informed S.B. We reconnoitred our planned section about 30 min walk from the camp and found suitable sampling sites. Gentle 12 returned and circled before disappearing in the direction of the camp and shortly after circled again and flew off. We had erected our tents on the previous landing site and with few landing spots nearby it took us some time to locate the fuel drop with the added luxury of fresh fruit and biscuits. While searching we found we could get through on our VHF from a knob about 300 m away. There was unfortunately no suitable campsite there. No signal mirror or extra HF batteries had been supplied. That evening VHF repeater 5 was out. Several events such as Bird and Vanda stations were unsuccessfully attempting to contact S.B. through HF. We had a busy evening relaying messages - with some difficulty as our comms with S.B. were not good but excellent with the other field parties.

Thurs 1 Dec: A clear day with 8 knot wind and temperature -23°. We had some initial problems with the drilling gear as the collet holding the drill stem had become frozen. Once overcome, we made very good progress. While Nerida and I were moving our equipment to the next site, Adam reconnoitred further sites. He slipped in a snow gully and slithered about 4 m on to a wide ledge. I returned to camp for crampons and rope and we soon had him out. We recommenced drilling and by day's end had collected 43 cores. This was a very satisfactory result, especially as the section is south facing and exposed to a steady wind.

Fri 2 Dec: We awoke to a wind of 30 knots, temperature -24°. It was clear except for wind blown snow. At our sampling site, winds were even stronger and we had to give up.

Sat 3 Dec: The wind had died to 15 knots and temperature risen to -23°. It was snowing but not unpleasant. The 0730 sched was unsatisfactory - S.B. could not hear us. We drilled another 10 cores at the site we had left the previous day. The snow had to be cleared first. We moved across a scree slope to a site under an overhang. It was slippery so we strung a handrail across the exposed part. We collected 50 cores. At the finish it was snowing quite heavily and with visibility of 50 m we were relieved that we had flagged the route.

Sun 4 Dec: It had snowed overnight but temperature had warmed to -19°. The wind had dropped to 10 knots. Again, 0730 comms were unsatisfactory. Still lightly snowing and it was very slippery at our sampling site. Even under the overhang, the rocks were snow covered. We drilled a further 12 cores, then moved to the next site. We drilled 24 cores at two further sites. This completed our scheduled programme at Mt Crean.By 2100 when we finished, it was snowing hard and visibility was very poor. Even our flags at 50 m intervals were hard to pick up.

Adam went up the hill to talk on VHF as the HF was not getting through. Confirmed our move to Portal Mt for the morrow.

Mon 5 Dec: Woke to winds above 30 knots and whiteout conditions. At 0730 communicated with difficulty with SB. Arranged a VHF schedule for 0825. Struggled up the hill and told Alan ops were off. There was also a whiteout at SB. These conditions continued all day with the wind increasing in the evening. Our batteries were low as over the past few days there had been either misty weather or snow on the solar panels.

Tues 6 Dec: Awoke to winds of 25 knots with blown snow but clear overhead. Temperature of -23°. Relayed conditions to Alan. He said he would await a better report. We stayed in our tent but wind was decreasing. At 1100 we were just about to call SB when Kiwi 03 arrived. They had come up on the offchance of conditions improving and caught us unprepared. They waited while we packed (about an hour). They were short of fuel so they said they would move us with minimum load and return with the rest. Our objective was a spur on Portal Mt. I had visited it in 1981 - pre GPS and due to a navigation confusion by the helicopter, we had never been quite sure of the particular spur we had landed at since Portal Mt is a complex massif with many radiating ridges. The coordinates we gave Kiwi 03 took us to a nunatak just on the edge of the massif but not my previous site. We flew on to the end of the next ridge off Portal but I could not recognise that either. So they dropped us at the nunatak. On inspection it contained a small exposure of the Aztec section at the

summit. However, on the return of Kiwi 03 we took a punt and got them to drop us back at the Lashly Mts as they could not take us on further, where I now realised our intended section was located. We were dropped on the SW side of the S ridge of the Lashly massif. A steady wind of about 25 knots was blowing from the plateau. The presence of sastrugi indicated that this was the normal state and proved to be the case. We erected our tents with some difficulty. We could not get communications on VHF and contact by HF was poor. A reconnaissance of the area revealed that there were no suitable rocks to sample in the vicinity while the steepness of the faces and SE ridge prevented safe access to the upper slopes. We established reasonable coms at 2030 but Alan was not available to arrange for the next move. We arranged for a sched at 0700 next day. K044 had just been put into the field and we had excellent communications with them.

