K047
2001/02

LOGISTICS REPORT

K047: Climate and Landscape History from shallow Drilling in the Dry Valleys
ANTARCTICA NEW ZEALAND 2001/02

Event Personnel :

Warren W Dickinson	Victoria University of Wellington
Karyn Hopkins	Victoria University of Wellington
Sarah Tammik	Victoria University of Wellington

*AIMS

A model to explain the occurrence of ground ice in glacial sediments and bedrock at high altitudes (>1000m) throughout the Dry Valleys where liquid water is rare was developed from work on Table Mtn. (Dickinson, 1997; Dickinson and Rosen, 2002). Although this model may apply at Table Mtn. for the very old glacial sediments of the Sirius Group, it has yet to be tested at other locations in the Dry Valleys.

The sampling programme of the 2001/02 season aims to test the Table Mtn. model by examining soils and ice cemented sediments from three geologically different locations, which are in close proximity to each other in the Dry Valleys. The three areas included: Beacon Valley for its polygonal ground, glacial sediments and old ice, Arena Valley for its potentially old, non-glacial soils, and Pearse Valley for its abundance of young glacial sediments at a low elevation. Evaluation of analytical results may lead to shallow core drilling of certain sites in the future to test the Table Mtn. model.

*PERSONNEL

Name	Designation	Organisation	Departed Chch	Returned Chch
Warren Dickinson	Event Leader	Victoria University	9 Nov 2001	21 Dec 2001
Karyn Hopkins	Technical Support	VUW	9 Nov 2001	8 Dec 2001
Sarah Tammik	Student	VUW	9 Nov 2001	8 Dec 2001

*PLANNING

i. No suggestions to change the application process
ii. Antarctica NZ staff are excellent
iii. No suggestions on maps and aerial photos
iv. Pre season information is generally good except it would be most helpful if the first aid/field manual could be sent prior to arrival and kit-up in Christchurch. Most all of the new comers would read these manuals with enthusiasm in trying to figure out what to pack and expect in Antarctica.
v. No suggestions on change to the medicals etc.

*PREPARATIONS FOR THE FIELD

i. Reception and planning for your event:
The K047 primary objective supported by Antarctica NZ was to carry out a reconnaissance program of soil and permafrost sampling in Beacon, Arena and Pearse valleys. Because there were only 3 people associated with the event, logistical planning was minimal. Selection of actual campsites in each of the valleys was accomplished largely during helicopter fly-overs. Criteria for camp selection were, in order of importance, central location to the valley, snow packed area, flat, sunny aspect and sheltered from the wind. The HNZ pilots were extremely helpful in camp selection and Scott Base personnel provided excellent support.

ii. Availability and condition of equipment received:
The equipment made available to K047 from Scott Base was in good condition and performed well in the field. All Scott Base equipment was tested and repacked at Scott Base, note on preparing hydrocarbon contaminated cores. However, it was difficult to obtain equipment that was not on the original request list, prepared 3

months in advance. The reason is largely because of the limited resources at Scott Base and the large number of field parties that must be supported. Each field season I have to supplement Scott Base field equipment with personal equipment. Obtaining equipment (because of an altered situation) at the last minute is always problematic.

iii. Field training:
Field training required for Karyn Hopkins was carried out after her sprained ankle had healed sufficiently. Dickinson and Tammik had the AFT refresher course.

iv. Delays at Scott Base, whatever the cause:
There was a delay of one to two day in getting into the field due to the sprained ankle of Karyn Hopkins which occurred at Scott Base shortly after arrival from Christchurch. Her AFT was delayed for about 2 days while her ankle healed. Return to Christchurch for Dickinson was delayed 8 days due to weather, clearing of the ice runway and mechanical problems with the arriving herc.

v. Safety and Risk Management Processes:
These processes were discussed with Jim Cowie, operations manager, prior to departure for the field.

