IMMEDIATE SCIENCE & LOGISTIC REPORT

K042: Cape Roberts Tide Gauge
ANTARCTICA NEW ZEALAND 2004/05

Event Personnel:

Alex Pyne	Victoria University of Wellington
Mike Cavanagh	Victoria University of Wellington
Tony Kingan	Webster Drilling and Exploration
Dion Matheson (K450)	LINZ/Inst. Geological & Nuclear Sciences

Proposed Programme & Work Achieved

Introduction

The permanent Cape Roberts Tide Gauge has been operating since November 1990. After 12 years of operation LINZ and the Antarctic Research Centre of Victoria University of Wellington proposed refurbishment and modernisation in a co-sponsored program. In November – December 2002 the equipment was refurbished and modernised (Annex 2). In March 2003 the new data logger failed and data was not recorded until 26 November 2003 when a temporary replacement logger was installed. (Annex 1)

Proposed Program

In the 2004/05 season it was proposed to:

- Replace the temporary data logger with the new repaired unit.
- Check and re-level the transducer where it exits the coastal rock in the sea. This was unsuccessful in 2003/04.
- Carry out the annual calibration of the tide gauge using GPS methods from the near shore floating sea ice platform (see LINZ event K450 for details).
- Consider options for future including transducer installation, metrological measurements and real time data recovery in conjunction with the continuous GPS station at Cape Roberts co-sponsored by LINZ and the USGS.

Equipment Replacement

The repaired Campbell CR10X was reinstalled and the temporary unit returned to McMurdo Station Crary Lab.

Transducer levelling

This procedure was successful and required two days this season. The following procedure was carried out:

- Drilling through the sea ice foot (approx 5-6 m thick) with a 200 mm diameter auger directly above the position where the transducer exits the submerged rock.
- Melting out ice in the 12 m long transducer casing using a mini hot water drill built for the purpose.
- Temporarily installing lighting and a submarine video camera in the tide crack approximately 3-4 m from the transducer position to locate the transducer under the sea ice foot.
- Locate the levelling probe on the transducer and level back to the Tide Gauge Bench Mark (CRTG BM1).
- Levelling Result: Transducer is 8.016 m below CRTG BM1.

The fast sea ice near shore to the tide gauge has remained in place for at least the last 3 years and probably has prevented flushing of ice from under the ice foot that would normally occur when the near shore ice and ice foot breaks away in late summer (Jan-Feb). A previous event affecting the tide gauge on 20 February 1997 has also shown that by late in the summer warming has occurred in the surrounding rock so that ice in the transducer casing can melt completely and potentially would allow the transducer to move from its location. A film of ice has grown on the submerged rock surfaces in the sub ice foot cavity over the last 3 years, obscuring the transducer but the ice is permeable so has not affected the tidal measurements. However the calibration measurements have indicated a nonlinear progressive shallowing of the transducer. Video observation this season showed that the transducer had physically moved up the casing and this probably occurred progressively as the last three years calibration results (shown below) would indicate.

CAPE ROBERTS TIDE GAUGE VALIDATION RESULTS
(Derived from LINZ calibration measurements and data processing)
Height of reference mark above Tide Gauge Zero

CAPE ROBERTS	(Cape Roberts TGBM1 (B93M))
2000 – 2001	8.553m
2001 – 2002	8.506m
2002 – 2003	8.332m
2002 – 2004	8.196m

The extended period of multi year fast ice near shore to the tide gauge has had an adverse effect on the tide gauge data. The transducer position should remain fixed for reliable long-term measurements but this is not guaranteed at present where the transducer is held in the cage by gravity and relies on ice in the casing locking it into position. A more reliable construction would be to replace the existing plastic transducer casing and locating cage with a new casing and J slot locking system that locates and locks the transducer. The techniques and equipment now developed to level the existing transducer would to used also to replace the transducer casing.

Annual Calibration

This was successfully carried out both prior to transducer levelling and after when the transducer was located in the correct position. (See K450 reports for detailed information).

Future work

- Replace the transducer casing with a new plastic casing that allows the transducer to be locked into position and enables recovery for maintenance or replacement.
- Consider what meteorological information should also be measured in conjunction with both the tide gauge and the continuous GPS tracking station at Cape Roberts.
- Continue to pursue real time data capability for the GPS station, tide gauge and additional metrological measurements.
- Continuing annual calibration and data retrieval is required.

Publications

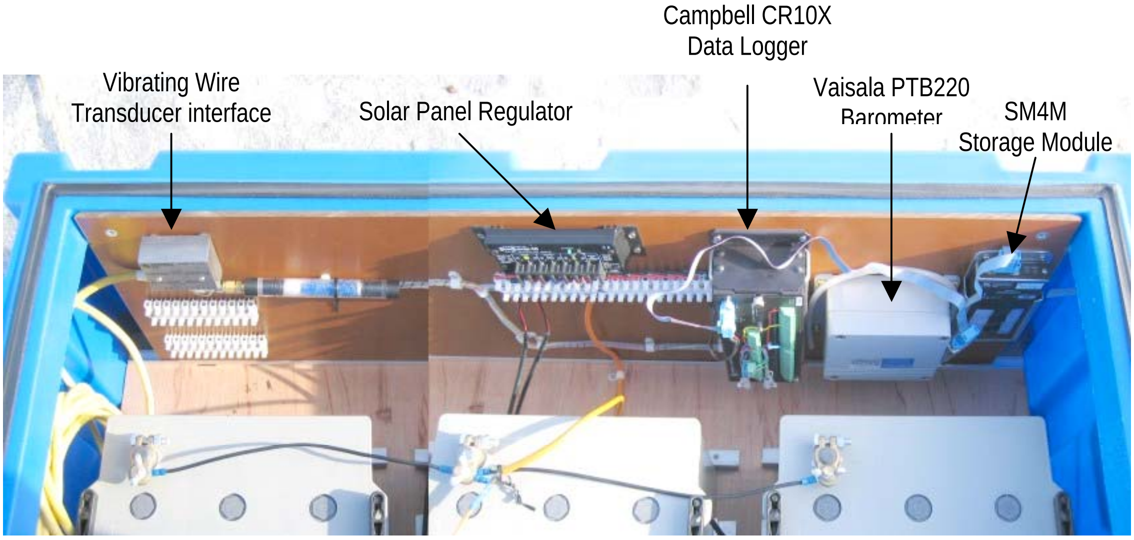
Goring, D. G., and A. R. Pyne (2003), Observations of sea- level variability in the Ross Sea, Antarctica, New Zealand Journal of Marine and Freshwater Research, 37, 241 – 249.

Han, A. S. K., (2002), An investigation into the Tidal Regime at Cape Roberts in Ross Sea, Antarctica. BSc (Hons) University of Otago, Dunedin, New Zealand.

Acknowledgments

We wish to acknowledge the continuing logistic support from Antarctic New Zealand. This program is co sponsored by Land Information New Zealand and the Antarctic Research Centre, Victoria University of Wellington, New Zealand.

Cape Roberts Tide Gauge Instrumentation. Solar Panel and instruments box. Meteorological mast (background) is not currently in use.



Cape Roberts Tide Gauge Instrumentation and three 110 Ahr lead acid batteries.

LOGISTIC NOTES

EVENT DIARY

Date	Main Activities and Location	Other Comments
Nov.		
14-15	Cavanagh & Matheson (K450) to C. Roberts from Scott Base	Hagglunds traverse
16	Pyne & Kingan to C. Roberts from Evans P. Gl.	Transfer from K049 by Twin Otter
16-19	Calibration, levelling and Maintenance of the tide gauge at Cape Roberts	
19	Party of 4 return to Scott Base	

REFUGE AND RESEARCH HUTS

Refuge/research hut name	Cape Roberts Huts
Overall condition	Good
Scale and condition of provisions	
Suitability of location	
Unnecessary equipment or rubbish/debris in the area	None, removed on previous K049 traverse 28-29 Oct.

Comment: Some Science equipment was left in the accommodation hut (Palace) for return in January to Scott Base ANDRILL LST container.

*ENVIRONMENTAL IMPACT

*Sites Visited

Site name	Cape Roberts
Site location (coordinates/description)	
Dates occupied	15-19 November
Total days (or hours) at site	
Maximum number of people at site (your event)	4
Total person-days (or person-hours) at site	16 man days
Main activity undertaken	Cape Roberts Tide Gauge
Cumulative impacts observed	None

Chemicals

Chemical form	Calcium Chloride
Quantity used	1 kg
Location of use	
Purpose	Melting ice at tide gauge transducer.

Chemicals

Chemical form	Ethanol
Quantity used	5 litres
Location of use	
Purpose	Melting ice at tide gauge transducer.

Waste management

Location	Cape Roberts
Approximate quantity	Urine
Disposal methods	Tide crack

Comment: Rubbish and solid human wastes returned to Scott Base

ANNEX 1

November 2003
Event K042

A. R. Pyne March 2004
Report on the Cape Roberts Tide Gauge
Antarctic Research Centre
Victoria University of Wellington

Summary

The Cape Roberts Tide Gauge that was refurbished in November & December 2002 with new data logging equipment failed recording in March 2003 due to a component failure in the new Campbell CR10X data logger. LINZ and USGS surveyors visited Cape Roberts on 10 November for a programmed tide gauge calibration and determined that the instrument had failed. I visited Cape Roberts the following day and determined that the data logger had failed and was not repairable in the field. The logger was returned to Scott Base for evaluation and the calibration postponed until replacement equipment could be installed and to coincide with another spring tide period on 24 November. The installation was checked, restarted and the calibration successfully completed during the period 22-26 November. Also planned this season was a submarine levelling of the transducer last done in 1993 by drilling through the ice foot 3+ m thick above the transducer with video camera and levelling probe. At this time the transducer was obscured due to extremely thick submarine anchor ice and the levelling not completed.

The failed logger was returned to New Zealand for repair under warranty and a replacement logger borrowed from the Crary Lab at McMurdo.

Future work and recommendations

- The Cape Roberts Tide Gauge should be visited in October prior to the annual survey calibration to recover stored data and determine that the installation is continuing to function.
- Repaired equipment should be reinstalled in the 2004-05 season and the installation checked.
- Annual survey calibration should be carried out during a spring tide period preferably in November or early December when access to the near shore fast sea ice is still possible.
- The submarine transducer levelling is still required. The anchor ice problem could be initially assessed with video camera but if present in thick quantities that may not be possible to clear with a mini hot water drill. Levelling may be postponed until January when the anchor ice is more likely to have been reduced in the late summer. This can be carried out independently of the annual GPS survey calibration.

ANNEX 2

Report on the Cape Roberts Tide Gauge refurbishment:
November – December 2002
Event K042

A. R. Pyne October 2003
Antarctic Research Centre
Victoria University of Wellington

Introduction and History

In November 1990 the permanent system was installed by diamond drilling an inclined hole through the coastal bedrock to locate and protect a new seawater transducer. The 12.8 m long drill hole is lined with 32 mm ID low density polythene pipe with a stainless steel cage at the bottom which locates the pressure transducer 8.04 m below the Cape Roberts tide gauge bench mark (CRTGBM #1). At start up the system consisted of a Campbell CR10 Data logger (S/N 0004172) and Geokon vibrating wire transducer (25 psi, 4500 ALV, S/N 13131). On 27 November 1994 at 1700 NZST the replacement transducer (25 psi, 4500 ALV, S/N 14740) became operative with a different CR10 data logger and this equipment continued to function until refurbishment in 2002.

Refurbishment

The Geokon 4500 ALV vibrating wire transducer SN 14740 was melted out of the polythene casing using a specially designed miniature hot water drill. This drill melted out the transducer in less than 2 hours and now provides a quick and simple method to replace a failed frozen transducer in the future. The transducer was checked for signs of corrosion and leakage, and returned to position in the cage at the bottom of the casing. The vented cabling that transmits the signal about 40 metres to the data recording instrumentation was re terminated in a sealed connection box and wire wrapped to the catenary cable for long term security.

A new instrument package with Campbell CR10X data logger, 4 MB storage module, Vaisala digital barometer, batteries and solar panels were installed in a single blue polyethylene enclosure (Space Case 0944). The housing is mounted on an aluminium frame bolted to the local gneiss basement rock with the Solar panels inclined and facing northwards.

Programming

The Vibrating wire transducer is plucked and read every 10 seconds and an average value (from 60 readings) calculated every 5 minutes and recorded at the beginning of the next 5-minute interval. Six Barometric pressure readings are made between 2 and 3 minutes in the 5-minute interval and averaged and recorded with the tide value at the beginning of the next 5-minute interval. Time is recorded in UTC.

> The transducer pressure value is converted to a seawater equivalent using a density value of 1.02825 for seawater with a salinity of 35 parts per thousand at a constant temperature of minus 1.8 degrees Celsius (freezing point).

ANNEX 2

Instrumentation: Cape Roberts Tide Gauge @ 3 December 2002

Pressure Transducer:	Geokon 4500 ALV SN 14740
Vibrating Wire transducer Interface:	Campbell AVW1
Data logger:	Campbell CR10X
Storage Module:	Campbell SM4M 4 M Byte
Barometer:	Vaisala PTB220 Class B, SN X3610009
Batteries:	Sonnenschein A212/110A (3 total 330 Ahr)
Solar Panels:	Solarex 20 W, two; 40 W total
Solar Regulator:	Morningstar SS-10-12
Enclosure:	Polythene Space Case 0944

Equipment Costs (Exclusive of GST)

Installed equipment value:	$ 14,870.5
Servicing & Installation equipment:	$ 2,793.5
Total:	$ 17,664

Future work: 2003-2004

The instrumentation will be checked, the data recovered and the data logger clock adjusted if required. Other instrumentation and programming corrections will be made if required.

The position of the transducer in the submerged casing cage will be checked and measured by drilling a hole through the ice foot above the transducer and levelling on to the cage. A portable submarine video system will be used to align the level rod and casing cage.

Future instrumentation

The new data recording instrumentation has capacity for Meteorological sensors to be installed at a future date. This option will be assessed this season after a year of operation and with discussion with LINZ to determine future the requirements.

Data and Data Processing

Data from the Cape Roberts tide gauge for the period November 1990 to the time of refurbishment (27 November 2002) have been supplied to LINZ for archive.

LOGISTICS REPORT

K047: Dating Relict Ice in the Dry Valleys
ANTARCTICA NEW ZEALAND 2004/05

Event Personnel:

Dr Warren Dickinson	Victoria University, Wellington
Dr Dan Zwartz	Victoria University, Wellington
Dr Andrew Mackintosh	Victoria University, Wellington
Ms Leigh Hyland	Victoria University, Wellington

Name of compiler: Warren Dickinson Signature of compiler:________________________

*AIMS

The ongoing aim of this project is to understand the origin and paleoenvironmental significance of relict ice from glaciers and lakes, which now lies buried by surficial sediments in many parts of the Dry Valleys. This phase of the project focuses on relict ice, buried in Lower Victoria Valley, which will be used as an analogue for relict ice in Beacon Valley. Of particular value will be the independent dating of sediments covering the ice using a new method of atmospherically derived beryllium-10.

Since the proposal was written, studies have shown that the use of atmospheric Be-10 to date Antarctic soil profiles gives equivocal results, and an independent test is needed. This requires sampling of a soil profile in a deposit of a known age. Unfortunately, such deposits are not available Lower Victoria Valley, but may possibly exist in Beacon Valley. Although we will have to wait until next season to sample such a deposit (Lower Wright Valley), Be-10 dating will be carried out on soils sampled in Beacon Valley and may give confirming dates.

In this field season, we sampled the modern environments and stratigraphically recent ice deposits in Lower Victoria Valley as well as the modern and buried ice deposits in Beacon Valley. The main aim will be to analyse the ice for percentages of O_2, N_2 and Ar in the occluded gas bubbles. Ratios of these gases can be used to distinguish glacial and lake ice. The gas analyses will be used in conjunction with standard chemical (6 cations and 3 anions) and stable isotopic analyses to help characterize the ice. Results from this study will not only help with interpreting the origin of the buried ice but also test Hall's (2002) lake model for Victoria Valley.

A further aim is to investigate the use of resistivity measurements for detecting massive ice and ice cemented sediment. Compared to other geophysical methods, this is a relatively simple and inexpensive method. Seismic methods will be attempted in Beacon Valley by the Marchant group (NSF program), while GPR has had limited success. Gravity measurements have been made (Sletten) but have not been processed. Thus, if resistivity methods prove to be useful, they would go a long way towards understanding the extent of buried ice in the Dry Valleys.