Wed 7 Dec: It blew all night. The sky was clear but driving snow reduced visibility at ground level. It covered our solar panels so our batteries did not charge. The temperature was -22°. Alan did not come up at 0700 and by our regular sched at 0730 the transmissions were almost undecipherable. We deciphered a message from Alan through the operator to say he had discussed the situation with Kiwi 03 and were moving us out ASAP. We went for a long walk around the massif to try and locate any rock sections that could be profitably sampled but we found none. For our schedule at 2000, messages had to be relayed through K044. They confirmed that a US helo was setting off at 0930 to shuttle us out.

Thur 8 Dec: A fine clear morning with temperature -20°. The wind had decreased to 5 - 10 knots. We packed but left one tent up. At 1100 we heard the helo and packed our tent. Gentle 11 landed and immediately shut down. They had a leak in their hydraulics. They were unable to communicate with McMurdo with their on-board radios. We attempted to contact SB with our HF radio. Communications were barely readable. Finally the helicopter crew were able to contact McMurdo with their portable emergency HF. They ordered a replacement for the fractured hydraulic coupling, hydraulic oil and material for cleaning up.

The crew were finding it cold so we unpacked our cooker and prepared hot food. Gentle 15 arrived with the replacement items and tools at about 1400. Gentle 11 was finally repaired and the spillage cleaned up. Our party returned to Scott Base in Gentle 15 after an exciting flight down the Ferrar Glacier.

Fri 9 Dec: At Scott Base, a busy day spent sorting out and packing our equipment and debriefing. We expressed our disappointment at not having completed our programme. We had experienced our fair share of holdups but fortunately had budgeted for such eventualities and our programme was incomplete through our being pulled out early.

Sat 10 Dec: The day was spent completing clearing up our equipment and packing.

Sun 11 Dec: Departed for Willie Field Bout 0500. Arrived Christchurch pm.

8 Event Map

See the attached map, figure 1, showing campsites and sampling areas.

9 Weather

Weather details are outlined in the diary. Overall, it was not good. Temperatures were low, ranging from -15° (rare), to -27° (more common). Both at the Table Mountain and Mt Feather sites we were plagued by mists rolling in most afternoons. Contrails effecting the performance of Gentle 15 prevented our move from Table Mt to Mt Feather on Tues 22 Nov. The next day cloud was closing in and contrails were appearing on the second trip. Our move from Mt Feather to Mt Crean was likewise aborted on 29 Nov when Kiwi 03 was delayed by mechanical trouble and by the time they arrived the cloud had rolled in. On the following day (Wed 30th), Gentle 12 arrived at 1020, ferried two to Mt Crean, arrived back at Mt Feather at 1130 and was only just able to collect the rest of the party before the cloud descended.

We had two storms with winds exceeding 50 knots. The first was on Thurs 24th at Mt Feather; the second was on Mon 5th Dec at Mt Crean.

Site	Stay (Days)	Snow (D)	Mist (D)	Clear (D)
Table Mt	5	3	3	1
Mt Feather	7	2	4	2
Mt Crean	6	3	3	3

10 Accidents, incidents or hazards

None

11 Field Equipment

i) Clothing: Our work necessitated standing or sitting, using a drill or hammer and drill and handling and marking rock samples. The latter could only be done with light gloves. This requires easily removable mitts or heavier gloves. The following is our experience with the various clothing items:

Handwear: We found that the windproof mitts with inners were not entirely satisfactory. They were too cumbersome to use as were the inner insulating mitts. We wore light gloves underneath, but the main problem was that when the outer was removed, sometimes the inners came off with them and sometimes they did not. It is awkward, with a wind blowing (as usually it was), trying to juggle two pairs of mitts and polypropylene gloves. The polyprop gloves were good, but could be worn unprotected, only briefly. We found the nosewipers, although cumbersome, were more suitable for outer protection. I believe our past combination, of polyprop gloves or fingerless woollen mitts over cotton glove and lined leather ski gloves or mitts were more satisfactory. For using the drill, the rubber gloves were very suitable, although after a time, the hands did get cold.

Bodywear: When drilling, it is difficult to avoid some fluid from getting splattered over trousers. It does not affect the material, but it can stain it. Previously, we had

worn old thermal trousers. This time we took overalls, which we believed would be suitable protection. However, temperatures were low and a wind was nearly always blowing. The overalls over thermal underwear and salopettes were too cold. They were too tight to fit over either the windproof or survival salopettes. So most times we had to wear the survival salopettes with windproof jacket over the thermal underwear and thermal salopettes. This kept us warm but the clothing was rather cumbersome. In retrospect, I believe that for our operations, our previous clothing combination, of woollen or polyprop underwear, woollen shirt, and trousers, old thermal or windproof trousers and jacket and lightweight leggings or overtrousers was more suitable.