*Event Diary

Date	Main Activities and Location	Other Comments
9 NOV	Lv Chch 6 am, Av SB 12pm; AFT brief and refresher	Hopkins sprains ankle
10 S	SB, cond 2: mtgn w/ Cowie for plans and needs	Pizza dinners
11 Su	SB, re-packed shipped boxes to ready for field	BBQ
12 M	SB, Hopkins cleared for AFT; sorted food boxes, wts to Cowie	Marked VUW exams
13 T	SB, tested hammer drill for field sampling, mods needed	Shopping at McM
14 W	SB, mods to drill at SB workshop,, final packing of field gear	Packed personal gear
15 Th	SB, to Univ Vly 2pm; risk mgmt w/ Cowie; camp & dinner by 10p	ST & KH cold at nite (-18)
16 F	UV, recon main valley floor 11- 7p; WD to Farnell Vly, 9p rtn	Long day; lite winds in BV
17 S	UV, dug 2 soil pits in UV to test methods; left UV-1 open for 4 days	Sun on camp 9a-to 10p
18 Su	UV, dug 1 pit in main Beacon Vly; found Univ Wash wx sta ctr of Vly	Early night
19 M	UV, Walk to Farnell Vly, dug 1 pit; WD climb Brawhm Pass	VHF comms difficult
20 T	UV, Walk to Friedman Vly, dug 2 pits on Rx Glacier; VHF aerial broke	Long day, late nite
21 W	UV, WD climb So Beacon ridge to get comms; girls dig pit BV	Pack boxes for moving
22 Th	UV, to Arena Vly 3p, lost VHF hand radio at UV camp, set camp AV	S. Tammik cuts finger 9pm
23 F	AV, 10p ST to McM for stitches in finger, KH & WD recon AV	ST delay to MCM no stch
24 S	AV, cond 2 @ camp; reading and writing; cleared by 10pm	ST @ SB until Wed
25 Su	AV, recon upper AV; WD recon Altar Mtn area	Early nite; strong wind in AV
26 M	AV, dig 1 pit in Moraine lwr AV; examined desert pvmnt	Early nite
27 T	AV, dig 2 pits in lwr AV	Talked to Wellington
28 W	AV, dig 1 pit in paleo dune ptn gnd; ST rtn 5p; Envi inspection group	ST for dinner!
29 Th	AV, dig 2 pits transect from paleo dune	Early dinner and bed
30 F	AV, WD recon New Mtn area; ST & KH dig shallow pit upper AV	Packing for camp move
1 DEC	AV, to Pearse Vly 10am; VHF coms up hill; camp set 5p, WD recon	Camp by House Lake, water!
2 Su	PV, recon dunes N side of vly; dig 1 pit found clear ice @ 50cm!	PV camp is warm! mod winds
3 M	PV, dig several pits to find extent of ice cored moraine	Early nite
4 T	PV, recon to Lake Joyce; dig 2 pits in ctr of PV; old camp site by lake	Sun on camp 7a to 12a
5 W	PV, found east extent of ice cored moraine	Big cook up for last nite
6 Th	PV to SB for ST and KH; WD to Table Mt. 10am; WD sample at TM	A Pyne & P Houston at TM

7 F	TM to SB 2p, repairs to temp probes complete and re program for 2002	Nite at SB; talks at McM
8 S	SB to Chch for ST & KH; WD cont' put away field gear;	Talk w/ HNZ directors
9 Su	SB, work on field report, talk w/ Bruce Koci; walk to Ob Hill	Warm, cloudless windless day
10 M	SB, melted ice samples; work on field report	Late nite
11 T	SB, work on field report; observed ice drilling Windless Bight	US scientists for dinner
12 W	SB, bag drag for 1a flite; flite cancelled @ 3p, worked on field report	Living out of hand carry bag
13 Th	SB, flite cancelled 11a; working on manuscript	Videos at nite
14 F	SB, cond 1 all day; working on manuscript	Videos at nite
15 S	SB, cond 2, working on manuscript and videos	Take out pizza nite
16 Su	SB, cond 1 then 2; walked to McM for arts festival	Videos at nite
17 M	SB, clearing; waiting on roads and runway to be cleared;	SB getting crowded
18 T	SB, working on manuscript, clear calm day, ski herc arrives	Bernard Hallet for dinner
19 W	SB, flite sched for 1a; at Pegasus by 11p, mech. prob, flite cand	Av SB at 5a!
20 Th	SB, flite sched for 9p, rest for most of day, walk up Crater Hill	Takaway dinner to herc
21 F	Chch arrived at 4:25a, de kit and 8am flite to Welly	

EVENT MAP

Figure 1. Topographic map of Beacon and Arena valleys.

The Beacon Valley camp (fig. 1) was located on a small patch of snow on the southwestern flank of University Valley (1650m; S77°51.368' E160°41.987') and was selected for the snow patch and central location to the valley. However, due to the rugged terrain and subsequent slow walking, it probably would have been more convenient and as climatically comfortable to camp adjacent to the main valley bottom on the southeastern flank. Winds during the field visit were generally down valley and less than 10 knots, however, diurnal up-valley winds were also encountered.