*PERSONNEL

Name	Designation	Organisation	Departed Chch	Returned Chch
Warren Dickinson	Event Leader	VUW	8 Nov 2004	14 Dec 2004
Dan Zwartz	Scientist	VUW	8 Nov 2004	14 Dec 2004
Andrew Mackintosh	Lecturer	VUW	17 Nov 2004	11 Dec 2004
Leigh Hyland	MSc Student	VUW	8 Nov 2004	16 Dec 2004

*PLANNING

- *Application process*

The process by which event leaders are informed of support needs modification. The review committee ranked my proposal 22 out of 35 proposals reviewed. The letter went on to say that the proposals would be supported in order of their rankings until the science resources were fully allocated. Although I was given a verbal indication my event would be supported, I was never given a formal letter confirming support. From my standpoint I was in limbo and it was not 100% clear that I would receive support until I received a movements spreadsheet in early May 2004. This is not acceptable, and a formal letter of support needs to be issued to the event leader no later than mid-February for the coming season.

- *Communications with Antarctica New Zealand staff*
  Communication for event operations and planning needs improvement. Event planning cannot take place through 2 people as communication is never perfect. For example, both Keith Springer and Pete Cleary worked on my event, and several items fell through the cracks. Although the number of events may be too large for one person to handle, it would be better to split the events between two people rather than spread two people over all the events. That is each event is assigned to one ANZ staff member.
- *Provision of maps and aerial photographs*
  Maps and photos are not provided by Antarctica NZ so it remains the responsibility of the event leader to obtain these. However, much of the Dry Valleys lacks low-level, high resolution photographs. A system currently under development by the USGS will provide digital photographs and laser altimetry. This system needs to be supported by Antarctica NZ so that detailed photographs and elevations are available to NZ scientists working in the Dry Valleys.
- *Pre-season information*
  Handbooks and info arrived in time!
- *Medicals, documentation and flights to Antarctica*
  All OK
- *Environmental Advice*
  I did not receive my environmental permit until after I had returned from the field! In addition, it needs to be made clear to scientists that it is now not possible to deviate from an event after the PEE has been processed by the ministry.
- *Other comments*
  For years now, event leaders have faithfully sent scientific and logistics reports to NZAP and now Antarctica NZ. These reports contain valuable information not only for a de-brief of the past season but also to future event leaders. Although event leaders make numerous copies of these reports, to my knowledge they are only available for perusal in two places: 1) the Scott Base library which is not accessible for 8 months out of the year and 2) the Antarctica NZ library in Christchurch. Most detrimentally they are not indexed. In other words, if I were going to a particular location in the Dry Valleys, it would be extremely useful (both scientifically and environmentally) for me to know who has been there and what they have done there in the past. At present, it is difficult and time consuming (but not impossible) to find this information for NZ events. However, as far as I know, it is impossible to get this information for US events. This situation is not acceptable, and in fact, it makes it impossible to answer fully certain questions on the PEE report.

Scientific reports should be indexed and made available on the web. This would not only provide valuable information for scientists but would also allow the public a further view into what happens in Antarctica. On the other hand, the logistics reports may be sensitive and probably should not be put on the web. However, they should still be index and available to event personnel. In addition, Antarctica NZ should pressure the US events to follow suit.

*PREPARATIONS FOR THE FIELD

- *Reception and planning for your event*
  Access to an indexed set of past Scientific and Logistics reports would make this much easier. Because these reports are difficult (impossible for past US events) to access, we are re-inventing the wheel in many places.
- *Availability and condition of equipment received*
  All equipment must be checked by people intending to take it into the field. This should be made clear to event personnel and extra time should be allotted for this.
- *Field training*
  Although fun, AFT is a joke and essentially a waste of time for those who have spent time in the Antarctic field. It is however, useful for those who have not been in the Antarctic field with NZ equipment. The policy should revert to the 3 yr guideline- that is, no AFT if you have been to Antarctica in the past 3 years.
- *Safety and Risk Management processes*
  It is getting a bit over the top. Keep the lawyers out of it. They make the money and cause us the work, yet we are no safer than before.
- *General comments about Scott Base*
  Good place but getting a bit crowded in the past few years. Chefs' cooking is an order of magnitude better than anyone else who has ever cooked there!
- *Other comments*

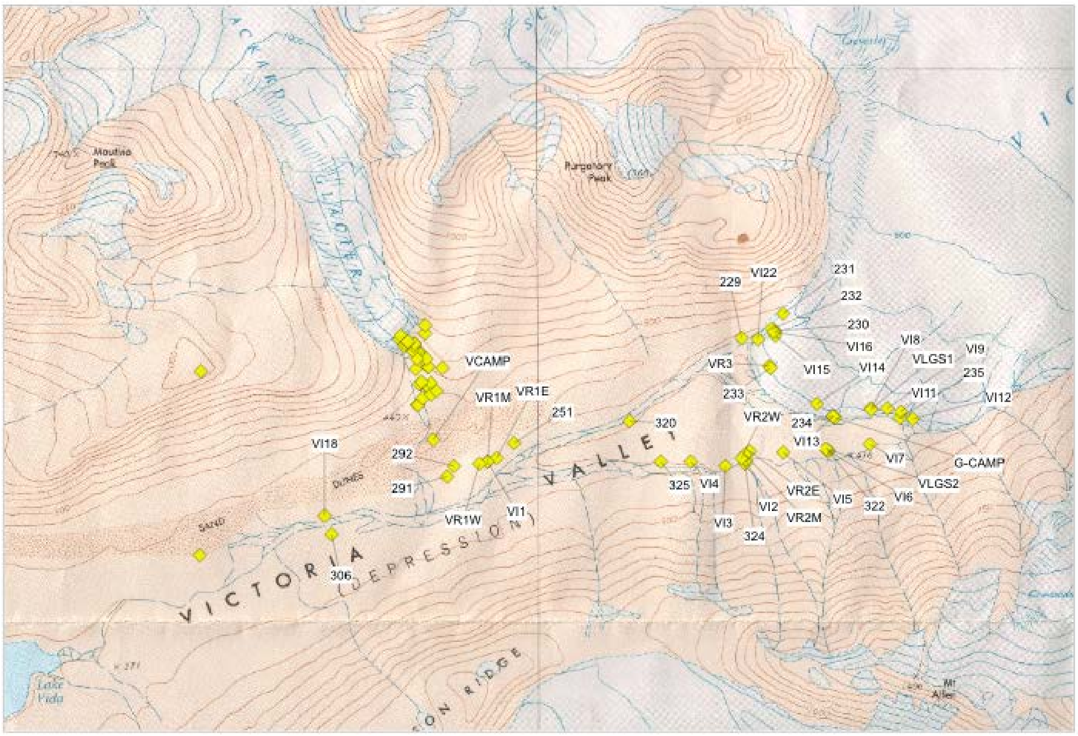
*Event Diary

Date	Main Activities and Location	Other Comments
7 NOV	Arrive in ChCh, kit-up	
8 Mon	Depart for SB at 12:00pm C-17, ariv McM 5:15 dinner at SB; Base/AFT	
9 Tue	WD, DZ, LH - AFT 8am; night in snow cave and tents	
10 Wed	AFT continued	windy conditions
11 Thu	SB, WD, DZ, & LH pack field equipment	beautiful walk on the sea ice
12 Fri	SB, testing and final packing of field equipment, repacking of food boxes	
13 Sat	SB to Victoria Valley Dunes 11am, WD, DZ & LH: set up camp; Packard	WD leaves back pack at SB!
14 Sun	VV, recon walk around the area	wind towards sea;
15 Mon	VV, Profiling relict channels below Packard Glacier	late finish; plot up data in
16 Tue	VV, Profiling relict channels below Packard Glacier; visit by Gary Steel in	Packard Stm flows
17 Wed	VV, Profiling relict channels below Packard Glacier	Temp near 0 C
18 Thu	VV, Profiling relict channels below Packard Glacier	plot up profile data in eve
19 Fri	VV, DZ, LH set up resisivity (RV-1) 500m south of Dunes; WD maps Pkard	Radio sched w/ AM; Temp 0
20 Sat	VV, WD & LH sample ice near RV-1; AM arrives 3p; helo photos of Vly	Helo move of core box to
21 Sun	VV, WD,LH,AM examine Pkard Gl/Stnm seds; DZ takes resisivity	Helo w/ Blake; cuts storge
22 Mon	VV, WD,LH,DZ,AM recon 'morains' sth side vly; examine 'deltas' near Lk	Back to camp against stng
23 Tue	VV, WD,LH,AM spl chaotica section DZ measures resisivity (RV-2) near	Early dinner 8pm

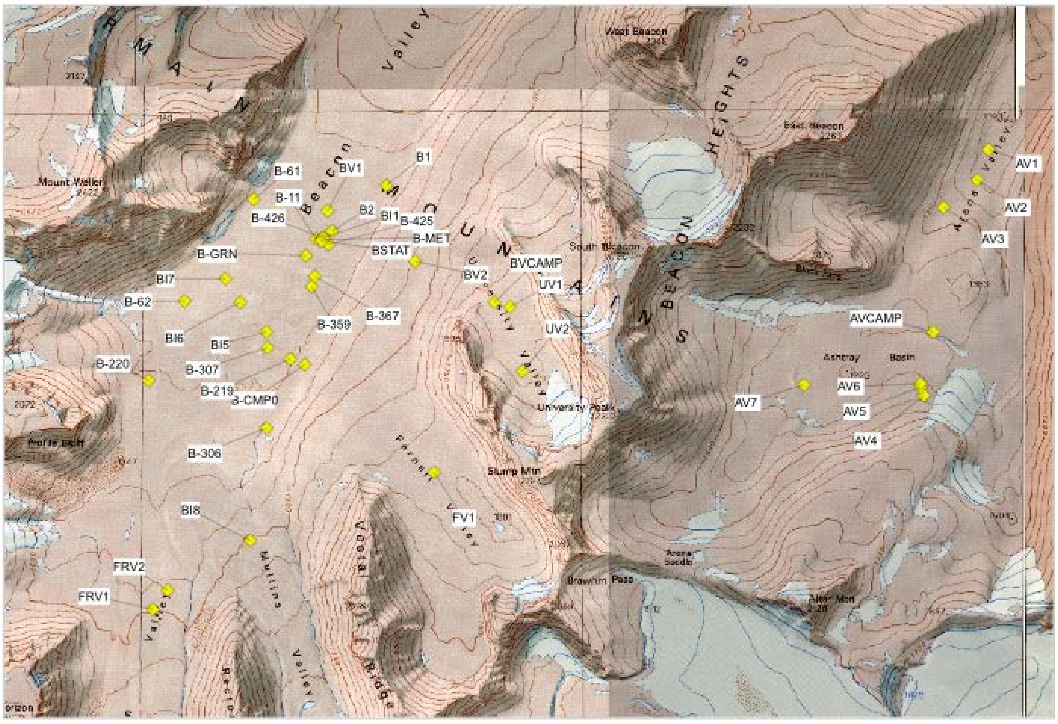
24 Wed	VV, WD,LH,AM,DZ working near chaotica section; DV visit @2pm	ANZ board and FoRST
25 Thu	VV, Cont splng ice up LV strm; DZ resisivity at RV-3	Ed Hillary fly-by
26 Fri	VV, WD,LH sipre core buried ice; AM,DZ taking resisivity measuremnts	McGowan event arivs at
27 Sat	VV, WD,LH sipre core buried ice & glacial ice; AM,DZ recon of Packard	AM fixes dinner
28 Sun	VV,WD,LH sipre core LV apron; AM,DZ splng and resisvity at Lk Vida	Late dinner
29 Mon	VV, WD,LH sipre core; AM,DZ splng and resisvity at Lk Vida	
30 Tue	VV, rationalize spl cashes to storage cave	Packing for helo move
1 DEC	VV to BV, 3pm WD,LH helo-1 DZ,AM helo-2 @ BV by 7p; set up camp;	Light winds in BV
2 Thu	BV, WD,LH,DZ,AM recon central BV and up into Univ Vly; 15-20 kt	Found hndhld VHF lleft 3yr
3 Fri	BV, Excavated trench in Granash polygon: spled blocks of relict ice	Windy/dusty diging
4 Sat	BV, WD,LH,AM cont spling Granash polygon; DZ resisivity sounding at	Lite wind –6 C
5 Sun	BV, WD,LH,AM,DZ recon of Arena Vly; pic at Brawhm Pass	Beaut day (no wind)
6 Mon	BV, WD,LH,AM finish spling Granash polygon; DZ resisivity sounding	Temps –2 C getting warm in BV
7 Tue	BV, WD,LH,AM recon of non-granite till loc ice spl sites; DZ cont	TwinOtter flying radar at
8Wed	BV, WD,LH,AM spl ice below non-granite till; DZ resisvity above camp on	Winds gusting 25 kts
9 Thu	BV, WD,LH sample buried ice Mullins Gl: DZ,AM resisivity work	Contact w/ Marchant event
10 Fri	BV to SB LH, AM 1st helo & WD,DZ on 2nd;10a start	Showers and chef
11 Sat	SB, cleaning, sorting & packing of field equipment; AM to Chch	Pizza & Beaker Babble talk
12 Sun	SB, WD,LH getting set up to subsample ice at Crary lab	Ob Hill
13 Mon	SB, WD,LH subsample ice at Crary lab; DZ packs equipmnt for home	Bag drag WD, DZ
14 Tue	SB. WD,DZ on Herc for Chch 11p; LH sampling at Crary, Tristian helps	In Welly by 9:30p
15 Wed	SB, LH sampling at Crary, Tristian helps	
16 Thur	SB-Chch, LH leaves sampling complete	

SB=Scott Base; VV=Victoria Valley; BV=Beacon Valley;
WD = Warren Dickinson; DZ = Dan Zwartz; AM = Andrew Mackintosh; LH = Leigh Hyland

EVENT MAP



Map 1. Lower Victoria Valley showing sample sites



Map 2. Beacon Valley showing sample sites.

*WEATHER

For most days in the field, the weather was generally good. Field movements by helicopter were not constrained by the weather. Fieldwork was not restricted due to weather conditions at any time. However, temperatures at Victoria Valley ranged from -7°C at night to +2°C during warmer days. This seemed unseasonably warm and made it difficult to store ice samples. In addition, because of some severe winter winds there was a lack of snowdrifts near camp and around the valley in which samples could be buried and kept below –10 C until they could be sent to Scott Base. Because of this was a major problem, Blake McDavitt was flown out from Scott Base to chainsaw a storage cave in the Lower Victoria Glacier. This provided a reasonable solution to the problem, although there was minor melt water running over the entrance to the cave and the internal temperature of the cave was only –7 C. Winds were diurnal with some days of up to 25 knots.

Temperatures in Beacon Valley were about 7 degrees cooler than Victoria Valley ranging mostly from -8°C to -4°C with a few nights of -10°C. Winds were diurnal with some gusts of up to 25 knots. Warmer temperatures in the last few days of our stay required the burial of the samples in a large snowdrift where temperatures of –12 C were maintained.

*ACCIDENTS, INCIDENTS OR HAZARDS

There were no accidents or incidents during this field season.

FIELD EQUIPMENT

- *Other comments*
  The new sleeping bags are great. The wood food boxes need to go and should be replaced with plastic (light weight) boxes. The food this year was greatly improved from the past several seasons, keep it up! Food variety is greatly appreciated. Some medium sized tents are needed. These would be for parties of 4-5 to cook and socialize in the field. Four people cooking in a polar tent is pretty cramped. For this purpose, next season I will be looking a buying an Arctic Oven from Alaska Tent and Tarp.

RADIO COMMUNICATIONS

VHF radio communications in the Lower Victoria Valley are excellent. However, VHF radio communications in Beacon Valley are extremely limited even with the high-gain aerial. HF communication with the Qmac was good but these radios lack portability. A satellite phone for emergency calls away from camp in Beacon Valley is probably necessary.

COMPUTER FACILITIES

- Bandwidth at Scott Base is a joke. For example, I needed to download a 30 Mb powepoint file for a beaker babble talk and it would have taken 3-4hrs at night had the fibre optic cable from Arrival Heights been working. As such I was never able to get this presentation. I suggest that either bandwidth is increased or visiters travelling to Scott Base should be made aware that internet traffic with the outside world is severly limited.

*ENVIRONMENTAL IMPACT

*Sites Visited

Site name	Victoria Valley Dunes, at Packard Stream
Site location (coordinates/description)	E 162.2020, S -773699
Dates occupied	13 Nov – 1 Dec 2004
Total days (or hours) at site	17
Maximum number of people at site (your event)	4
Total person-days (or person-hours) at site	61
Main activity undertaken	Measuring ground resistivity, sampling ice, surveying
Cumulative impacts observed	Little because most of area is on mobile sand

Site name	Central Beacon Valley (previously occupied camp)
Site location (coordinates/description)	E 162.2020, S -773699
Dates occupied	1 Dec – 10 Dec 2004
Total days (or hours) at site	9
Maximum number of people at site (your	4

event)	
Total person-days (or person-hours) at site	36
Main activity undertaken	Measuring ground resistivity, sampling ice, surveying
Cumulative impacts observed	Campsite had been occupied numerous times in the past

Chemicals: Not used

Explosives: Not used

Importation: None

Interference: None

Geological Material: See attached sample list below

Equipment installed/left in field: None

Disturbance to ice-free areas: General foot prints from walking on desert pavement

Waste management: All waste was removed back to Scott Base

Spills and incidents: None

Other samples: None

*Differences from original Preliminary Environmental Evaluation (PEE)

The total number of samples and the total sample weight taken at each site was less than the amount (60 spls/site 100 kg/site) approved on the PEE.