Footwear: Mukluks were comfortable, warm and entirely satisfactory for our work.

ii) Tentage, climbing equipment and kitchen gear: Polar tents would be hard to better. We weathered two reasonably severe storms in relative comfort and with complete confidence. We did no climbing as such but most of the equipment was useful. We used the rope as a handrail to get us over a slippery spot. We occasionally wore crampons where icy slopes needed negotiating to reach our section and on the occasion when Adam slid on to a ledge we were able to practice our belaying techniques, if rather unnecessary. The kitchen box is virtually unchanged and except for the occasional jet blockage, the cookers performed well.

iii) The ration system: Our ration requirements were more than usually complex as one member had special dietary needs. As the specially ordered items did not arrive in time, we had to select suitable items from the store and substitute for the standard. In addition, with the wider choice of substituted frozen food, it was more difficult keeping track of items. At times we ran low on staples such as sugar, egg powder and bacon or had difficulty finding them. With the old system, all boxes had the same items and there was no confusion. Nevertheless, the food was excellent. The diced pork, steaks and roast lamb were particularly popular.

12 Radio Communications

i) Some of the radio equipment was ineffective under our field conditions. Communications on VHF via any of the repeaters was either marginal or impossible at our field camps.

The hand held booster antenna with which we were provided would have helped at some sites (see below), except it very soon became inoperative. At the low temperatures, the coaxial cable became stiff and pulled out of the connector, where there is no satisfactory mechanical anchoring system to prevent this.Polyethylene coaxial cable which remains flexible to low temperatures is readily available and should be used for these applications.

Communications with our HF transceivers was necessary at three of our four field sites. However, communication with Scott Base was almost always poor or non-existent. We suspect that some of this was due to inadequacies at the Scott Base end since on most occasions we had good communications with other distant field

stations (eg K061 and K044). However, the equipment was old (not a criticism in itself) and the battery lives were short. Most of the rechargeable batteries were clearly nearing their end.

The solar panels for recharging the batteries did not work efficiently at our sites. We either had frequent misty conditions or blown snow which covered the panels. Also the wiring and connectors were unsuitable for field conditions. Firstly, sufficient cabling should be provided so that the batteries can be left inside in the warmth. Secondly, the plugs and sockets should be such that they can be connected with gloved hands and there is only one way that they can be connected.

On the HF antenna, one lead was broken at a connector, and we had to repair it in the field.

ii) Reception/transmission: Our sched times were at 0730 and 2000. They were generally satisfactory, except that at 0730, Alan would not have returned from McMurdo with the flight sched and we often had to arrange an alternative time.

At Table Mountain: From our campsite, we could not communicate with the hand held VHF sets. Communication on Channel 3 with the booster antenna was marginal. However the coax lead very soon pulled away from the connector (see above). Despite many attempts to repair this, no repair lasted very long. HF communication with Scott Base was also inadequate. Despite our taking care to optimise our antenna configuration, two - way communication was seldom satisfactory. In contrast, communication with K061, at the Renwick Gl was excellent.

By going 50 m up the hill, we could get reasonable communication with the hand-held VHF set. However, this was not very convenient,as at our 0730 and 2000 scheds, weather conditions were often very unpleasant.

At the low temperatures we experienced, battery life was short. Spare batteries were kept in our sleeping bags, but this was impractical for the bulky HF batteries. These 12V batteries, which were old, had very little capacity. The solar panels were ineffective, as for most of the time they were either covered in snow or we were in mist.

At Mt Feather: Here, at an altitude of 2500 m, looking down the Ferrar Gl. we could see Mt Erebus and could communicate on both channels 3 and 5. Our main problem here was with batteries running down. The solar panels were plastered with snow most of the time. By the end of our stay almost all our batteries were flat.

At Mt Crean: Here, we could communicate only with the HF sets. Communication with Scott Base was always poor, we had excellent reception with K044. Very often they had to relay our messages for us. Despite having another set of 12V batteries, They soon discharged and again the solar panels were ineffective. We discovered a site on a rise about 300 m away where we could communicate by VHF through channel 3. Without this discovery, we would probably have lost communications with Scott Base.

At Mt Lashly: Communications were possible only with HF. Transmissions to and from Scott Base were poorly received. We often had to rely on K044 to relay our messages. The most obvious shortcomings of the system were shown up on Thurs 8 December, when Gentle 11 landed with mechanical trouble. None of their on board transceivers could communicate with McMurdo. Communications with Scott Base via Our HF set were almost unreadable. Finally, by deploying their emergency HF set, Gentle 11 were able to get McMurdo, on a similar frequency.

Summary. For communications in the far field, the situation has deteriorated. In our previous Events at similar sites in 1978 and 1981, we used the same type of HF equipment as we were supplied for this Event. Communications then were generally better. The differences were that then we had two HF transceivers and the same batteries, but they were younger and we were provided with more of them. In these regions, solar panels cannot always be relied on for recharging the batteries. The HF communication system urgently needs updating.

iii) The efficiency of the operators was good. All our problems arose from inadequate reception.