The Arena Valley camp (fig. 1) was located at the western end (generally the leeward end) of a linear snow patch at the northern edge of Ashtray Basin (1130m; S77°51.593' E160°56.915') and was selected for the snow patch and central location to the valley. Winds, generally down valley, were 10 – 15 knots stronger than Beacon Valley during the field visit and probably averaged between 15 and 25 knots. Wind strength and duration at this location was about average for the valley floor.

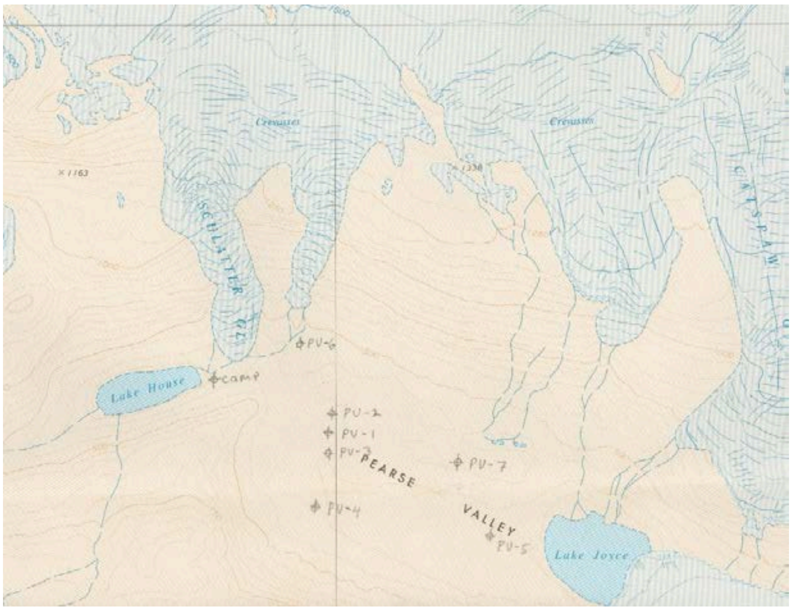

Figure 2. Topographic map of Pearse Valley.

The Pearse Valley camp (fig. 2) was on an alluvial terrace located at the eastern edge of Lake House (325m; S77°42.101' E161°26.924') and was selected for its proximity to a source of water. Wind direction and strength seems highly variable throughout the valley and diurnal variations were common. During the field visit, winds did not exceed 20 knts and seemed strongest from 2 – 5 am. In general wind strength and duration were inbetween those of Beacon and Arena valleys.

*WEATHER

For the 22 days in the field the weather was generally good. Field movements by helicopter were not constrained by the weather. Nov 24th was the only day in which field reconnaissance and sampling was not possible because of poor visibility and blowing snow. Temperatures in Beacon Valley ranged from -25°C at night to -12°C during warmer days. Arena Valley was slightly warmer and ranged from -18°C to -8°C, but windier than Beacon Valley. By comparison, Pearse Valley was warm with night temperatures about -6°C and day temperatures about -1°C.

*ACCIDENTS, INCIDENTS OR HAZARDS

Accident #1: Occurred at Scott Base, 3pm Fri 9 Nov at the bottom of the administration stairs outside entrance. Karyn Hopkins slipped and fell on ice at the base of the stairs. Initially her ankle was sore, but 1-2 hours later it became swollen and was diagnosed by the Scott Base nurse as a moderate sprain for which it was treated. On Mon 12 Nov, Hopkins was medically cleared for AFT provided a splint was applied to the ankle. The timing of this accident was such that it caused no delay to the event.

Accident #2: Occurred at Arena Valley camp 8pm Thurs 22 Nov in a Scott Polar tent. While attempting to open a frozen can of mushroom soup, Sarah Tammik cut the middle finger of her right hand. The cut was about 2.5 cm long and 3-4 mm deep. Although medical supplies were frozen, the wound was washed with boiled water, dried and bound with plastic suture strips. It was dressed with antiseptic cream and wrapped with gauze. Because the cut would not heal properly without stitches, Tammik was medivacked to McMurdo Station at 10p the next day. Due to a weather delay at Marble Point, she did not arrive at McMurdo until 4p that day. Because it had been significantly longer than 12 hrs since the incident, the doctor on duty decided not to stitch the wound, which would now require daily cleansing. Consequently, Tammik did not return to the field until Wed, 28 Nov. During her absence, Dickinson and Hopkins were able to carry out field work in Arena Valley with only minor inconveniences of not having our third member of the event.