Samples Taken During the Event

Ident	Lat	Long	Location	Ice/sediment type	Type & Wt. (Kg)
VI1-1	-77.3721	162.227	valley floor - geophys site	clear ice pod in gravel lag	ice (10)
VI1a			valley floor - geophys site	clear ice pod in gravel lag	ice (0.2)
VI1b			valley floor - geophys site	clear ice pod in gravel lag	ice (0.2)
VI1c			valley floor - geophys site	clear ice pod in gravel lag	ice (0.2)
VI1d			valley floor - geophys site	clear ice pod in gravel lag	ice (0.2)
VI2a	-77.3720	162.345	Kaotica - Victoria Stream	massive clear ice	ice (0.2)
VI2b			Kaotica - Victoria Stream	massive clear ice	ice (0.2)
VI2c			Kaotica - Victoria Stream	massive clear ice	ice (0.2)
VI2d			Kaotica - Victoria Stream	massive clear ice (~ 1m away from a,b,c)	ice (0.2)
VI2e			Kaotica - Victoria Stream	massive clear ice (~ 1m away from a,b,c)	ice (0.2)
VI2f			Kaotica - Victoria Stream	undeformed sediment-rich ice sample	sed-rich ice (0.2)
VI2g			Kaotica - Victoria Stream	homogeneous sand bleb (OSL sample taken)	ice-cement sed (0.2)
VI2h			Kaotica - Victoria Stream	homogeneous sand bleb (OSL sample taken)	ice-cement sed (0.2)
VI2i			Kaotica - Victoria Stream	massive clear ice (above main outcrop)	ice (0.5)
VI2j			Kaotica - Victoria Stream	homogeneous sand boudin (OSL sample taken)	ice-cement sed (0.2)
VI2k			Kaotica - Victoria Stream	homogeneous sand boudin (OSL sample taken)	ice-cement sed (0.2)
VI2l			Kaotica - Victoria Stream	homogeneous sand boudin (OSL sample taken)	ice-cement sed (0.2)
VI3a	-77.3726	162.335	Victoria Stream downstream from (VI2)	massive, clear ice in bank	ice (0.2)
VI3b			Victoria Stream downstream from	massive, clear ice in bank (few cm from	ice (0.2)

			(VI2)	a,c,d)	
VI3c			Victoria Stream downstream from (VI2)	massive, clear ice in bank	ice (0.2)
VI3d			Victoria Stream downstream from (VI2)	massive, clear ice in bank	ice (0.2)
VI4a	-77.3721	162.319	Victoria Stream downstream from (VI3)	massive, clear ice in bank	ice (0.2)
VI4b			Victoria Stream downstream from (VI3)	massive, clear ice in bank	ice (0.2)
VI4c			Victoria Stream downstream from (VI3)	massive, clear ice in bank (~1m from a,b)	ice (0.2)
VI5a	-77.3712	162.362	Victoria Stream upstream from VI2	massive, clear ice in bank	ice (0.2)
VI5b			Victoria Stream upstream from VI2	massive, clear ice in bank	ice (sed at base) (0.2)
VI5c			Victoria Stream upstream from VI2	massive, clear ice in bank (~5m away from a,b)	ice (sed at base) (0.2)
VI5d			Victoria Stream upstream from VI2	massive, clear ice in bank (~10 away from c)	ice (0.2)
VI6a	-77.3710	162.381	Victoria Stream upstream from VI5	massive, clear ice in bank (~4m from c)	ice (0.2)
VI6b			Victoria Stream upstream from VI5	massive, clear ice in bank (~4m from c)	ice (0.2)
VI6c			Victoria Stream upstream from VI5	ice overlain by sed. then ice (OSL + algae taken)	ice (0.2)
VI6d			Victoria Stream upstream from VI5	ice overlain by sed. then ice (OSL + algae taken)	ice (0.2)
VI6-1			Victoria Stream upstream from VI5	ice overlain by sed. then ice (OSL + algae taken)	ice (5)
VI7a	-77.3704	162.401	Victoria Stream upstream from VI6	massive, clear ice in bank	ice (0.2)
VI7b			Victoria Stream upstream from VI6	massive, clear ice in bank	ice (0.2)
VI8a	-77.3669	162.402	Victoria Lower Glacier front (south)	clear ice within pod of lake sed in glacier (OSL)	ice (0.2)
VI8-1			Victoria Lower Glacier front (south)	glacier ice	ice (5)
VI8-2			Victoria Lower Glacier front (south)	glacier ice	ice (5)
VI9-1	-77.3669	162.409	VLG apron/front (south)	ice-cored mound in apron	ice (5)
VI9-2			VLG apron/front (south)	ice-cored mound in front ~ 4m upslope from VI91	ice (5)
VI9-3			VLG apron (south)	wedged-up pro-glacial lake	ice (5)
VI10	-77.3626	162.355	VLG (north) geophys site	wedged-up pro-glacial lake (sed in core at 108cm)	ice (5)
VI11a	-77.3672	162.415	VLG (south)	ice-cored mound ~ 50m in front of glacier	ice (0.2)
VI11b			VLG (south)	ice-cored mound ~ 50m in front of glacier	ice (0.2)
VI11c			VLG (south)	ice-cored mound ~ 50m in front of glacier	ice (0.2)
VI12	-77.3679	162.421	VLG (south)	linear lines of ice outcropping ~ 70m in front of glacier	ice (8)
VI13a	-77.3677	162.384	VLG (south) stream bank	clear, massive ice (with assicated contortions)	ice (0.2)
VI13b			VLG (south) stream bank	clear, massive ice (with assicated contortions)	ice (0.2)
VI14-1	-77.3664	162.377	VLG apron (middle)	glacier apron ice	ice (5)
VI15-1	-77.3597	162.358	VLG (north) by ice cave	ice-cored moraine ~ 20m from glacier cliff	ice (5)
VI16-1	-77.3594	162.357	VLG (north) by ice cave	lake over glacier ice in ice-cored moraine	ice (5)
VI17-1			VLG (north) by ice cave	glacier ice from ice cliff (ice cave blocks)	ice (3)
VI18a	-77.3775	162.152	Victoria Stream (north) west of camp	clear, massive ice in stream bank (OSL taken)	ice (0.2)
VI18b			Victoria Stream (north) west of camp	clear, massive ice in stream bank (OSL taken)	ice (0.2)
VI18c			Victoria Stream (north) west of camp	clear, massive ice in stream bank (OSL taken)	ice (0.2)
VI19	-77.3603	162.190	Packard glacier cliff (west)	glacier ice from ice cliff by sed bleb	ice (3)
VI20	-77.3587	162.198	Packard glacier cliff (east)	glacier ice from cave behind icicles	ice (3)
VI21			Lake Vida ice sample		ice (3)
VI22	-77.3600	162.350	Victoria Stream (north) west of camp	clear, massive ice (with assicated contortions)	ice (0.2)
BI1a	-77.8484	160.603	Polygon by weather station	profile in shoulder	dirty ice (5)

BI1b			Polygon by weather station	profile in shoulder - taken from below sample BI1a	dirty ice (0.2)
BI1c			Polygon by weather station	profile in shoulder - taken from below sample BI1a	dirty ice (0.2)
BI1d			Polygon by weather station	profile in shoulder - taken from below sample BI1a	dirty ice (0.2)
BI1e			Polygon by weather station	profile in shoulder - taken from below sample BI1a	dirty ice (0.2)
BI2a	-77.8484	160.603	Polygon by weather station	profile in top	ice-cemented (0.2)
BI2b			Polygon by weather station	profile in top (melted and refrozen)	ice-cemented (0.2)
BI2c			Polygon by weather station	profile in top	ice-cemented (0.2)
BI2d			Polygon by weather station	profile in top	ice-cemented (0.2)
BI2e			Polygon by weather station	profile in top	ice-cemented (0.2)
BI3a	-77.8484	160.603	Polygon by weather station	profile in side (clockwise from BI1 looking upvalley)	dirty ice (10)
BI4a	-77.8484	160.603	Polygon by weather station	profile in side (clockwise from BI3 looking upvalley)	dirty ice (10)
BI4b			Polygon by weather station	profile in side (clockwise from BI3 looking upvalley)	ice-cemented (5)
BI5	-77.8595	160.570	600m across valley from camp	profile in side	dirty ice (10)
BI6	-77.8560	160.556	1100m across valley from camp	profile in side	dirty ice (10)
BI7	-77.8532	160.547	1500m across valley from camp	profile in side	dirty ice (10)
BI8	-77.8844	160.560	slope up to Mullen's Valley	shoulder, by triple junction	dirty ice (10)

IMMEDIATE SCIENCE REPORT

K047: Dating Relict Ice in the Dry Valleys
ANTARCTICA NEW ZEALAND 2004/05

Event Personnel:

Dr Warren Dickinson	Victoria University, Wellington
Dr Dan Zwartz	Victoria University, Wellington
Dr Andrew Mackintosh	Victoria University, Wellington
Ms Leigh Hyland	Victoria University, Wellington

1 Popular Summary of Scientific Work Achieved

In the last 15 years, deep cores through the Antarctic ice sheet have provided a wealth of high resolution climate data, which have been invaluable for testing both regional and global climate models. Although ice core data only cover the last 500,000 years of earth history, the possibility of obtaining much older climate data is now recognized in a few select areas where ancient glacial ice has stagnated and lies buried beneath rock debris. Beacon Valley contains the best known relict ice, which if glacial has been dated by a volcanic ash layer as more than 8 million years old. This age remains controversial, but other occurrences of relict ice have recently been discovered in Pearse, Columnar, and Victoria Valleys and appear to be analogous to Beacon. The ongoing aim of this project is to understand the origin and paleoenvironmental significance of ice from these areas and place them in context with the Beacon Valley ice. Of particular value will be the independent dating of debris covering the ice. We will use a new method of beryllium-10 dating, which unlike exposure age methods, can extend back at least 20 million years.

2 Proposed Programme

Lower Victoria Valley (13 Nov – 1 Dec)

1) Sample ice in modern glacial and lake environments at snout of Lower Victoria Glacier. Sample buried ice and ice cemented sediment down valley (stream) from Lower Victoria Glacier.

2) Sample several soil profiles for Atm Be-10 on top of buried ice, down valley from Lower Vic Glacier.

3) Survey profiles of meltwater channels around the Packard Glacier for a paper by Atkins and Dickinson entitled ‘Landscape modification by meltwater channels at margins of cold-based glaciers’.

4) Testing of resistivity soundings/profiling over known occurrences of ground ice (both massive and ice cemented sediment).

Beacon Valley (1 – 10 Dec)

1) Sample ice in modern glacial and lake environments around Beacon Valley. Sample buried ice and ice cemented sediment in central Beacon Valley as well as one of the side valleys (University or Farnell). Also to sample the main body of ice in central Beacon Valley to look for spatial differences/variations since vertical variations are nil.

2) Sample several soil profiles for Atm Be-10 on top of the buried ice.

3) Testing of resistivity soundings/profiling over central Beacon Valley. These should follow the gravity and GPR lines of Ron Sletten.

3 Scientific Endeavours and Achievements

Summary

The four members of the event spent 17 days in Lower Victoria Valley from 13 Nov to 1 Dec and 9 days in central Beacon Valley from 1 Dec to 10 Dec. Ice and permafrost samples (Table 1), resistivity soundings, and topographic profiles were completed in both of these areas. Resistivity soundings may be useful in imaging subsurface ice in Beacon Valley. However, variable conditions (thawing) on the surface of the Lower Victoria Valley caused unstable resistivity readings and these yielded ambiguous results in this area.

Method

Sampling sites were selected for the occurrence of massive relict ice. At each site, a 1.5 square metre pit was dug into the ice free soil or sediment above the relict ice. In some areas ice cemented sediment was above the relict ice. This was sampled by means of a small gasoline powered hammer drill with a diamond or carbide core bit. Once into the relatively sediment-free relict ice, a sipre auger with carbide cutters was used to core to a depth of about one metre.

Ian Graham and co-workers at GNS, Lower Hutt, will carry out the dating method using atmospheric 10Be. The procedure will be similar to that used in previous studies (Dickinson et al. 2003b; Graham et al. 1995; Graham et al. 2002). To streamline the method, we will only process the >62 micron fraction of sediment which we believe contains most of the Be.

Samples of relict ice taken at 5cm intervals down the sipre auger cores were subsampled and sent to Ron Sletten at the University of Washington for chemical and isotopic analyses (see supporting letter).

Resistivity soundings (one dimensional, vertical profile) were made in selected locations where relic ice was sampled. The results are expected to help characterize the extent and depth of the relict ice. Previous attempts by A. Hubbard (pers. comm. 2001) and H. Conway (pers. comm. 2003) to define the depth of the ice by ground penetrating radar (GPR) have yielded ambiguous results because of salts that have accumulated in the soils and ice. Apart for these two surveys, other geophysical surveys to define the depth of the ice have not been conducted in Beacon Valley.

4 Publications

A paper on landscape modification by meltwater from the Packard Glacier will be submitted to the Journal of Glaciology in April 2005. Results from OSL sampling of Victoria Valley sediments will be published as a paper and poster for the *11th International Conference on Luminescence and Electron Spin Resonance Dating* (LED 2005), at the University of Cologne, July 2005. Results from sampling the relict ice in Victoria Valley will first be published as an MSc thesis at Victoria University in 2006. Copies of these will be sent to Antarctica NZ. The resistivity data will be published as an Antarctic Research Centre Report in may 2005.

Further publications of the scientific results will be published in international peer-reviewed scientific journals. Copies of this work will also be sent, when available, to Antarctica NZ.

5 Acknowledgments

Thanks to the following:

Prof Peter Barrett, (Director, Antarctic Research Centre, VUW)
Dean Peterson, Paul Woodgate and Keith Springer, (Antarctica NZ)
All of the Scott Base personnel (Nov-Dec 2004)
Special thanks to NSF and personnel at the Crary Lab for use of freezer space and ice core storage
Websters Drilling, for equipment preparation and cargo handling

Funding and Support

Antarctica New Zealand,
University Grants Committee, VUW
Foundation of Research and Technology, NZ

Ident	Lat	Long	Location	Ice/sediment type	Type & Wt. (Kg)
VI1-1	-77.3721	162.227	valley floor - geophys site	clear ice pod in gravel lag	ice (10)
VI1a			valley floor - geophys site	clear ice pod in gravel lag	ice (0.2)
VI1b			valley floor - geophys site	clear ice pod in gravel lag	ice (0.2)
VI1c			valley floor - geophys site	clear ice pod in gravel lag	ice (0.2)
VI1d			valley floor - geophys site	clear ice pod in gravel lag	ice (0.2)
VI2a	-77.3720	162.345	Kaotica - Victoria Stream	massive clear ice	ice (0.2)
VI2b			Kaotica - Victoria Stream	massive clear ice	ice (0.2)
VI2c			Kaotica - Victoria Stream	massive clear ice	ice (0.2)
VI2d			Kaotica - Victoria Stream	massive clear ice (~ 1m away from a,b,c)	ice (0.2)
VI2e			Kaotica - Victoria Stream	massive clear ice (~ 1m away from a,b,c)	ice (0.2)
VI2f			Kaotica - Victoria Stream	undeformed sediment-rich ice sample	sed-rich ice (0.2)
VI2g			Kaotica - Victoria Stream	homogeneous sand bleb (OSL sample taken)	ice-cement sed (0.2)
VI2h			Kaotica - Victoria Stream	homogeneous sand bleb (OSL sample taken)	ice-cement sed (0.2)
VI2i			Kaotica - Victoria Stream	massive clear ice (above main outcrop)	ice (0.5)
VI2j			Kaotica - Victoria Stream	homogeneous sand boudin (OSL sample taken)	ice-cement sed (0.2)
VI2k			Kaotica - Victoria Stream	homogeneous sand boudin (OSL sample taken)	ice-cement sed (0.2)
VI2l			Kaotica - Victoria Stream	homogeneous sand boudin (OSL sample taken)	ice-cement sed (0.2)
VI3a	-77.3726	162.335	Victoria Stream downstream from (VI2)	massive, clear ice in bank	ice (0.2)
VI3b			Victoria Stream downstream from (VI2)	massive, clear ice in bank (few cm from a,c,d)	ice (0.2)
VI3c			Victoria Stream downstream from (VI2)	massive, clear ice in bank	ice (0.2)
VI3d			Victoria Stream downstream from (VI2)	massive, clear ice in bank	ice (0.2)
VI4a	-77.3721	162.319	Victoria Stream downstream from (VI3)	massive, clear ice in bank	ice (0.2)
VI4b			Victoria Stream downstream from (VI3)	massive, clear ice in bank	ice (0.2)
VI4c			Victoria Stream downstream from (VI3)	massive, clear ice in bank (~1m from a,b)	ice (0.2)
VI5a	-77.3712	162.362	Victoria Stream upstream from	massive, clear ice in bank	ice (0.2)