18 Management of Science in the Ross Dependency

Apart from problems with communications, noted above, NZAP is very capable of catering for our type of work.

We were disappointed that we were taken out of the field early, before we had completed our programme. Two more days would have seen our programme 100% complete. When one considers that we were able to maintain our scheduled programme up to that time, despite indifferent weather and transport delays, I believe another move for us was justified.

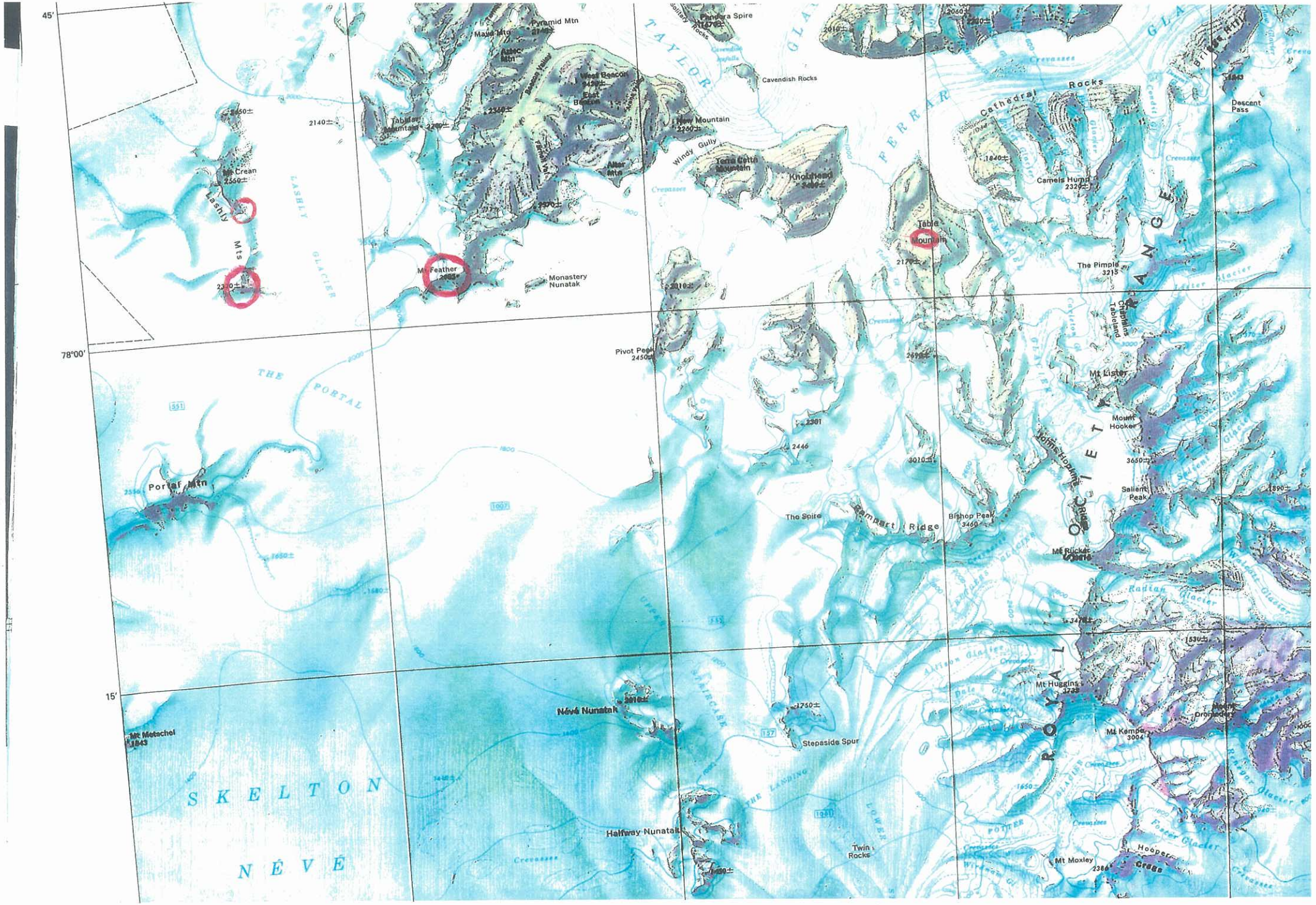

Figure 1: Map showing locations of field sites.

Figure 2(a). Adam and Nerida collecting samples from the Sirius deposits, Table Mt.

Figure 2(b). Orienting drill cores, Mt Crean.

Figure 3a. Returning from lower Sirius section, Table Mt.