RADIO COMMUNICATIONS

VHF radio communications at each of the valley campsites was extremely limited. At Beacon and Arena valleys the VHF high-gain aerial worked in selected places, but there was a fault with the connector pin fitting and this made the antenna unreliable and not usable. Although this problem was eventually fixed, Pearse Valley was too isolated for the aerial to work. Here communication was possible only with the HF ‘butterbox’ or by climbing .5 hr to a suitably high location.

In addition to poor communications, a hand-held VHF radio was lost at the Beacon Valley campsite during the helicopter landing and loading for the move to Arena Valley. A limited search for it was made with the helicopter waiting during the move to Pearse Valley.

Field operations in Antarctica now require reliable and quick communications with Scott Base. Because of this, **I strongly recommend that satellite phones be provided to field parties that are out of VHF radio contact.**

*ENVIRONMENTAL IMPACT

*Sites Visited

Site name	University Valley (Beacon Valley proper)
Site location	S77°51.368' E160°41.987'
Dates occupied	15 – 21 Nov 2001
Total days (or hours) at site	7
Maximum number of people at site	3
Total person-days (or person-hours) at site	21
Main activity undertaken	Recon, soil sampling and description

Site name	Arena Valley
Site location	S77°51.593' E160°56.915'
Dates occupied	22 – 30 Nov 2001
Total days (or hours) at site	9
Maximum number of people at site	3
Total person-days (or person-hours) at site	27
Main activity undertaken	Recon, soil sampling and description

Site name	Lake House (Pearse Valley proper)
Site location	S77°42.101' E161°26.924'
Dates occupied	1-5 Dec 2001
Total days (or hours) at site	5
Maximum number of people at site	3
Total person-days (or person-hours) at site	15
Main activity undertaken	Recon, soil sampling and description

Site name	Table Mountain
Site location	S77˚57.011' E161˚59.350'
Dates occupied	6 Dec 2001
Total days (or hours) at site	1
Maximum number of people at site	3
Total person-days (or person-hours) at site	3
Main activity undertaken	Repair/programme temp probes; soil spling

Geological Material

For more detail, see table of samples in Scientific Report

Name and Location of Soil Pit	Total Quantity of Sample from Pit (kg)
UV-1; S77˚51.397' E160˚42.536'	1.4
UV-2; S77˚51.859' E160˚42.925'	1.0
BV-1; S77˚50.708' E160˚3.361'	1.0
FV-1; S77˚52.577' E160˚39.879'	1.6
FRV-1; S77˚53.553' E160˚30.278'	0.8
FRV-2; S77˚53.414' E160˚30.768'	1.4
BV-2; S77˚51.070' E160˚39.289'	1.2
AV-1; S77˚50.287' E160˚58.876'	2.4
AV-2; S77˚50.508' E160˚58.476'	2.8
AV-3; S77˚50.699' E160˚57.327'	1.2
AV-4; S77˚52.042' E160˚56.602'	2.0
AV-5; S77˚51.986' E160˚56.500'	0.2
AV-6; S77˚51.958' E160˚56.497'	1.6
AV-7; S77˚51.967' E160˚52.487'	1.0
PV-1; S77˚42.168' E161˚30.340'	1.6
PV-2; S77˚42.094' E161˚30.380'	1.0
PV-3; S77˚42.274' E161˚30.257'	2.0
PV-4; S77˚42.670' E161˚29.422'	1.4
PV-5; S77˚43.127' E161˚35.611'	1.6
PV-6; S77˚42.002' E161˚29.540'	0.8
PV-7; S77˚42.378' E161˚32.785'	1.2

PV-UD; S77˚41.734' E161˚31.132'	0.2
PV-MD; S77˚41.904' E161˚30.319'	0.2
PV-SP; S77˚42.060' E161˚30.422'	0.2
TM-1-01; S77˚57.011' E161˚59.350'	0.4

Equipment installed/left in field

Type of equipment/marker installed	2 temperature probes 2 m deep
Location of installation left in field	S77˚57.011' E161˚59.350' (install Table Mtn. 2000)
Size of items left in field	(2 m deep in ground, 0.25m^3 on surface) x 2
Number of items left in field	2 probes
Date of intended retrieval	Nov 2004

*Differences from original Preliminary Environmental Evaluation (PEE)

Environmental impact from the 2001-2002 season was well within the limits of the PEE which was approved 13 Oct, 2001. For example, the PEE approval for total sample weight was 80kg but only 35 kg was taken during the season.