			VI2		
VI5b			Victoria Stream upstream from VI2	massive, clear ice in bank	ice (sed at base) (0.2)
VI5c			Victoria Stream upstream from VI2	massive, clear ice in bank (~5m away from a,b)	ice (sed at base) (0.2)
VI5d			Victoria Stream upstream from VI2	massive, clear ice in bank (~10 away from c)	ice (0.2)
VI6a	-77.3710	162.381	Victoria Stream upstream from VI5	massive, clear ice in bank (~4m from c)	ice (0.2)
VI6b			Victoria Stream upstream from VI5	massive, clear ice in bank (~4m from c)	ice (0.2)
VI6c			Victoria Stream upstream from VI5	ice overlain by sed. then ice (OSL + algae taken)	ice (0.2)
VI6d			Victoria Stream upstream from VI5	ice overlain by sed. then ice (OSL + algae taken)	ice (0.2)
VI6-1			Victoria Stream upstream from VI5	ice overlain by sed. then ice (OSL + algae taken)	ice (5)
VI7a	-77.3704	162.401	Victoria Stream upstream from VI6	massive, clear ice in bank	ice (0.2)
VI7b			Victoria Stream upstream from VI6	massive, clear ice in bank	ice (0.2)
VI8a	-77.3669	162.402	Victoria Lower Glacier front (south)	clear ice within pod of lake sed in glacier (OSL)	ice (0.2)
VI8-1			Victoria Lower Glacier front (south)	glacier ice	ice (5)
VI8-2			Victoria Lower Glacier front (south)	glacier ice	ice (5)
VI9-1	-77.3669	162.409	VLG apron/front (south)	ice-cored mound in apron	ice (5)
VI9-2			VLG apron/front (south)	ice-cored mound in front ~ 4m upslope from VI91	ice (5)
VI9-3			VLG apron (south)	wedged-up pro-glacial lake	ice (5)
VI10	-77.3626	162.355	VLG (north) geophys site	wedged-up pro-glacial lake (sed in core at 108cm)	ice (5)
VI11a	-77.3672	162.415	VLG (south)	ice-cored mound ~ 50m in front of glacier	ice (0.2)
VI11b			VLG (south)	ice-cored mound ~ 50m in front of glacier	ice (0.2)
VI11c			VLG (south)	ice-cored mound ~ 50m in front of glacier	ice (0.2)
VI12	-77.3679	162.421	VLG (south)	linear lines of ice outcropping ~ 70m in front of glacier	ice (8)
VI13a	-77.3677	162.384	VLG (south) stream bank	clear, massive ice (with assicated contortions)	ice (0.2)
VI13b			VLG (south) stream bank	clear, massive ice (with assicated contortions)	ice (0.2)
VI14-1	-77.3664	162.377	VLG apron (middle)	glacier apron ice	ice (5)
VI15-1	-77.3597	162.358	VLG (north) by ice cave	ice-cored moraine ~ 20m from glacier cliff	ice (5)
VI16-1	-77.3594	162.357	VLG (north) by ice cave	lake over glacier ice in ice-cored moraine	ice (5)
VI17-1			VLG (north) by ice cave	glacier ice from ice cliff (ice cave blocks)	ice (3)
VI18a	-77.3775	162.152	Victoria Stream (north) west of camp	clear, massive ice in stream bank (OSL taken)	ice (0.2)
VI18b			Victoria Stream (north) west of camp	clear, massive ice in stream bank (OSL taken)	ice (0.2)
VI18c			Victoria Stream (north) west of camp	clear, massive ice in stream bank (OSL taken)	ice (0.2)
VI19	-77.3603	162.190	Packard glacier cliff (west)	glacier ice from ice cliff by sed bleb	ice (3)
VI20	-77.3587	162.198	Packard glacier cliff (east)	glacier ice from cave behind icicles	ice (3)
VI21			Lake Vida ice sample		ice (3)
VI22	-77.3600	162.350	Victoria Stream (north) west of camp	clear, massive ice (with assicated contortions)	ice (0.2)
BI1a	-77.8484	160.603	Polygon by weather station	profile in shoulder	dirty ice (5)
BI1b			Polygon by weather station	profile in shoulder - taken from below sample BI1a	dirty ice (0.2)
BI1c			Polygon by weather station	profile in shoulder - taken from below sample BI1a	dirty ice (0.2)
BI1d			Polygon by weather station	profile in shoulder - taken from below sample BI1a	dirty ice (0.2)
BI1e			Polygon by weather station	profile in shoulder - taken from below sample BI1a	dirty ice (0.2)
BI2a	-77.8484	160.603	Polygon by weather station	profile in top	ice-cemented (0.2)
BI2b			Polygon by weather station	profile in top (melted and refrozen)	ice-cemented (0.2)
BI2c			Polygon by weather station	profile in top	ice-cemented (0.2)

BI2d			Polygon by weather station	profile in top	ice-cemented (0.2)
BI2e			Polygon by weather station	profile in top	ice-cemented (0.2)
BI3a	-77.8484	160.603	Polygon by weather station	profile in side (clockwise from BI1 looking upvalley)	dirty ice (10)
BI4a	-77.8484	160.603	Polygon by weather station	profile in side (clockwise from BI3 looking upvalley)	dirty ice (10)
BI4b			Polygon by weather station	profile in side (clockwise from BI3 looking upvalley)	ice-cemented (5)
BI5	-77.8595	160.570	600m across valley from camp	profile in side	dirty ice (10)
BI6	-77.8560	160.556	1100m across valley from camp	profile in side	dirty ice (10)
BI7	-77.8532	160.547	1500m across valley from camp	profile in side	dirty ice (10)
BI8	-77.8844	160.560	slope up to Mullen's Valley	shoulder, by triple junction	dirty ice (10)

K049
2004/05

LOGISTICS REPORT

K049 NZ ITASE – Holocene Climate Variability along the Victoria Land Coast
ANTARCTICA NEW ZEALAND 2004/05

Event Personnel :

Dr. Nancy Bertler	Antarctic Research Centre, Victoria University
Mr. Alex Pyne	Antarctic Research Centre, Victoria University
Mr. Tony Kingan	Webster Drilling and Exploration Limited
Dr. Sepp Kipfstuhl	Alfred Wegener Institute, Germany
Mr. Daniel Bayliss	School of Physics, Victoria University
Mr. Mike Cavanagh	School of Earth Sciences, Victoria University

Name of compiler: Nancy Bertler Signature of compiler:

*AIMS

Seven key locations were identified for the NZ ITASE (International Transantarctic Scientific Expedition) programme. The analyses on the ice core from the first site, Victoria Lower Glacier in the McMurdo Dry Valleys, have almost been completed. During the 2003/04 field season we carried out a detailed reconnaissance of sites 2 and 3: Evans Piedmont Glacier (EPG) and Mt Erebus Saddle (MES) and determined the most suitable locations of the ice core recovery. During the 2004/05 field season we recovered to intermediate length ice cores (180m and 200m, respectively) from these locations and conduct further in-situ measurements, such as borehole temperature and light penetration characteristics, snow density and stratigraphy and its geographical variability. Furthermore, we installed a weather station and mass balance devices at EPG and cased the borehole at MES for future measurements.

The programme has five objectives:

1. ITASE-Objective
   The focus of the New Zealand ITASE group is to provide information from the climate sensitive, low altitude, coastal sites. This will capture the climate signature of the troposphere, which represents a regional account on the Ross Sea climate. The ice core data are expected to provide a record of air temperature, snow accumulation, precipitation source, atmospheric circulation strength, storm frequency, sea ice variation, ocean productivity, and anthropogenic influences. The results will help to decide whether the Ross Sea region is currently cooling or warming with a longer-term prospective, taking low frequency climate variability (100 to 1000 year cycles) into account. Furthermore, proposed tele-connections such as the Amundsen Low-ENSO correlation [*Meyerson et al.*, 2002; *Bertler et al.*, 2004] or the Southern Hemisphere Annual Mode [*Thompson and Solomon*, 2002] can be further constrained.

2. Latitudinal Gradient Project Objective
   The project is expected to contribute substantially to the Latitudinal Gradient Project, as it can provide a history of temperature, humidity, sea ice cover, precipitation source, atmospheric circulation, and ocean productivity along the Victoria Coast for the last 200 to 10,000 years. Furthermore, the timing and velocity of the Ross Ice Shelf retreat some 9 to 5ka years ago is still discussed controversially [*Steig et al.*, 1998; *Hall and Denton*, 2000; *Steig et al.*, 2000].

3. ANDRILL Objective
   The ice core locations 2 and 3 (Evans Piedmont Glacier and Mt. Erebus Saddle) are in the vicinity of planned ANDRILL coring locations (Granite Harbour and Windless Bight). The ice core records will provide a high resolution climate dataset, which serves as a reference for the younger part of marine record recovered through ANDRILL.

4. Longer-Term Mass Balance Objective
   During the 1999/2000 season mass balance measurement devices (submerge velocity method [*Hamilton et al.*, 1998; *Hamilton and Whillans*, 2000]) have been deployed at Victoria Lower Glacier. The device has since been revisited during season 2000/2001 and 2001/2002. The measurements show that the glacier has a slightly negative mass balance, losing around 12cm thickness per year. A continuation of the measurements will allow monitoring changes in the ablation intensity of the McMurdo Dry Valleys.

5. The Antarctic – New Zealand Connection Objective

New Zealand's future economic and social development, environmental sustainability, and infrastructural planning relies critically upon the accurate assessment of the impact of "global warming" in our sector of the planet. Future climate change is a result of both natural variability and anthropogenic influence. A joint programme between IGNS, University of Maine, Victoria University is investigating ice core records from New Zealand (Tasman Glacier and Mt. Ruapehu ice field). The comparison between our NZ and Antarctic ice core records will provide much needed data for the development of realistic regional climate models to predict NZ climate in the 21th Century [*Mullan et al.*, 2001].

*PERSONNEL

Name	Designation	Organisation	Departed Chch	Returned Chch
Nancy Bertler	PI	Antarctic Research Centre, Victoria Uni	18 Oct 2004	14 Dec 2004
Alex Pyne	Drilling Expert	Antarctic Research Centre, Victoria Uni	18 Oct 2004	07 Dec 2004
Tony Kingan	Drillling Expert	Webster Drilling and Exploration Limited	18 Oct 2004	19 Dec 2004
Sepp Kipfstuhl	Glaciologist	Alfred Wegener Institute, Germany	18 Oct 2004	14 Dec 2004
Daniel Bayliss	Student Assistant	School Physics Sciences, Victoria Uni	18 Oct 2004	14 Dec 2004
Mike Canvenah	Student Assistant	School of Earth Sciences, Victoria Uni	09 Nov 2004	14 Dec 2004

*PLANNING

- *Application process*

  The application process was organised in professional and efficient manner. However, it would be of advantage if the NZ review of a science proposal was transferred to an overseas reviewer if there no NZ expert can be found. The assessment of the value of the proposed science from a non-expert is likely to be misleading.

- *Communications with Antarctica New Zealand staff*

  In contrast to previous years, pre-season communication with some of Antarctica NZ staff was slow and difficult at times. Despite multiple attempts of key K049 members, namely Nancy Bertler and Alex Pyne, to discuss the 2004/05 season in person in Christchurch, via email and phone, little response was received. The first draft of the movement annex was received a week before the scheduled flight to Antarctica, and the contract was received during the last week of field deployment.

  This lack of communication might also partially be responsible for the misunderstanding of how important an early field deployment was for the success of this project. We stressed throughout the preparation that the typical temperature rise during late October / early November might lead to early termination of the drilling at the low elevation site at Evans Piedmont Glacier, as the gradient between air temperature and drill hole increases. For this reason we requested to deploy to Antarctica and into the field as soon as possible, which seemed to be reflected in the first draft of the movement annex. While we appreciate that the delay caused by the damaged ice runway is beyond Antarctica NZ's responsibility, we are disappointed that a decision was made to further delay specifically the departure of Bertler and Pyne to Antarctica, while seats on earlier flights after the runway repair were available and offered to the remaining members of

K049. The explanation given for this decision was, that Bertler and Pyne were perceived too much of a burden for the Scott Base staff at this early stage of the season, while the remaining K049 members would be welcome to start with their AFT. We strongly object to this decision, because: a) especially Pyne but also Bertler are experienced in Antarctic fieldwork and have a track record of well prepared and soundly organised field deployments, b) Bertler and Pyne were both indispensable to start field preparations, c) as discussed, further delay imposed a threat to the success of this project, d) we feel an obligation to assist and advise our new members (two VUW students and a senior scientist from the Alfred Wegener Institute), who travelled for the first time to Scott Base. Furthermore, Pyne and Bertler agreed to the request of Antarctica NZ staff, that they would not require any Scott Base staff support for the first three days after their deployment to Antarctica. Regardless of our agreement, the decision was made to delay us until the 18 Oct 2004.

Despite our best efforts to make up for the lost time, temperature at the final phase of our drilling at Evans Piedmont Glacier reached a critical threshold, putting the drilling operation under threat. Nonetheless, we are happy to report that due to the expertise of especially Pyne, Kingan, and Kipfstuhl, and the exceptional effort of every K049 member, the team successfully recovered a 180m core of excellent core quality.

We would also like to mention that once we arrived at Scott Base, support and communication was very efficient and helpful.

- *Provision of maps and aerial photographs*

  N.A.

- *Pre-season information*

  The information received was received late and without the option of further discussion.

- *Medicals, documentation and flights to Antarctica*

  The information received was timely and valuable

*PREPARATIONS FOR THE FIELD

- *Reception and planning for your event*

  The reception was well organised, friendly and efficient. The main issues of the event were promptly discussed and organised. The delayed travel to Antarctica was constructively discussed.

- *Availability and condition of equipment received*

  Most of the equipment requested from Scott Base was supplied in time and in good condition. In the following we would like to point out a few details.

Chainsaw : An electric chainsaw was provided from Scott Base to help cutting the drilling and core logging trench on Mt Erebus Saddle where the firn below 1.5 m was extremely dense and difficult to cut with hand saws. Regrettably, the saw available was externally vented and ice cutting dust was sucked into the motor where it melted and caused mote arcing. The saw was not used once this began but confirmed that a suitable un-vented electric chain saw would be very helpful for trench cutting in the future.

Electrical: Field Equipment: We were grateful for the provision of a 25 m electrical extension lead from Scott Base. Unfortunately this heavy-duty lead and the smaller white leads provided are PVC sheaved and become extremely stiff in the cold. Leads made from either natural rubber cabling or new synthetic low temperature cabling would give better and safer field service.

Field Fuel storage and use:
K049 used both a mixture of 209 and 60 litre drums of Mogas and Kerosene. In general the drums were in good condition and no spills occurred. To improve handing of fuel in the field we suggest that Ant.NZ consider providing:

- Collapsible bunds for bulk drum storage. The US program has several sizes of bund available ranging from single drums to butyl rubber bunds for multiple drums.
- Trigger hand pieces on manual fuel pumps used in the field.

- *Field training*

The field training was helpful and appropriate for the new members of our team. The full AFT training for Kingan was unhelpful and a waste of resources and time. The re-fresher AFT for Pyne and Bertler was helpful and appreciated. The frequency of full AFT requirements for experienced people should be reviewed to take account of personal experience and regular Antarctic activity that includes fieldwork. The “current” 3 year frequency is too short.

- *Field party equipment 'shakedown' journey*

To test our drilling equipment before deploying to EPG, we conducted a test drill at Windless Bight (Fig.1). This is a convenient location, as it is close to Scott Base and also a future drill site of ANDRILL. The shakedown went well, none of the equipment suffered from the transport. The 21m firn core will be the basis for a MSc study to quantify dust input into the McMurdo Sound and hereby has the potential to contribute directly to the ANDRILL science effort.

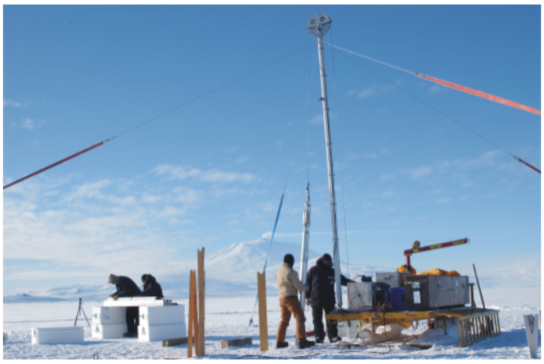


Fig. 1: Test drilling at Windless Bight

- *Delays at Scott Base, whatever the cause*

All staff at Scott Base were very helpful and supportive, allowing a smooth operation of our project. However, three independent breakdowns of Hugglands delayed somewhat our test drilling and traverse to EPG. Due to unsuitable weather conditions at MES, field deployment was deferred for one day.