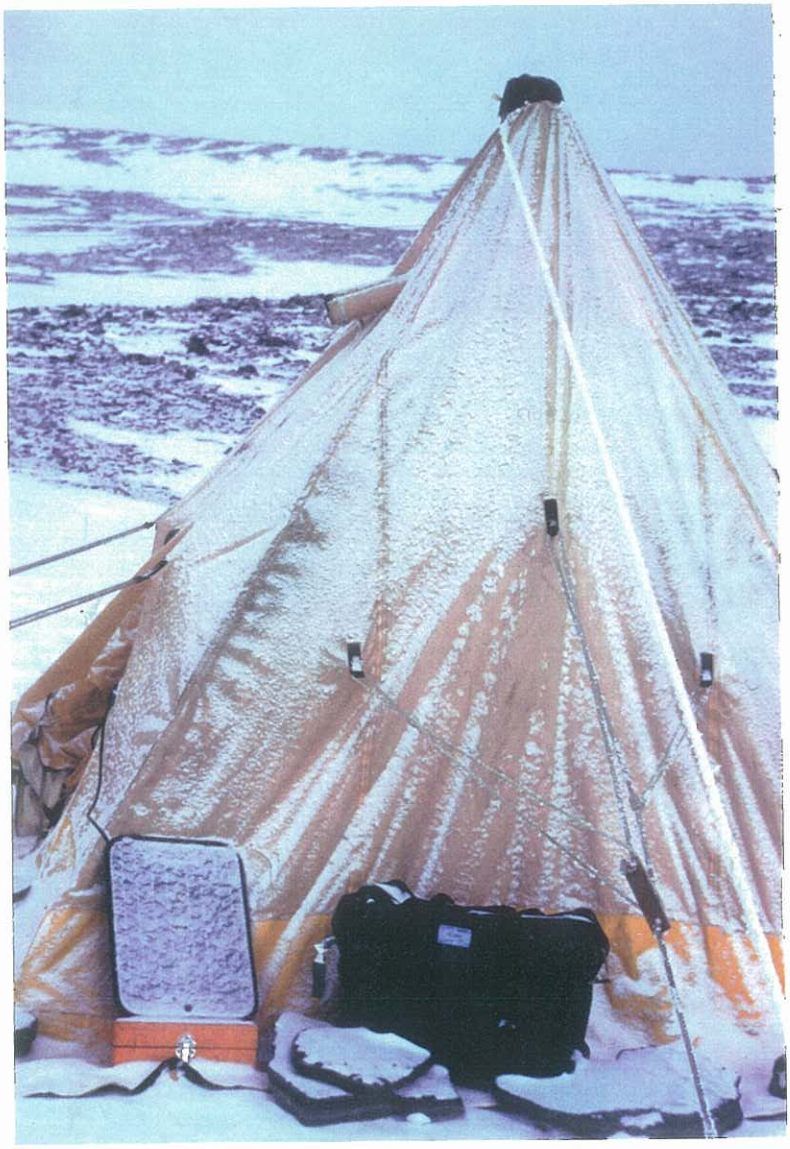

Figure 3b. Normal state of the solar panel.

K045
1994/95

IMMEDIATE SCIENCE REPORT

K045 : Polar Wander of Gondwanaland

New Zealand Antarctic Programme 1994/95

Event Personnel:

D.A. Christoffel (Scientific Leader)
A. Wooler (Scientist, Gondwanaland Programme)
Nerida Bleakley (Scientist and Principal Investigator, Sirius Programme)

November-December 1994

IMMEDIATE SCIENTIFIC REPORT
EVENT K045: INVESTIGATION OF

i) THE POLAR WANDER PATH OF GONDWANALAND;
ii) THE STABILITY OF THE ANTARCTIC ICE SHEET THREE MILLION YEARS AGO

Event K045 had two separate objectives with separate investigators. They were:

i) the determination of a Polar Wander path for the East antarctican portion of Gondwanaland.

Investigators: David A Christoffel, Research school of Earth Sciences, Victoria University of Wellington, Adam Wooler, RSES, VUW and University of Plymouth, United Kingdom.

ii) determining the climatic environment during the formation of the Sirius glacial deposits three million years ago.

Investigator; Nerida Bleakley, RDRC Scholarship holder, RSES, VUW.

Popular Summary of Scientific Work Achieved

i) The Beacon sediments of East Antarctica were deposited over the Devonian to Triassic geological periods, from 400 to 200 million years ago. They show evidence of significant changes in climate over that time. Palaeomagnetic measurements on rocks having similar time spans, from Africa, Australia, India and South America, which were then also part of Gondwanaland, give conflicting results regarding the continental drift of that landmass. Many researchers have made palaeomagnetic measurements on Antarctic rocks, including those collected on our previous VUW Antarctic Expeditions in the 1978-79 and 1980-81 seasons. To date, all these have yielded a single pole, for a time 160 million years ago in the Jurassic period, corresponding to a massive intrusion of dolerite sills into the Beacon sediments. Heat and fluid from these intrusions largely destroyed the primary magnetisation acquired by rocks older than them. We have recently remeasured some rock samples from the VUW expeditions, using newly developed techniques. Some rock samples from Mt Crean, Portal Mountain and Alligator peak appear to have retained some primary magnetisation. However, insufficient unprocessed samples remained for us to obtain statistically acceptable results. It was thus necessary to obtain further samples from those promising sites in order to corroborate the measurements.