- *Safety and Risk Management processes*

The safety and risk assessment was appreciated.

- *General comments about Scott Base*

  The staff at Scott Base create a very friendly, supportive environment. We are grateful for the helpful and professional support we received from Scott Base staff.

FIELD TRANSPORT

- *Vehicles*

  For our test drilling at Windless Bight we used H3 and one Huggland sledge. The test drilling had to be deferred by two days, as H3 had mechanical issues, while the other two were committed to other work. However, once repaired H3 performed well for the test drilling. For our field deployment to Evans Piedmont Glacier we traversed with two Hugglands and three Huggland sledges to Cape Roberts via Marble Point. Unfortunately, on the first day of the traverse, H1 broke down at the sea-ice transition and had to be town back to SB (Fig.2A). For this reason we were given H26 the next day, and set off for our traverse. Despite its age it performed better than H1 or H3 and had a higher sledge pulling capacity. We felt that the petrol driven Huggland was superior over the two diesel vehicles. Between SB and Marble Point H3 lost antifreeze liquid. No leak could be found. After discussions with the SB mechanic, he was flown to Marble Point, where he joint us for the remaining traverse. The problem was not fixable in the field, but re-supply of antifreeze liquid allowed the traverse to continue.

Fig.2: A) Broken Huggland is town back, B) sledges remain at the sea ice, C) two of the three Huggland sledges packed for the traverse, D) on the traverse from SB to EPG

- *Aircraft Operations*
- All aircraft operations were performed professionally. We are especially grateful for the support of the Twin Otters. This was a good test for our proposed deep field deployments and verified, that all our equipment was moveable by Twin Otter. The pilots were professional, supportive, practical and very good to work with. The capacity of Twin Otters in regard to volume and weight was advantageous to move our field camps and ice core boxes swiftly and efficiently. Their ability to land and take off in difficult terrain and weather makes them a very desirable means of transport for operation like ours. We are also particular grateful for the support of HNO, Rob and Brent, and also their US colleagues. Difficult cargo, such as heavy, bulky drilling equipment and fuel barrels was handled in a very professional and safe manner. None of our loads got damaged or lost.

Date	Location	PAX	Total Weight (lbs)
28 Oct	5x Twin Otter loads, CR to EPG	5	12,000
08 Nov	2x212 (US and HNO) helo loads, EPG to SB (ice core retro)	0	3,000
15 Nov	2x Twin Otter loads, EPG to SB (ice core retro and cargo)	0	5,000
16 Nov	1x Twin Otter load, EPG to CR	2	1,200
16 Nov	1x Twin Otter load, EPG to SB	0	4,000
16 Nov	1x US 212, EPG to VLG	3	1,750
20 Nov	1x HNO, VLG to SB	3	1,800
24 Nov	3x Twin Otter loads, SB to MES	6	10,500
24 Nov	1x HNO underslung, SB to MES	0	1,500
28 Nov	1x HNO, resupply, SB to MES	0	50
29 Nov	1x A-Star, evacuate Bayliss	1	250
04 Dec	1x HNO, SB to MES	1	1,000
04 Dec	1x HNO, MES to SB	1	1,800
07 Dec	1x HNO, MES to SB (ice core retro)	0	1,800
10 Dec	3x Twin Otter loads, MES to SB	6	10,000

SB = Scott Base, CR = Cape Roberts, VLG = Victoria Lower Glacier, EPG = Evans Piedmont Glacier, MES = Mt. Erebus Saddle

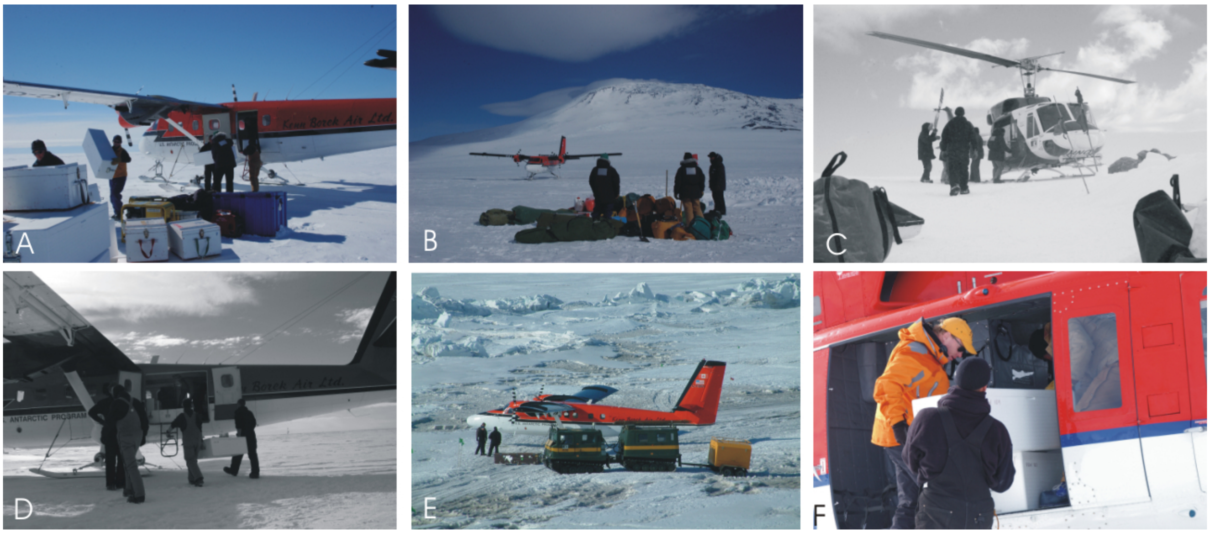


Fig. 3: A) Deployment at EPG, B) Pick-up at MES, C) ice core retro from MES, D) ice core retro from EPG, E) ice core and cargo retro to SB, F) ice core retro from EPG

*EVENT DIARY

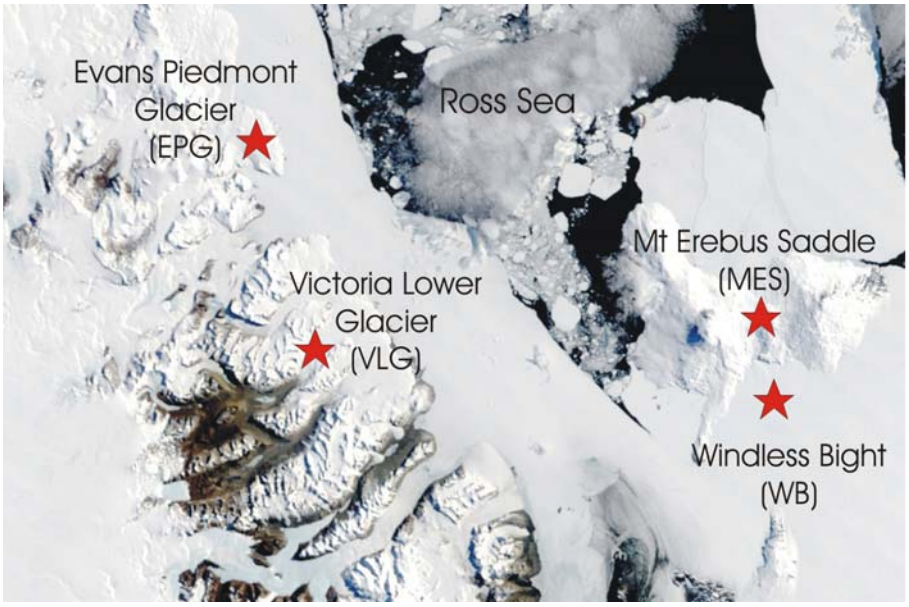
Date	Main Activities and Location	Other Comments
18 Oct	Arrival at Scott Base	
19 Oct	Full AFT training for Kingan, Kipfstuhl, Bayliss, refresher AFT for Bertler and Pyne Equipment shake-down and field preparation	
20 Oct	Equipment shake-down and field preparation	
21 Oct	Attempt test drilling at Windless Bight aborted due to mechanical problems of Huggland Loading the three Huggland slegdes	

22 Oct	Continuing field preparation and loading of three Huggland sledges In the afternoon, Huggland is repaired and the drill is set-up at Windless Bight	
23 Oct	Successful test drilling at Windless Bight, recovery of 21m core	See Fig.1
24 Oct	Attempt to traverse to Marble Point with two Hugglands and three sledges aborted due to mechanical problems	See Fig.2
25 Oct	Bertler, Pyne, Kingan, Kipfstuhl, Bayliss, McBearty, and "Doug" traverse to Marble Point Scott joins K049 at Marble Piont via helo to repair Huggland and continues to accompany the group to Cape Roberts	See Fig.2 Weather conditions are good, H3 looses vast quantities of antifreeze
26 Oct	Bertler, Pyne, Kingan, Kipfstuhl, Bayliss, McBearty, and "Doug" traverse to Cape Roberts	Weather conditions deteriorate, low visibility less than 100m, blowing snow (Fig.2)
27 Oct	Bertler, Pyne, Kingan, Kipfstuhl, Bayliss, McBearty, and "Doug" wait at Cape Roberts	
28 Oct	Bertler, Pyne, Kingan, Kipfstuhl, Bayliss deploy to Evans Piedmont Glacier with two Twin Otters (total of 5 shuttles from Cape Roberts) Camp set-up	
29 Oct	Drilling preparation, excavating drill pit	See Fig. 7, 8, and 9
30 Oct	Completion of drill pit preparation, start of high resolution snow pit sampling of 4m deep pit at the drill site	
31 Oct	High resolution snow pit sampling, deployment of meteorological station, preparation of second 4m snow pit for geographical variability	
01 Nov	Completion of high resolution snow pit sampling, deployment of mass balance devices (coffee-cans). Completion of two further snow pits (3 and 4m deep respectively) for snow density and stratigraphy measurements	
02 Nov	Set-up of drill and recovery of 10m core	
03 Nov–12 Nov	Recovery of 180m deep ice core, continuing mass balance measurements, and weather station wiring and programming	See Fig. 9
08 Nov	Pick-up of two 212 helicopter (US & HNO) loads of ice core boxes (total of 22 boxes). Boxes were transferred to Crary Ice Core Freezer at MCM	Visit by Keith Springer
13 Nov	Dissembling of drilling system and light penetration measurement in the drill hole.	
14 Nov	Borehole temperature measurement, preparation of cargo shipment	
15 Nov	Two Twin Otter pick-up of ice core boxes to Crary Ice Core Freezer and retro cargo to Scott Base Completion of mass balance measurement and weather station programming	
16 Nov	Pyne and Kingan transfer to K042 moving to Cape Roberts via Twin Otter where they meet up with Cavanagh Twin Otter transports on load of retro cargo to SB Bertler, Kipfstuhl, and Bayliss more to Victoria Lower	See Fig.3

	Glacier with US 212 helo Camp set-up at Victoria Lower Glacier	
17 Nov	Bertler, Kipfstuhl, Bayliss – set-up of base station at Staeffler Ridge (2km from camp) in the afternoon after white-out partially cleared. Snow mounts in 20m intervals were used for track marking. Transport via skies and pulk. Initiation of mass balance measurement	See Fig. 5
18 Nov	Check on base station at Staeffler Ridge, continuation of mass balance measurement, high resolution snow pit sampling at former drill site.	
19 Nov	Check on base station at Staeffler Ridge, initiation of mass balance measurement at second location at VIC II (3km away from camp), completion of high resolution snow pit sampling. Investigation of second 3m deep snow pit for geographical variability in snow stratigraphy, density, and temperature	
20 Nov	Completion of investigation of second snow pit. Bertler, Kipfstuhl, Bayliss move to SB with HNO (1 load). Ice core box is transferred to Crary Ice Core Freezer	
21 Nov–22 Nov	Bertler, Pyne, Kingan, Kipfstuhl, Bayliss, Cavanagh - field preparation at Scott Base for deployment to Mt Erebus Saddle	
23 Nov	Deployment to Mt Erebus Saddle deferred because of bad weather at destination	
24 Nov	Bertler, Pyne, Kingan, Kipfstuhl, Bayliss, Cavanagh move to Mt Erebus Saddle with 3 Twin Otter loads and one HNO underslung load Camp set-up and secure cargo	See Fig. 3
25 Nov	Drilling preparation, excavating drill pit. Slow progress due very dense snow, high winds (~35knots) and blowing snow.	See Fig.7 and 9
26 Nov	Completion of drill pit, start of high resolution snow sampling at the drill site, continue preparation of drill pit	
27 Nov	Completion of high resolution snow sampling, completion of preparation of drill pit. Commencement of drilling operation	
28 Nov	Continuation of drilling operation. HNO drops off electric chains saw to cut ice core box storage in drill pit Bayliss suffers work painful accident injuring a finger, first aid is applied	See Fig. 7
29 Nov	Continuation of drilling operation. Bayliss's condition is not improving with increasing swelling and pain. As weather situation deteriorates we request pick-up of Bayliss. Bayliss is moved to SB and MCM hospital via PSA A-Star.	Planned visit of Minister Geoff and media was deferred due to deteriorating weather conditions at Mt Erebus Saddle.
30 Nov–02 Dec	Due to bad weather conditions all activities are aborted, with the exception of necessary camp maintenance, such as snow cover relief and secure cargo.	See Fig.6
03 Dec	Continuation of drilling operation with new time	

	schedule, starting at 5am	
04 Dec	Pyne moves to SB and Bayliss returns to Mt Erebus Saddle with HNO. Retro of ice core boxes to Crary Ice Core Freezer. Re-supply of polar tents for generator and toilet Continuation of drilling operation.	
05 Dec	Continuation of drilling operation.	
06 Dec	Continuation of drilling operation.	
07 Dec	Continuation of drilling operation Pick-up of ice core boxes by HNO Pyne return to NZ	
08 Dec	Completion of drilling operation. Achieved depth 200m	
09 Dec	Down-hole light and temperature measurement, dissembling drilling system, packing cargo	
10 Dec	Bertler, Kingan, Kipfstuhl, Bayliss, Cavanagh move to SB, pick-up by Twin Otter (3 loads)	As ice run way has been closed for the season, the Twin Otter lands on the sea ice in front of SB to minimise travel distance of ice core boxes and cargo.
11 Dec–14 Dec	Preparation of cargo shipment and return of SB equipment	
13 Dec	Kingan transfers to warm store construction crew	
15 Dec	Bertler, Kipfstuhl, Bayliss, Cavanagh return to NZ	
19 Dec	Kingan returns to NZ	

EVENT MAP



*WEATHER

Evans Piedmont Glacier (EPG, 25 Oct to 16 Nov)

Deteriorating weather conditions during the traverse from Marble Point EPG made GPS navigating necessary, due to low visibility, high winds, blowing snow and poor surface definition. At EPG weather conditions were good and we did not loose working days due to weather. Temperatures ranged from about -28ºC to –12ºC. The rising temperatures during early November, increasing sharply the gradient between air and borehole temperature, posed a threat of freezing in the drilling equipment. A weather station was deployed at EPG for the next 2 years. The data will be made available once recovered.

Fig. 4: A) Traverse from Marble Point to Cape Roberts; B) camp at EPG

Victoria Lower Glacier (VLG, 16 Nov to 20 Nov)

At VLG low clouds caused frequently white-out conditions especially in the afternoon during on-shore winds. Since we were working 2-3km away from the camp, we used GPS navigation and snow mounts to return to camp. In tandem these methods worked very well. Temperatures were unusually warm and reached OºC.

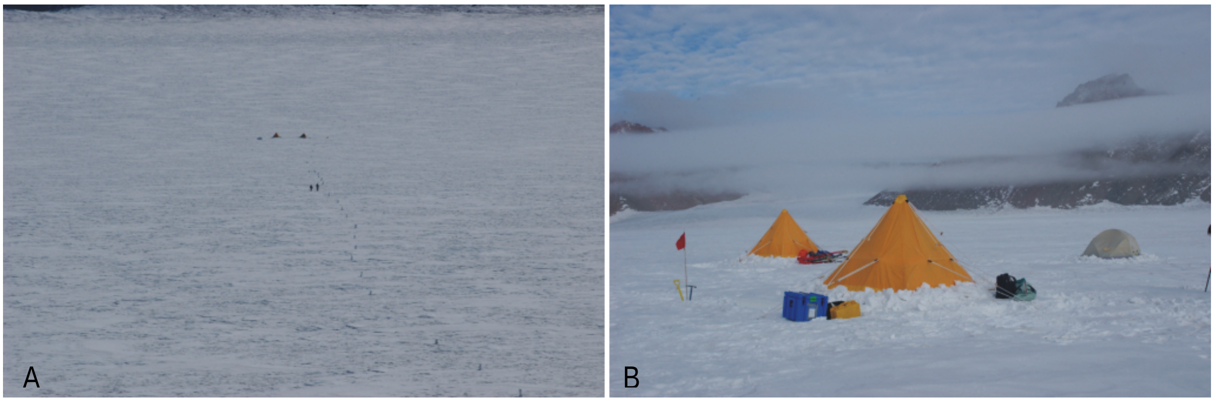


Fig. 5: A) Snow mounts between Staeffler Ridge and VLG camp; B) low clouds moving in.

Mt Erebus Saddle (MES, 24 Nov to 10 Dec)

Weather at MES was characterised by constant strong winds averaging 20knots, exceeding 50knots multiple times. The blowing snow caused havoc especially for generators and tents. The resupply of a polar tent for the generators and a toilet tent proofed essential to work in those conditions. While before we lost 3days due to weather, we were able to work on all subsequent days. Snow walls were not sufficient, especially due to slight changes in wind direction. Large snow drifts moved within few hours. Temperatures ranged from about -25ºC to -8ºC. The dense snow at MES did not allow excavating an adequate ice core storage. The unusual warm temperatures at the final phase of the drilling operation posed a challenge for the drilling and core storage. We are particular grateful for the fast pick-up of ice core boxes.

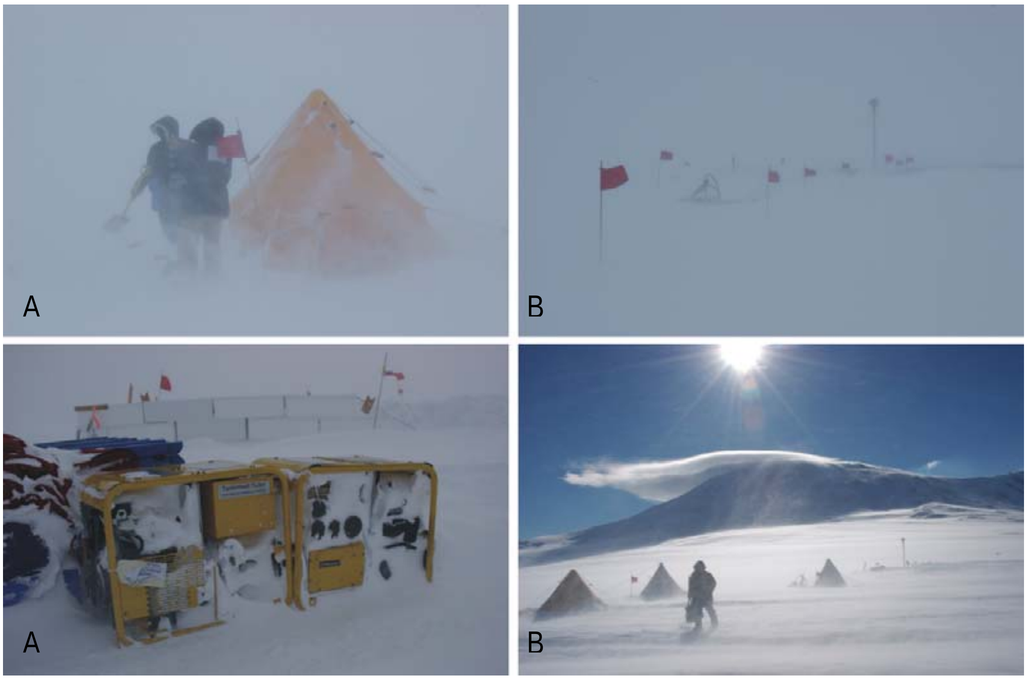


Fig.6: a) camp maintenance – removal of snow, b) flagged route between camp and drill site, c) blowing snow freezing on the drilling generators, d) a good working day

*ACCIDENTS, INCIDENTS OR HAZARDS

Accident

During the 2004/05 field season we moved more than 80 t of snow by manual labour for the drilling pits alone. While good working procedure avoided strains on backs etc., an insufficiently repaired shovel provided by SB caused an injury to the right-hand middle finger of Bayliss (Fig.7). The handle of the shovel had been fixed to the shovel rod with aluminium wire nails. When the wire nails broke while pushing forcefully down into rather dense snow, Bayliss' hand became trapped between the handle and the shovel rod. First aid was provided immediately and the blood blister underneath the fingernail was relieved by burning two holes into the nail. Despite Bayliss' intake of codeine painkillers the pain remained for the next 12 hours and the swelling increased. After discussions with the SB nurse, Bayliss was evacuated on 29 Nov and brought to MCM hospital. He received treatment and was able to come back into the field on 04 Dec. However, he was not able to use his right hand until we returned to NZ on 14 Dec. We are grateful for the quick and professional response by Scott Base staff to this situation.

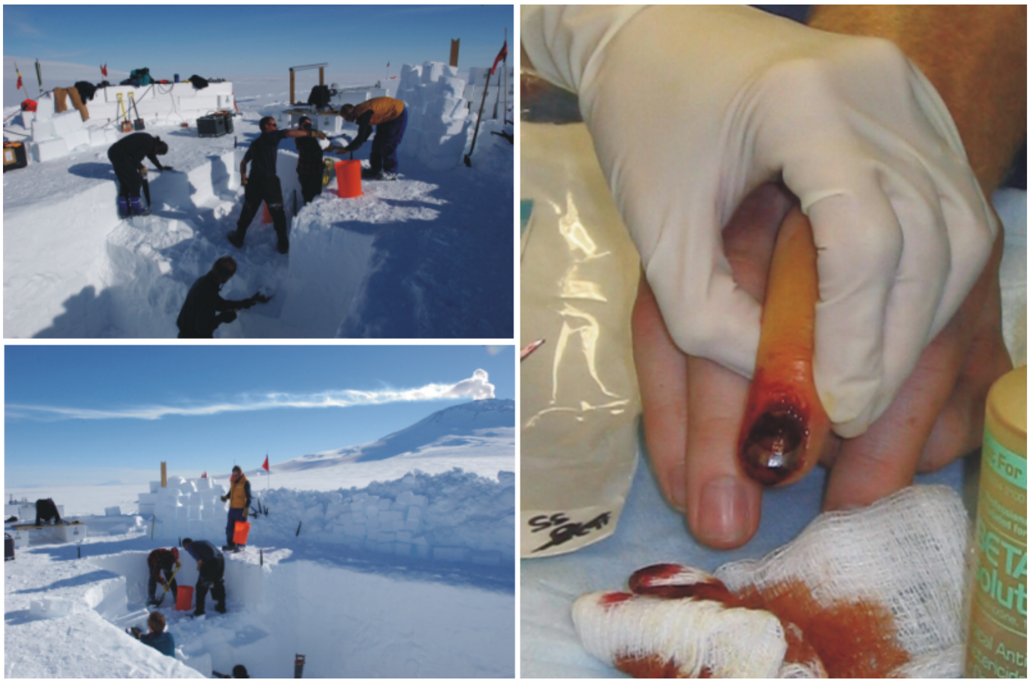


Fig.7 A) and B) excavating drilling pit at MES, C) injured finger of Bayliss

Avoided hazards:

Snow stairs: In previous years we cut stairs into the snow without further fortification, which proofed a hazard when carrying heavy equipment, such as full ice core boxes. For this reason we experimented this year with aluminium angles (Fig.8). These are anchored by about 15-20cm and protect the edge of the step. They are relatively light weight and performed extremely well.

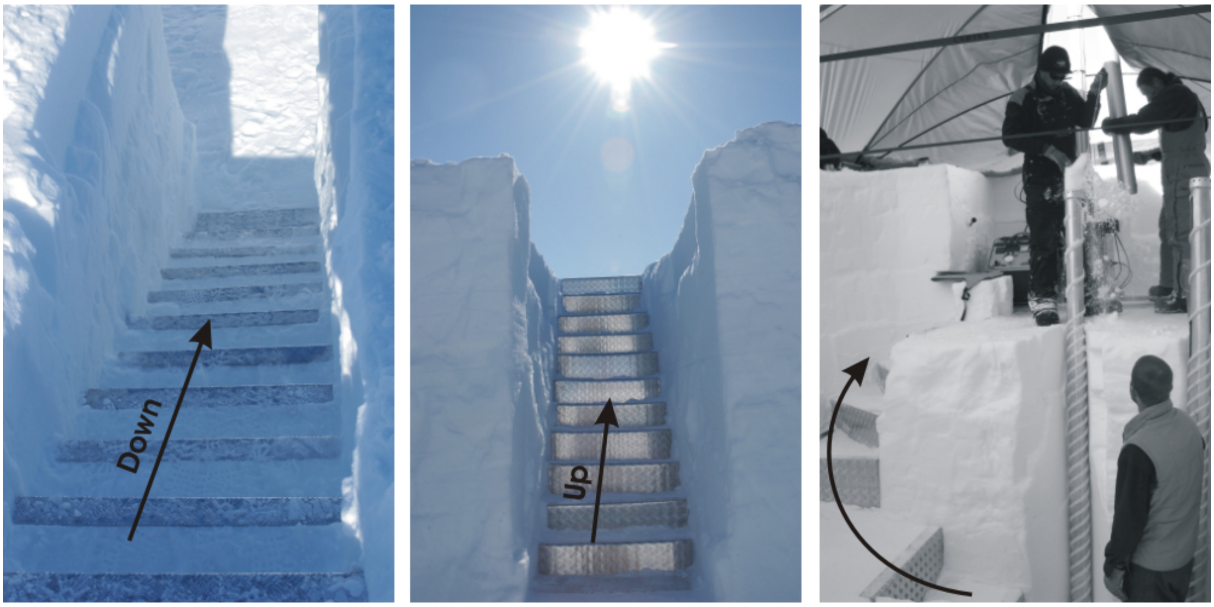


Fig.8 Aluminium stairs in the drilling pit.

Drilling Tent: This year we used for the first time a new tent designed by Pyne (Fig.9) to protect not only the core processing pit, but also the drilling crew. This was essential for windy conditions as we expected and experienced especially at Mt Erebus Saddle. The tent performed extremely well, even in 50+knots of wind and blowing snow. The tent only stands 1.5m above the ground, with a 3-4m deep pit underneath. The tent rods are aluminium-titanium alloy. Snow walls were not sufficient to protect the tent from blowing snow at Mt Erebus Saddle, instead a 2m high x 10m long wall out of heavy cargo was established to reduce the amount of wind stress and snow accumulation.

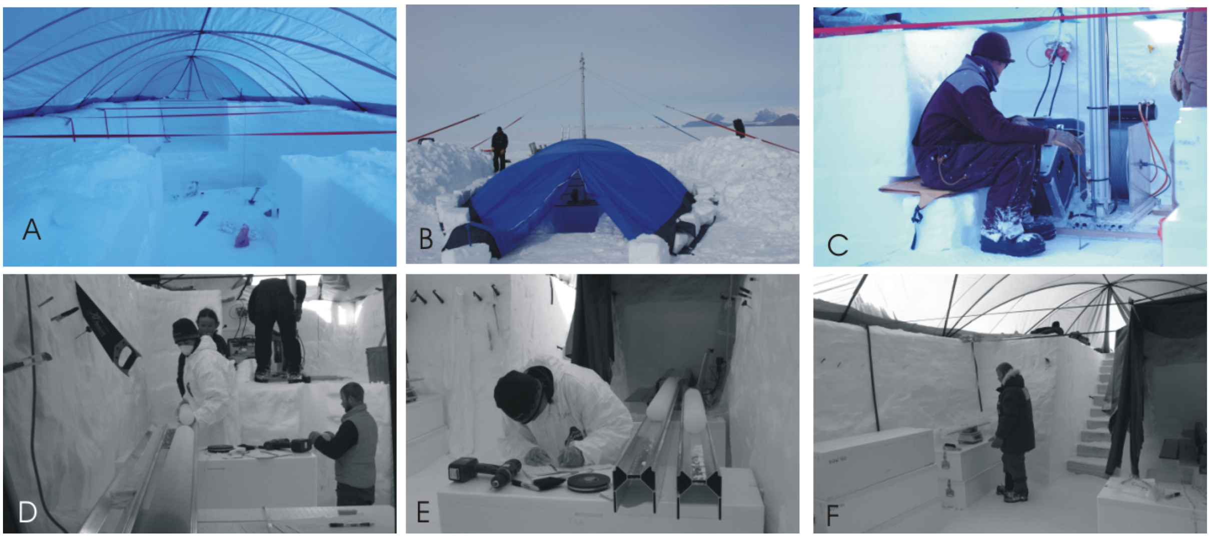


Fig.9 A) empty drilling tent, B) drilling tent from outside with drill mast, C) Drill platform (1.2m deep below surface), D) processing floor (2.2m below surface) and drill handling platform (3.5m below surface), E) core processing space, F) core processing and storage place

FIELD EQUIPMENT

- *Quality, suitability and performance of field clothing*

Clothing

The new Canadian goose down blue/black jackets were used by K049 members. The jackets are warm but blowing snow is easily trapped in the zip and Velcro pockets and the artificial fur ruff causing parts of the jackets to freeze solid in the limited warm/drying conditions of the field camp. The outer jacket material is also rough and does not shed snow well. Natural fur would have been a better option for the hood and the pocket closures should be improved for future purchases.

Fig.10: Challenges on Antarctic field clothing

We used both Carhart insulated jackets and bib overalls and the ECW salopetts. The Carhart bibs are significantly warmer than the ECW's but the zips and closures pack blown snow freezing the garmets and making them difficult to dry. A long leg zip option for the bibs was easier to get into with boots on but trapped more snow and was colder in strong winds. The Carhart cotton Duck and ECW outer materials do not shed snow well, get wet and are difficult to dry in the field. The Carhart and Canadian Goose Jackets come only in medium sizes and larger.

Furthermore, there are no women Carhart bibs. It would good, if a few smaller sizes and possibly women Carharts could be purchased

Overall, the Carhart garmets and the ECW's are not very satisfactory active field clothing in locations subject to blowing snow, strong winds and cold conditions. Field camps have limited warm and drying conditions for clothing.

Recommendation:

- Antarctica NZ should investigate active field clothing that is warmer than the standard ECW's, sheds snow and is semi waterproof for some filed parties working in cold glacial locations.

Boots

Muckluks were commonly used by K049 members often with "Sorel felt' liners. These were the warmest boots available but at times were cold and also froze with blowing snow and limited drying conditions. A "drillers boot" was also trailed with a protected toe and is bulky for the foot size. This boot was colder than the mukluks, regularly required toe warmers in temperatures above –20°C and became very stiff when cold and was difficult to put on even though the boot is a "large fit". This boot would be better in a larger field camp with better drying and warming conditions.

- *Performance and design of tents, technical climbing equipment, kitchen gear and sledges*

Fig.11: Polarhaven at Mt Erebus Saddle

The 12 ft by 8ft Polarhaven framed tent was used at both the Evans Piedmont Glacier and the Mt Erebus Saddle sites (Fig.11). It was heated with a flued SIGMA stove burning kerosene (consumption approx.10 l/day) and was used for cooking, messing and operating and maintaining equipment including lap top computers. The tent is a very useful size for helicopter and small fixed wing aircraft (Twin Otter) transport and suitable for parties up to 6 personnel. The tent remained secure on Erebus saddle in winds estimated to be over 50 knots but is over 10 years old and should be replaced for remote location use. The insulation sandwiched between the walls has broken down in several places so that the heat cannot be retained in winds above 35 knots and the main door zips have become worn through normal use and have now failed in the cold with snow and ice build-up. The entrance door had to be sewed shut.

Recommendations:

- This tent should be replaced for use at remote and robust sites and a cold porch entrance considered.
- An exit for a flued heater like that on the existing tent is required.
- -An insulated floor that is aircraft friendly is required. This could be a soft folding pocketed floor that accepts high-density closed cell foam panels about 4'x3' and 1" thick.

Since 2000 both K049 and K047 have had up to 5-7 personnel supported from aircraft portable field camps for drilling and other scientific activities. The small (12'x8') Polarhaven has provided a major contribution to the success of the field support and was used as a kitchen/mess and laboratory. Some new equipment is suggested to improve the support of 5-7 person groups in this type of field camp.

- Portable camp kitchen (box) for 7 people, including sink and bench surface.
- Two burner LPG burner or preferably two burner/oven combination.
- Kerosene heater (SIGMA). Previously supplied by VUW.

One Planet polar tent. This tent was used on Erebus saddle (Fig.12) and performed well in high snowfall conditions and winds of at least 50 knots where it remained stable. We initially considered that the fixed tent floor could be dangerous and lock in the inmates if the tent blew away in extreme weather but this was less of a concern as we became more confident of the tent and the open vestibule floor reduces this risk. The tent was pitched with the vestibule down-wind so that the entrance was partially side to the wind where it remained relatively free of snow. The tent with the vestibule is more complicated to put up than the standard polar tent and is probably better suited for longer-term camps rather than overnight. In comparison to the standard tent the lighter nylon inner probably make the tent warmer in sunny conditions but it will also be more difficult to erect in windy conditions. We did not cook in this tent and the vestibule was used to store personnel kit, wet/frozen clothing and boots. We are undecided if cooking should be done in the main tent or in the vestibule which could be a less safe option as the primus would be in the way of the exit and the tent ceiling is lower.