We obtained over 200 oriented cores, 25 mm in diameter and 50 to 150 mm long using a light portable drill specially adapted at VUW for Antarctic conditions. The sampling was carried out between 30 Nov and 6 Dec 1994 at Mt Crean, on the edge of the Polar plateau, 200 km west of Scott Base. The sediments sampled are red siltstones from the Aztec Group, of Upper Devonian age (approximately 350 million

years ago). They were probably deposited in fresh water lakes and contain finely divided haematite which has the highest stability of any magnetic mineral.

Some preliminary measurements have been made on these samples. They give results similar to those of our remeasured samples. If confirmed by further measurements, it would mean that these rocks were deposited within 12° latitude of the equator. These results differ from those found from African and Australian rocks of similar age. A reassessment of the structure of Gondwanaland and its climate at the time will be necessary in the light of these new results.

ii) Sampling and mapping the Sirius glacial moraines; the age of the Sirius Group glacial deposits in the Transantarctic Mountains has been the topic of considerable debate. The controversy centres on the source of the three million year old marine microfossil diatoms found in tillite beds in the glacial deposits.There are two conflicting models for the source of these microfossils. One is that the diatoms were from the antarctic interior and were subsequently eroded and deposited in the tillite. This implies extensive deglaciation and the existence of marine basins inland of the Transantarctic Mountains three million years ago. The second model is that the three million year old diatoms were blown by wind into the tillite, which could have been of much greater age (fourteen million years or more) and incorporated by periglacial processes. The aim of this project is to distinguish between these two models.

Two sites having Sirius deposits were surveyed and a series of rock sections was sampled at various depth intervals. Neighbouring snow samples were collected, melted, filtered and the residue collected to check for currently existing diatoms. The field work was carried out between the 18th and 30th November, 1994. The first site was at Table Mountain, 150 km west of Scott Base at an altitude of 1800 m on the south side of the Ferrar Glacier. The formation was draped for 2 km along the upper edge of the valley. The second site was at Mt Feather, on a bench at altitude 2500 m on the western edge of the Ferrar Glacier.

A contamination free laboratory has been prepared for processing the sediments to extract the diatoms. Experiments to find the most effective extraction method have been completed and the main extraction programme has commenced. Many diatoms have been found and meaningful interpretations will soon be possible.

Proposed Programmes

i) Palaeomagnetic Programme. The objective was to collect oriented core samples from the Devonian Aztec red beds at Mt Crean and Portal Mountain to complement the samples collected at these sites in the reconnaissance expedition in 1980.

ii) Sirius Programme. The objectives were twofold.

1. To accurately map the distribution of the Sirius Group tillite deposits on Table Mountain and Mt Feather and make measurements on the tillite to determine the origin and direction of the glaciers that deposited the sediments.

2. To take samples to precisely document the distribution of Diatoms in and around the tillite. This was to be achieved by sampling at different depths in the tillite, from weathered regolith from adjacent older material and from melted snow by filtering the water through a five micron sieve.

Scientific Endeavours and Achievements

Methodology

i) Palaeomagnetic sampling

The equipment and techniques have evolved from experience gained from the previous sampling expeditions in 1978 and 1980. Oriented core samples, 25 mm in diameter and 50 to 200 mm long are collected. The corers utilise a modified chain saw and weed eater which have been adapted for attaching diamond tipped coring stems. The cutting fluid is a 60/40 ethylene glycol/water mixture to prevent it freezing at the temperatures encountered. The equipment is similar to that developed and used by us in NZ except that connecting tubes and seals were chosen and tested to withstand the low temperatures. The orienting device is a barrel that fits over the in situ core to which is attached a levelling table holding both a magnetic and sun compass. When the core orientation has been recorded, it is removed and marked before being stored for transport in a magnetically shielded container. For statistical purposes, six closely spaced cores per site are required. The site locations have to be levelled with respect to a marker - preferably a trig station or surveyed summit.

ii) Sirius tillite sampling

After mapping the tillite deposits with a staff and Abney level, the matrix is sampled at varying depth intervals, depending on the deposit thickness. Care must be taken to avoid cross contamination. The deposit, which can be very hard and may be permafrost cored were to be broken up with bolster and chisels. A hand operated percussion tool was specially made for breaking up the harder deposits. The residue from filtering 10 l of water melted from snow through a five micron filter was to be collected to test for airborne diatoms.