Recommendations:

- A separate cut floor is required for the vestibule.
- An emergency knife should be part of the tent kit.
- The tent bag should be made big enough to accommodate the inner wall in the attached position and the extra poles.
- Bungee cord in the poles like the standard folding polar tents may be an advantage.
- The door material is very stiff in temperatures below -10°C and the plastic extremely difficult to use. A more flexible door material, additional Velcro incorporated with the buckles and a Velcro closure like the standard tents should be considered.

Fig.12: One Planet Polar Tent at Mt Erebus Saddle.

Sleeping bags: Then new single mummy style Polar sleeping bags with fleece inners were used by some members of K049. We found the bags were unsuitable in temperatures below –15°C when using the old mattresses that included the closed cell foam insert. On Mt Erebus the performance of the bags was satisfactory with the addition of a separate old style polar outer bag and a thin foil mattress on the standard mattress.

Recommendations:

- A warmer and larger bag than the new Polar bag is required for the early season, high altitude locations and larger people.
- Many of the old mattresses should be replaced. A new mattress or combination should include an insulating/waterproof closed cell layer, a comfort layer 2” thick and a heat reflective layer.

- *20 person day ration box system*

  The new food boxes were well packed in terms of quantity and nutrition and were favourably received by all members. The addition of savoury snack food and new innovative extras, such as bagged tuna and couscous was very much appreciated. The provision of bulk food supply for medium sized field parties still has scope for improvement and development.

RADIO COMMUNICATIONS

- *Suitability and effectiveness of the radio equipment*

  VHF radios were used at Evans Piedmont Glacier, Lower Victoria Glacier and Mt Erebus saddle. Transport and management of VHF radio and their accessories could be improved by providing a easily identified radio bag or case to carry and protect VHF radios, spare batteries, chargers and solar panels.

- *Reception/transmission conditions and suitability of radio schedule timing*

  A high gain aerial was required at EPG and MES locations. We noted that communications at EPG on channel 3 and 5 were poorer than the previous season at a very similar location when a hand held without high gain aerial was reliable. The timing of the radio schedule convenient

- *Scott Base's general efficiency during radio schedule*

  Radio communication was efficient, professional, and appreciated

COMPUTER FACILITIES

- *Suitability and effectiveness of computer network*

  The computer network met our needs satisfactorily. A possibility to connect laptops to the Scott Base external net connection would be highly appreciated, especially during prolonged delays at Scott Base.

- *Quality, suitability and performance of public computers*

  The quality and suitability of public computers was sufficient and appreciated, albeit somewhat busy.

*ENVIRONMENTAL IMPACT

*Sites Visited

*Sites Visited

Site name	Evans Piedmont Glacier
Site location (coordinates/description)	77°43.542' S, 162°34.836' E, glacier surface
Dates occupied	28 Oct 2004 to 16 Nov 2004
Total days (or hours) at site	20 days
Maximum number of people at site	5
Total person-days (or person-hours) at site	100
Main activity undertaken	Ice core drilling, high resolution snow pit sampling, installation of weather station and deployment of mass balance device

Geological Material

Location	77°43.542' S, 162°34.836' E
Specimen type	Ice cores and snow samples
Quantity (kg)	5000 lbs

Equipment installed/left in field

Type of equipment/marker installed	Weather station and submergence velocity device for mass balance measurement (Fig.13)
Location of installation left in field	77°43.533' S, 162°35.294' E
Size of items left in field	2x3m stainless tube, 3m mast, battery, solar panel, wire guides (weather station) 2x3m stainless tube (submergence velocity device)
Number of items left in field	3
Date of intended retrieval	Weather station in 2006, submergence velocity device - end of project

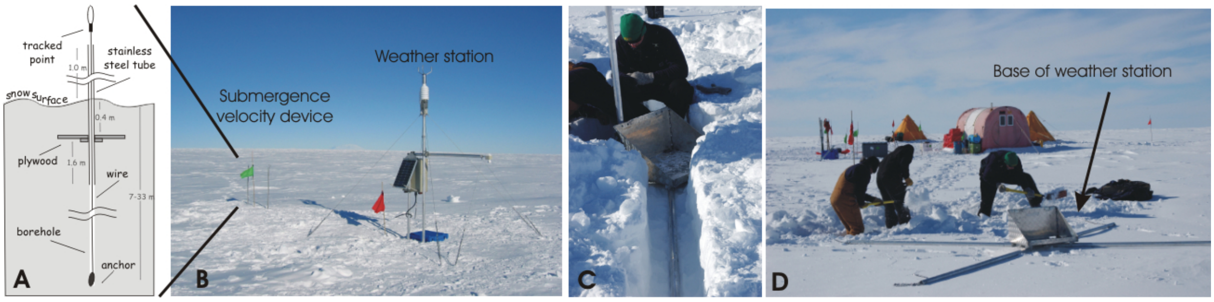


Fig. 13: A) Schematic figure of submergence velocity device, B) submergence velocity device and weather station at EPG, C) base and battery seat for the weather station dug in, D) dimension of weather station base.

An automatic weather station has been established near the 2004/2005 ice coring site that will record several parameters to help characterise the snow accumulation regime of the local glacier area (Fig.8B).

Parameters measured as of 15 November 2004 are:

- Air Temperature at 2.5 height
- Snow accumulation, and air temperature at 1.5 m height
- Dew point temperature at 2.5 m height
- Solar radiation (incoming) at 2.5 m height
- Snow temperatures (thermistor resistance) from 0.5 to 2.5 m depth in at 12 cm intervals

Barometric pressure and wind speed/direction (ultrasonic) sensors are installed but were inoperative when the party left on 16 November.

The installation is expected to operate throughout the upcoming winter. The data will be downloaded from the site in 2005/06 and the installation maintained and the non operational sensors incorporated into the recording program.

*Other environmental impacts

Exhaust fumes from generators

*Differences from original Preliminary Environmental Evaluation (PEE)

None

*Sites Visited

Site name	Mt Erebus Saddle
Site location (coordinates/description)	77° 30.90’ S, 167°40.59’ E
Dates occupied	24 Nov to 10 Dec 2004
Total days (or hours) at site	17
Maximum number of people at site	5/6
Total person-days (or person-hours) at site	101
Main activity undertaken	Ice core drilling, high resolution snow pit sampling, casing of the borehole

*Other environmental impacts

Exhaust fumes from generators

*Differences from original Preliminary Environmental Evaluation (PEE)

In-situ investigation of crystal structure and stratigraphy during the drilling suggests that the ice at MES – although only 210m deep – might be as old as 200,000 years. This was unexpected but make the site scientifically exceptionally interesting. For this reason we requested to case the borehole, so that if our assumption proves to be correct, further sensitive borehole temperature measurements can be performed. The casing consists of a plastic bucket, which is has been dug 30cm into the borehole and anchored with two 2m long stainless steel rods, placed in a horizontal cross through the bucket. The vertical 3m long stainless steel rod has been frozen into the bucket and is kept in place by three rope guides. The structure was filled in with snow almost immediately, hence the lack of a close up picture.

The structure is easily removable to allow access to the borehole and will be removed once the measurements have been conducted within the next 3 years.

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Fig. 14: Borehole casing at MES

*Sites Visited

Site name	Victoria Lower Glacier
Site location (coordinates/description)	77°43.7’ S, 162°33.7’ E, glacier surface
Dates occupied	16 Nov 2004 – 20 Nov 2004
Total days (or hours) at site	5 days
Maximum number of people at site	3
Total person-days (or person-hours) at site	16
Main activity undertaken	Mass balance measurement and high resolution snow sampling

*Other environmental impacts

None

*Differences from original Preliminary Environmental Evaluation (PEE)

None

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K049
2004/05

IMMEDIATE SCIENCE REPORT

K049 NZ ITASE – Holocene Climate Variability along the Victoria Land Coast
ANTARCTICA NEW ZEALAND 2004/05

Event Personnel :

Dr. Nancy Bertler	Antarctic Research Centre, Victoria University
Mr. Alex Pyne	Antarctic Research Centre, Victoria University
Mr. Tony Kingan	Webster Drilling and Exploration Limited
Dr. Sepp Kipfstuhl	Alfred Wegener Institute, Germany
Mr. Daniel Bayliss	School of Physics, Victoria University
Mr. Mike Cavanagh	School of Earth Sciences, Victoria University

1 Popular Summary of Scientific Work Achieved

Unprecedented changes are occurring in the Earth's climate. The 1990's were the warmest decade in the last 2000 years and average global temperature is projected to rise between 1.4ºC and 5.8ºC by 2100 [*IPCC*, 2001]. Although the scientific evidence of global warming is now widely regarded as incontrovertible, predicting regional impacts is proving more problematic. Especially, conclusions of the Southern Hemisphere record are limited by the sparseness of available proxy data at present [*Mann and Jones*, 2003].

While meteorological records from instrumental and remote sensing data available display the large intercontinental climate variability, the data series are insufficient to infer trends or to understand the forcing, which renders prediction difficult [*Jones et al.*, 1999; *Mann and Jones*, 2003]. The long ice core records from the Antarctic interior and Greenland revolutionised our understanding of global climate and showed for the first time the occurrence of RCE (Rapid Climate Change Events) (for review e.g. Mayweski and White [2002]). To understand the drivers and consequences of climate change on timescales important to us humans, a new focus of ice core work is now moving to the acquisition of 'local' ice cores that overlap with and extend the instrumental records of the last 40 years back over the last several thousand years.

This has been a key motivation behind the US-led International Transantarctic Scientific Expedition (ITASE) of which New Zealand is a member. The NZ ITASE objective is to recover a series of ice cores from glaciers along a 14 degree latitudinal transect of the climatically sensitive Victoria Land coastline to establish the drivers and feedback mechanism of the Ross Sea climate variability [*Bertler et al.*, 2004; *Bertler and 54 others*, in press; *Bertler et al.*, in press-a; *Bertler et al.*, in press-b; *Mayewski et al.*, in press; *Patterson et al.*, in press]. Furthermore, the ice core records will provide a baseline for climate change in the region that will contribute to the NZ-led multinational Latitudinal Gradient Project as well as providing a reference record for the NZ-led ANDRILL objective to obtain a high-resolution sedimentary archive of Ross Ice Shelf stability.

During the 2004/05 field season one shallow and two intermediate length ice cores (21m, 180m and 200m) have been recovered from Windless Bight, Evans Piedmont Glacier, and Mt Erebus Saddle, respectively. The drilling activity was complemented by in-situ measurements of crystal morphology, density, and borehole temperature. High resolution snow samples were collected at Evans Piedmont Glacier and Mt Erebus Saddle. A weather station was installed at Evans Piedmont Glacier for a 2 year deployment. Furthermore, Victoria Lower Glacier, the first ice core site of this programme has been revisited to maintain the longer-term mass balance measurement time series, which commenced in 1999.

2 Proposed Programme

Seven key locations were identified for the NZ ITASE (International Transantarctic Scientific Expedition) programme. The analyses on the ice core from the first site, Victoria Lower Glacier in the McMurdo Dry Valleys, have almost been completed. For the 2004/05 field season we proposed to recover intermediate length cores from sites 2 and 3: Evans Piedmont Glacier and Mt Erebus Saddle. Additionally we recover a shallow 21m core from Windless Bight. Furthermore we continued our longer-term mass balance measurement time series at Victoria Lower Glacier.

Evans Piedmont Glacier Ice Core Record

To our knowledge the Evans Piedmont Glacier site is, with 380m asl, the lowest elevation site identified for drilling in Antarctica. As such it has the potential to provide a climate record with unprecedented sensitivity for tropospheric climate variability and hereby contributing directly to the discussion on the dominant driving force of Antarctic climate variability [*van den Broeke*, 2000; *Hall and Visbeck*, 2002; *Thompson and Solomon*, 2002; *Venegas*, 2003].

The Evans Piedmont Glacier is located in the vicinity of the proposed ANDRILL site in 'Granite Harbour', which is expected to provide also a Holocene record. The comparison of the overlap between the two records provides us with the unusual opportunity to distinguish between the terrestrial and marine signal. This will add significantly to the discussion on the relative importance of the Antarctic Circumpolar Wave (ACW, oceanic), Southern Annular Mode (SAM, atmospheric), and El Niño Southern Oscillation (ENSO, both); their forcing and feedback mechanism. Furthermore, the sub-annual to decadal ice core record from Evans Piedmont Glacier can help to tune the marine Granite Harbour record and potentially provides a record of the final retreat of the Ross/McMurdo Ice Shelf.

The regional climate record contained in the ice will provide background information for the Latitudinal Gradient Project site 'Granite Harbour', especially for temperature, precipitation, sea-ice extent, storminess, seasonality, and snow accumulation. As mentioned before, this will help to determine if the current ecological system found has evolved under prevailing climate, or how much time the ecological system had to adjust to potential climate change in the recent past.

In collaboration with the US ITASE effort (a traverse from South Pole to Northern Victoria Land along the plateau side of the Transantarctic Mountains) we aim to provide continentality and elevation gradients, to compliment to our understanding of deep ice core records from the Antarctic interior. Furthermore, the importance of katabatic winds and the intrusion frequency of marine airmasses into the Antarctic interior through time can be established.

Mt. Erebus Saddle Ice Core Record

Mt Erebus Saddle lies in the pathway of the ENSO initiated katabatic surges across the Ross Ice Shelf [*Cullather et al.*, 1996; *Bromwich et al.*, 2000] and also of enhanced cyclonic activity from the Southern Ocean [*Bertler et al.*, 2004]. Therefore, the ice core record from Mt Erebus Saddle is likely to show the strongest ENSO influence of all proposed sites. The ENSO record (Southern Oscillation Index) is short and various proxies have been tentatively proposed to reconstruct ENSO variability [*Adams et al.*, 2003; *Tudhope and Collins*, 2003]. The ice core record from Mt Erebus Saddle potentially provides a mean to reconstruct ENSO since its initiation in the early Holocene. Furthermore, the comparison between Mt Erebus and Mt Prior at Cape Hallett will provide a mean to distinguish ENSO driven climate variability from SAM and ACW forcing.

The semi-permanent Ross Ice Shelf polyna, just east of Ross Island, is also the result of these katabatic winds and is an important area for the production of sea-ice [*King and Turner*, 1997] and Antarctic Bottom Water [*Bromwich et al.*, 1993]. The Mt Erebus ice core is likely to provide a record of the winter polyna activity through time, via the marine fingerprint in the ice chemistry.

Moreover, the Mt Erebus Saddle is located in the vicinity of the proposed ANDRILL location 'Windless Bight'. The sub-annual to decadal ice core record provides a high resolution Holocene record for the much longer but overlaying ANDRILL ice shelf and marine record.

Additionally, the site is only 37km from Scott Base and McMurdo Station and will provide a long-term perspective on climate variability and iceberg discharge, relevant for both, Evans Piedmont Glacier and Mt Erebus sites.

3 Scientific Endeavours and Achievements

During the 2004/05 season we visited four sites: Windless Bight, Evans Piedmont Glacier, Victoria Lower Glacier, and Mount Erebus Saddle.

Windless Bight

To test our drilling equipment before deploying to Evans Piedmont Glacier, we conducted a test drill at Windless Bight (Fig.1). This is a convenient location, as it is close to Scott Base and also a future drill site of ANDRILL. The shakedown went well, none of the equipment suffered from the transport. The recovered 21m firn core will be the basis for a MSc study to quantify dust input into the McMurdo Sound and hereby has the potential to contribute directly to the ANDRILL science effort.

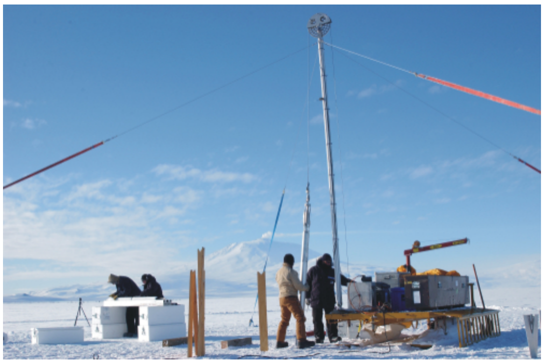

Fig. 1: Test drilling at Windless Bight

Ice core drilling at Evans Piedmont Glacier (EPG) and Mt Erebus Saddle (MES)

At EPG and MES 180m and 200m deep ice cores of excellent core quality were recovered. This was only possible due to the drilling expertise of Pyne, Kingan, and Kipfstuhl and high quality ice core drill of the German Alfred Wegener Insitute. Furthermore, the drilling tent designed by Pyne greatly improved drilling conditions and provided a clean room facility for core processing in the immediate vicinity of the drilling operation. This allowed the drilling crew to monitor directly changes in ice core properties and drilling performance and easy communication with the core processing team. Furthermore, it made the drilling operation largely weather independent.

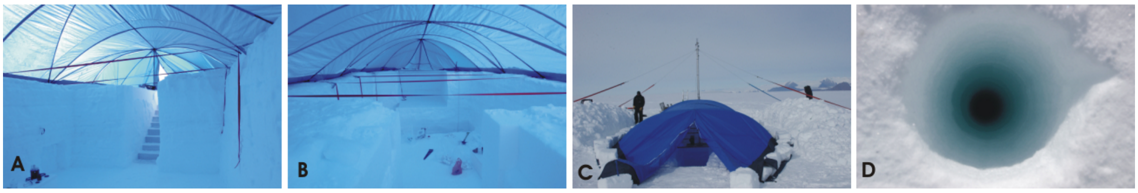

Fig.2 A) and B) inside the drilling tent, C) outside the drilling tent, D) 180m deep borehole

The daily core recovery at EPG averaged at about 18m, ranging from about 10m to 30m, decreasing with increasing depth due to longer travel times. Core quality between 0 and 120m is excellent. A brittle zone between 120m and 140m provided good core quality, while between 140m and 160m core quality was again excellent, and fair between 160m and 180m. At MES core recovery averaged 22m, ranging from 16m to 45m. Core quality with depth displayed similar pattern to EPG.

Fig.3: A) Core barrel loading, B) record of core quality, C) control panel, D) extracting cuttings, E) core barrel extracted from drill barrel, F) discharging cuttings, G) adjustment of cutters and core catchers, H) drilling discussions, I) drilling at 165.5m depth.

Above the firn-ice transition the recovered core consisted of snow and firn and therefore clean suits, facial masks, and thin polyethylene gloves are used by the core processing crew to avoid contamination during core handling (Fig.4a to 4c). Below the firn-ice transition, after gas bubble close off, the inner section of the core is protected from contamination, and more comfortable, warmer clothing can be worn (Fig.4d to 4e)

Fig.4: A) Firn core handling, B) firn core logging, C) core has been packed in layflat and is investigated over a light table, D) ice core fitting and marking, E) ice core logging, F) ice core packing in layflat and logged on light table.

Once the core is extruded from the core barrel (Fig.4A), the piece is fitted to the previous run (Fig.4D) and the recovery is measured and logged (Fig.4E, B). The core is then cut into 1m long sequences (Fig.5A). Before the pieces are sawed, a 2mm hole is drilled at the meter mark and the core temperature is measured (Fig.5B). This measurement has to be done within 5min of core recovery, as ambient temperatures in the drilling tent can influence core temperature. Therefore, temperature is only measured if the core could be processed within 5min. The temperature is a direct measurement of glacier temperature and reflects in the upper 10m seasonal temperature fluctuations, at around 10m, average annual temperature, and below 15m the signal is a memory of major past temperature fluctuations, such as the Last Glacial Maximum. Temperature at EPG remained relatively stable below 10m, indicating that the record represents the Holocene. However, the MES record showed an unusually high increase of temperature with depth, which is likely be caused by the geothermal gradient from the active volcano Mt Erebus. The temperature increase was about 2K over 100m.

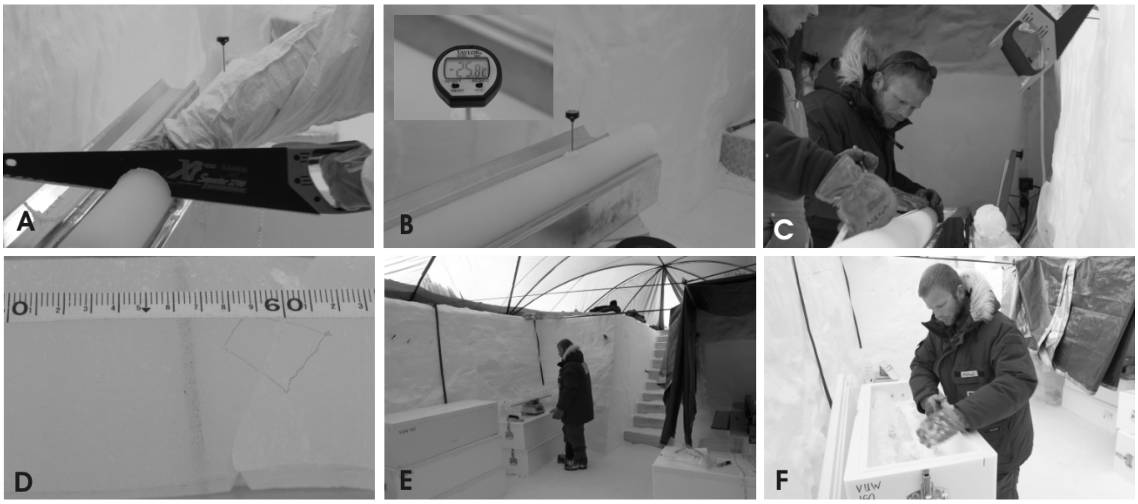

Fig.5: A) core sectioning to 1m length, B) core temperature measurement, C) core packing and logging, D) visible layer, E) core weighing for density measurements, F) core storage of six 1m long core in ice core boxes, packed with cuttings

The core then was packed in layflat and investigated on the light table for crystal structure, melt and dust/tephra layer occurrence (Fig.5D). At EPG several coarse grained dust layers are observed, evidence of large katabatic storms. Analyses of volume, grain size, and mineralogy will allow us to determine source region in the Transantarctic Mountains and to infer circulation patter and wind strength through time. At MES a total of six visible layers are observed (Fig. 5D). These are potentially tephra layers from pervious eruption and could provide a time line of Mt Erebus activity through the recent past. Samples are currently analyses at the Alfred Wegener Institute.

The 1m sections are then weight to calculate density and determine the depth of bubble close-off and firn/ice transition. The densification depends on annual temperature and snow accumulation. Warmer temperatures and higher snow accumulation lead to rapid densification. This is important, as it determines the age difference between the gas trapped in the bubbles and the ambient ice. The faster the bubble close-off is reached, the smaller the age difference and the smaller the dating error. While both sites reach in comparison to other sites bubble close-off very rapidly, the extraordinary setting of MES, makes it a site of special interest. Due to the prevailing high wind speeds snow density at the surface is much higher than at other ice core sites. This in combination with extremely high snow accumulation, and warm annual temperature, the gas bubble close-off is reached at the depth, that is likely unprecedented even in the high accumulation areas of Greenland. For this reason the gas record of this ice core could potentially provide the best dated, highest resolution CO_2 and methane record yet available.

Once these initial measurements on the core are conducted, the core is then packed into well insulating ice core boxes. Cuttings are used to cement the cores into the box for stability and to maintain core temperature, as the cuttings are recovered from the same depth as the core. Furthermore, small chips were used to study gas bubble properties, such as porosity, gas bubble size and geometry. This is especially interesting close to bedrock, as bubble geometry provides clues as to whether the ice is moving or is frozen to bedrock. At MES we drilled within ~2m of bedrock. The lack of cloudy bands or elongated bubbles so close to bedrock indicates that the ice is not moving. This suggests that core was taken at the ice divide and furthermore, that it is frozen to bedrock. For this reason the ice drains in this region only through compaction, and hence could be up to 200,000 years old at the bottom of our core.

Borehole Measurements

Once the drilling operation was completed borehole temperature and light penetration measurements were conducted. Borehole temperature provides a back-up measurement for the core temperature and verified that average annual temperature at EPG is -22ºC and at MES –25.6ºC. The light penetration measurement was conducted to investigate if optical stimulated luminescence (OSL) could be used to date independently dust layers in the ice core record. Our measurements are encouraging. The OSL clock starts counting, when the sample is in complete darkness and is reset when exposed to light. We therefore wanted to determine the depth at which the OSL age would start counting. Our light measurements reveal that the light extinction curve is very sharp at both sites and darkness (< micro lux) is reached within 6m of the surface.

Analyses of Snow Properties

At EPG and MES a 4m and 2m deep snow sequence was sampled at the drilling site prior to drilling to allow high resolution snow analysis. The snow profile was sampled with 1cm resolution for analysis on snow chemistry (Na, Ca, K, Mg, Cl, NO_3, SO_4, MS, Al, Fe, Si, Sr, Tr, Zn) and isotopic composition ($\delta^{18}O$ and δD), dust content and mineralogy (Fig.6). This is necessary as the top 4m are usually of very low density, providing too little material to run high resolution analyses. Due to the unusually dense snow at MES, only the upper 2m were sampled. The data are used to establish transfer functions between meteorological records and the snow/ice core record, for temperature, precipitation, airmass origin, wind strength and direction, storm frequency, etc. The high sampling resolution provides sub-annual resolution of the climate record. At EPG additionally three snow pits were excavated to measure density and temperature of the snow pack and to study snow crystal structure and their geographical variability (Fig.7). This information is important to

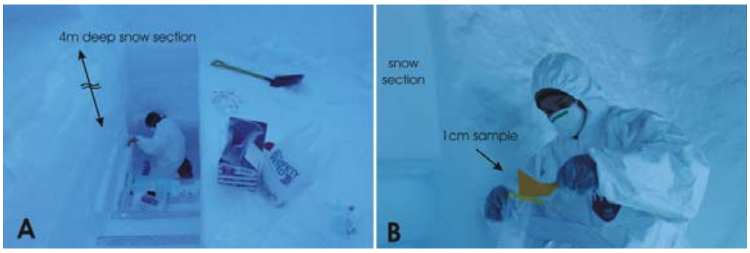

Fig.6: A) 4m deep snow pit at EPG, B) high resolution snow sampling

calculate annual accumulation rates and to evaluate the potential of re-crystallisation in the snow pack. Our initial results suggest excellent characteristics for ice core analyses. Annual layers did not show any sign of inclination or erosion and only 2 fine melt layers (<2mm) were found. This is particularly surprising, considering the coastal and low elevation (380m asl) setting of this site. The snow profile temperature showed the winter temperature wave travelling downwards in the snow pack. At the bottom of the profile the temperature touched upon the winter wave, reaching –33.6ºC with a decreasing tendency.

The geographical variability of density, temperature and stratigraphy was small and within the limits of ±σ.

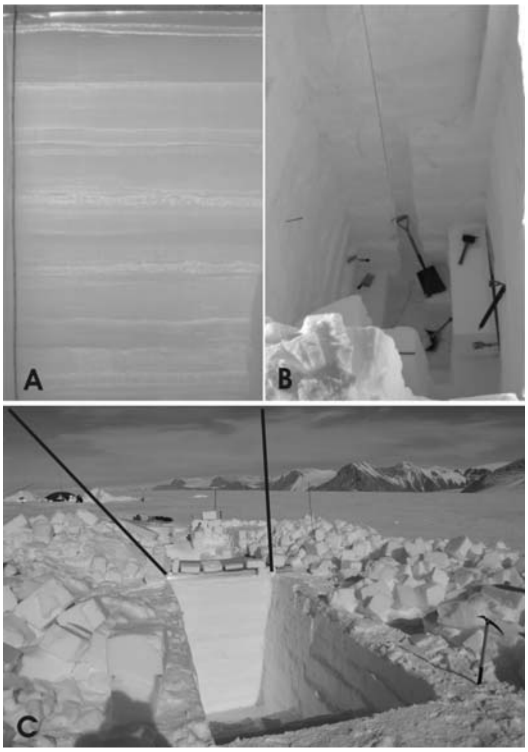

Fig.7: A) Snow stratigraphy – annual layers are clearly visible, B) additional snow pit to measure geographic variability of snow density and temperature, C) double snow pit with snow wall in-between to study snow stratigraphy

Automatic Weather Station at Evans Piedmont Glacier

An automatic weather station has been established near the 2004/2005 ice coring site that will record several parameters to help characterise the snow accumulation regime of the local glacier area (Fig.8B).

Parameters measured as of 15 November 2004 are:

- Air Temperature at 2.5 height
- Snow accumulation, and air temperature at 1.5 m height
- Dew point temperature at 2.5 m height
- Solar radiation (incoming) at 2.5 m height
- Snow temperatures (thermistor resistance) from 0.5 to 2.5 m depth in at 12 cm intervals

Barometric pressure and wind speed/direction (ultrasonic) sensors are installed but were inoperative when the party left on 16 November.

The installation is expected to operate throughout the upcoming winter. The data will be downloaded from the site in 2005/06 and the installation maintained and the non operational sensors incorporated into the recording program.

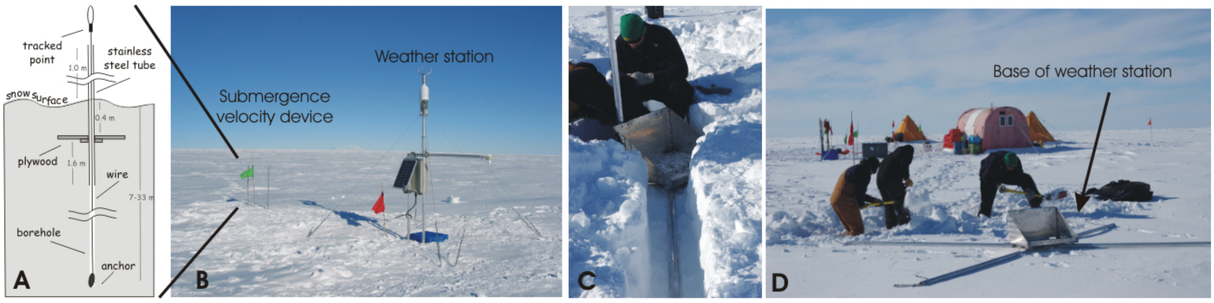

Fig. 8: A) Schematic figure of submergence velocity device, B) submergence velocity device and weather station at EPG, C) base and battery seat for the weather station dug in, D) dimension of weather station base.

Submergence Velocity Measurements at Victoria Lower and Evans Piedmont Glacier

During the 1999/2000 season three submergence velocity devices [*Hamilton and Whillans*, 2000] for mass balance measurements in the McMurdo Dry Valleys were installed (Fig.9). During the 2004/2005 season two submergence velocity devices have also been installed at EPG (Fig.8A and B). This method is used to determine mass balance by comparing vertical velocity of a marker in firn or ice with long-term, average snow accumulation rates. The movement of the marker is the result of three motions: firn compaction, gravitational glacial flow, and changes in mass balance. The device (Fig.9) consists of a non-stretchable, stainless steel wire attached to a metal anchor that is heated and placed into a drilling hole drilled in firn (or ice). The anchor melts the bottom ice and freezes in. A wire is stretched tight and guided by a stainless steel tube from the top of the drilling hole. A rod is held in place using plywood that has been buried ~40cm into the snow to avoid melt around the darker wood surface. The top end of the wire has a loop and permanent marker, the tracking point. High precision GPS measurements are used to determine absolute position of the tracking point during subsequent years. Density measurements are made on the core recovered from the drilling. To calculate the surface slope in the direction of the glacier flow, the ice surface topography is surveyed using GPS in the vicinity the device. We revisited the three sites to measure current mass balance in continuation of the time series over the last 5 years. A GPS base station was deployed for the time of our visit at Staeffler Ridge. Our time series indicates a negative mass balance of about 12cm per year. At EPG we measured this year's position and mass balance data will be available from next year onwards.

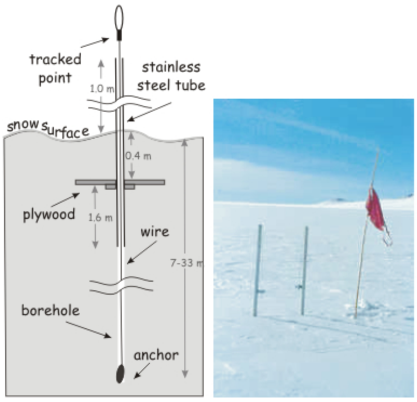

Fig.9 Mass balance measurement device at Victoria Lower Glacier

4 Publications

Planned publications from this work include:

Bertler, N., Kipfstuhl, S., Barrett, P., Mayewski, P.: High resolution climate record from coastal Victoria Land.

*Bertler, N., Naish, T., Barrett, P., Mayewski, P., Morgenstern, U.:*ENSO's influence on Antarctic climate variability over the last two millennia

Bertler, N., Kipfstuhl, S.: The ice core record from a volcano – unfreezing hot gas

Bertler, N., Ferretti, D., Riedel, K., Kipfstuhl, S.: High resolution CO_2 and methane record from Antarctica.

Current publications from this work are:

Bertler, N.A.N., and 54 others, Antarctic Snow Chemistry, *Annals of Glaciology*, in press.

Bertler, N.A.N., P.J. Barrett, P.A. Mayewski, R.L. Fogt, K.J. Kreutz, and J. Shulmeister, El Niño suppresses Antarctic warming, *Geophysical Research Letters*, *31* (L15207, doi:10.1029/2004GL020749), 2004.

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