Field Work

Camp 1: Table Mountain, 77°58'S, 160°E, 18-23 November

This was the first site for sampling the Sirius tillites. We established camp within metres of the upper end of the deposit. This was not a planned palaeomagnetic sampling site so all three of us worked on the Sirius programme. We surveyed the

deposits and found them to be draped for about 2 km along the edge of the slope facing the Ferrar Gl.; more extensive than previously reported. Exposures were good at the upper end but were sparse in the middle and became more continuous towards the lower end. It was misty for most of the time so we flagged a route along the ridge. There were frequent snow showers so we had to clear the rocks before commencing to take samples. Considerable effort was needed, at times even to loosen a few cm depth of deposit. Fifteen samples were taken in the top section and seven in the bottom section. The in situ fabric (ie the orientation and size distribution of the pebbles) was measured to find the mean flow direction of the glacier which deposited the moraine. For all but one day, when the survey was carried out, conditions were misty and it frequently snowed. Temperatures were between -22° and -27° so despite the effort of hammering, working conditions were a little cool and slowed progress. Nevertheless our objectives were achieved.

Camp 2: Mt Feather, 77°56'S, 160°28'E, 23-30 Nov.

Our camp was at 2500 m altitude on a bench covered with Sirius tillite. We were flown in on the second attempt, one day later than scheduled. Rachel Brown joined our Event, to gain first hand experience of field work and to assist Nerida with sampling since we also hoped to collect palaeomagnetic samples. On the first day we had gale force winds and were confined to camp. The second was clear and we reconnoitred to determine the extent of the Sirius formation and to look for a section suitable for palaeomagnetic sampling. The Sirius was extensive but we were unable to reach the Aztec red beds, which were overlain by a thick dolerite sill. In any case this would have made them unsuitable for sampling. However, we found an accessible exposure of Permian Weller coal measures and decided to sample them. The following three days were spent by Nerida and Rachel surveying and collecting 15 samples from three sites of the Sirius deposits. Adam and Chris surveyed the Weller coal section, finding a series of thin beds suitable for sampling. Again, by flagging a route along the valley edge both parties were able to work in poor visibility without danger of getting lost. Fifty cores were obtained - some from positions under overhangs, making drilling difficult. Weather conditions were again indifferent. By 1000 a mist would come up from the Beacon Valley to the north and stay all day. Temperatures were around -25°. Working conditions were similar to those at Table Mt except it was generally a little colder. We exceeded our objectives.

Camp 3: Mt Crean, 77°55'S, 159°32 E, 30 Nov - 6 Dec.

We camped at 2200 m on an ice covered section of the ridge leading to the south facing Aztec red beds. We arrived a day behind schedule, again due to poor weather conditions. There was no Sirius programme although a sample of glacial regolith and a sample from melted snow were collected to check for airborne diatoms. Rachel left our party and Nerida helped with the coring. Our section was located 30 mins from the campsite. During the next five days we experienced whiteout conditions, strong winds, snow and temperatures down to -27° with a storm on Dec 2 which confined us to our tents. However, we obtained 150 cores from sites we had previously identified as the most promising. This more than fulfilled our objective.

Camp 4: Lashly Mts, 6 - 8 Dec.

This site was on The Portal at the south end of the Lashly massif. Our objective had been to land at the foot of the SE ridge of Portal Mt but due to lack of fuel and some confusion about its location we were dropped here. No suitable section was accessible from this site and after some delay from helicopter mechanical problems, we returned to Scott Base on Thurs, 8 Dec.

Summary

Despite generally poor weather conditions - it was consistently cold, frequently misty, with regular snowfalls which partially covered the rocks we wished to sample, the objectives of both programmes were fulfilled at the sites where we worked. The disappointment was that we missed out on sampling at Portal Mountain.

Both programmes involved our working at climatically exposed sites and handling and marking of specimens, which necessitated the use of thin gloves. We had to take care to avoid frostbite and exposure. Adam Wooler had previous experience on an Arctic ice island, but this was Nerida Bleakley's first Antarctic experience. All members performed well and we cooperated well on both programmes.

For the palaeomagnetic programme, a preliminary set of measurements has been made on selected samples. In many of these from Mt Crean, a very weak primary magnetisation has been isolated from a strong overprint from the Jurassic dolorite intrusions. It gives a direction in agreement with the previous pilot results. Considerably more analysis is necessary before final results can be obtained. Results to date are in agreement with our previous deduction that the sites were 12 degrees in latitude from the equator when the sediments were deposited.

For the Sirius program, a contamination free laboratory has been set up for the extracting diatoms from the tillite samples. Some samples have been processed and diatoms have been found. Each extraction is a lengthy process. More samples need analysing before meaningful interpretations are possible.

Publications

Abstracts for conferences have been submitted and accepted as follows:

A Wooler and D Christoffel, An Upper Devonian palaeomagnetic pole position for East Antarctica; International Symposium on Antarctic Research VII, Oct 1995.

P Barrett, N Bleakley, W Dickinson and M Hannah, Occurrence of diatoms in Sirius diamectite on Mt Feather, Antarctica; Pliocene antarctic Glaciation workshop, Woods Hole, April, 1995.

N Bleakley, abstract submitted to International Symposium on Antarctic Research, VII, Italy, Sept, 1995.

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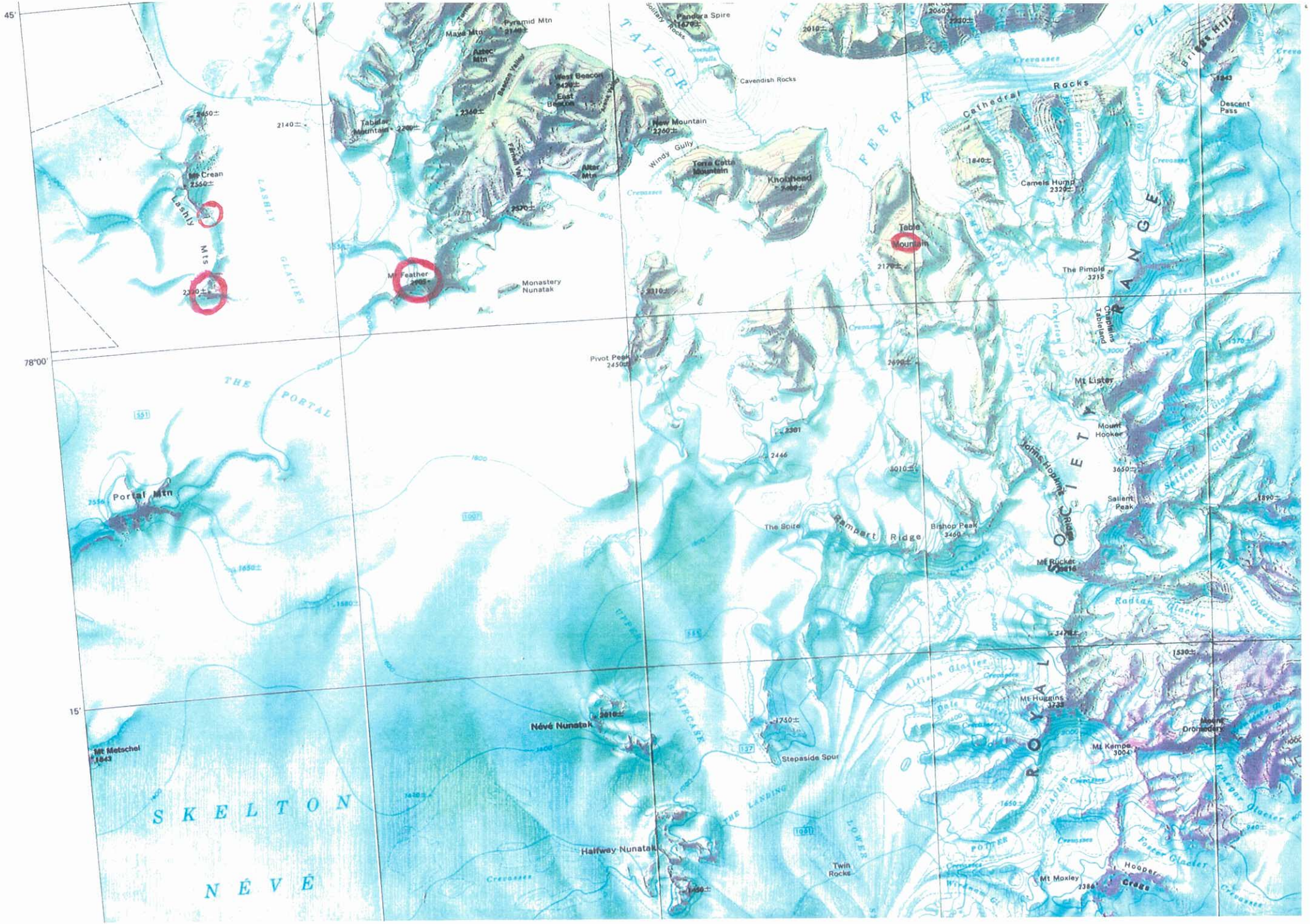

Figure 1: Map showing locations of field sites.

Figure 2(a). Adam and Nerida collecting samples from the Sirius deposits, Table Mt.

Figure 2(b). Orienting drill cores, Mt Crean.