IMMEDIATE SCIENCE REPORT

K047: Climate and Landscape History from shallow Drilling in the Dry Valleys
ANTARCTICA NEW ZEALAND 2001/02

Event Personnel :

Warren W Dickinson	Victoria University of Wellington
Karyn Hopkins	Victoria University of Wellington
Sarah Tammik	Victoria University of Wellington

1 Popular Summary of Scientific Work Achieved

A model to explain the occurrence of ground ice in glacial sediments and bedrock at high altitudes (>1000m) throughout the Dry Valleys where liquid water is rare was developed from work on Table Mtn. (Dickinson and Grapes 1997; Dickinson and Rosen 2002). The model is based on mineralogical, chemical and isotopic analyses of ground ice and frozen sediments that come from cores of Sirius Group sediments at Table Mtn. It indicates that the ground ice and diagenetic minerals accumulated over long periods of time from atmospheric water vapour and brine films formed on the surface of the ground. Although this model may apply at Table Mtn. for the very old glacial sediments of the Sirius Group, it has yet to be tested at other locations in the Dry Valleys.

The sampling programme of the 2001/02 season aims to test the Table Mtn. model by examining soils and ice cemented sediments from three geologically different locations, which are in close proximity to each other in the Dry Valleys. The three areas included: Beacon Valley for its polygonal ground, glacial sediments and old ice, Arena Valley for its potentially old, non-glacial soils, and Pearse Valley for its abundance of young glacial sediments at a low elevation. Evaluation of analytical results may lead to shallow core drilling of certain sites in the future to test the Table Mtn model.

2 Proposed Programme

To understand the processes by which ground ice is formed, a comparative set of samples is needed from a variety of ground surfaces. These surfaces must lie on a transect from low to high elevation and extend through a range of ages. In sampling and analyzing the soils and their underlying ice cemented sediments there were three aims: 1) To determine if a chemical and mineralogical relationship exists between the soils and ice cemented sediments. 2) To determine if there are differences in the chemistry and mineralogy of the soils and ice cemented sediments between the different areas. 3) To determine the relationship of relative soil age, chemistry and ice content to polygonal ground. Evaluation of analytical results may lead to shallow core drilling of certain sites in the future.

3 Scientific Endeavours and Achievements

Summary

The three event people spent 21 days in the field from 15 Nov to 5 Dec. Dickinson spent an additional day (6 Dec) with Alex Pyne (VUW) and Paul Houston (Antarctica NZ) at Table Mtn. collecting samples and re-programming the data loggers on two temperature probes for 2002. A total of 21 soil pits were described and sampled in Beacon, Arena, and Pearse valleys (Table 1). Soil pits were generally dug in the centers of polygons to control the comparison between different sites and areas. Polygon centres are thought to be the least active area and hence should contain the oldest most chemically developed soil.

Method

The following method was used in digging most all of the soil pits: In the area to be excavated (1m x 1m x.5m), the surface material was scrapped off and placed on a 2m square polythene tarpaulin. The underlying soil was then dug out and placed on another 2m square polythene tarpaulin. Loose soil material was dug to a depth of one metre or the top of the ice-cemented soil which ever was the shallowest. The top of the ice-cemented material was sampled by using a gasoline powered hammer drill to excavate fist-sized samples. After the soil profile and permafrost were described and sampled, all material from the respective polythene tarpaulins was replaced. The ground surface was raked and swept to restore as much as possible of the original appearance. Analyses of the samples will include; thinsections of soil clods as well as major cation and anion chemistry of soluble salts in the soils and ice from the permafrost. These methods were used to achieve the three aims listed above.

The term "ground ice" refers to all types of ice formed in freezing and frozen ground (Permafrost Subcommittee, 1988 p 46). Permafrost refers to the permanently frozen (<0º C) condition and includes both dry and wet (ice) materials. Subsurface conditions in the Dry Valleys are generally different from those in arctic and alpine environments in that there is usually 30 to 60 cm of dry frozen sediments above ice cemented sediments. However, because most workers think of permafrost as ice cemented, the term permafrost in this report will include only the ice cemented materials.

Beacon Valley

Beacon Valley together with its 12 side valleys (McKelvey and Webb 1959) have the most extensive and best defined polygonal ground in the Dry Valley area. Elevations of the main valley floor are between 1300 and 1500 m while elevations of the side valleys are about 200 m higher. Winds during the field visit were generally down valley and less than 10 knots, however, diurnal up-valley winds were also encountered. Our camp location was on a small patch of snow on the southwestern flank of University Valley (1650m; S77º51.368' E160º41.987') and was selected for the snow patch and central location to the valley. However, due to the rugged terrain and subsequent slow walking, it probably would have been more convenient and as climatically comfortable to camp adjacent to the main valley bottom on the southeastern flank.

The polygonal ground of Beacon Valley was studied in the 1960's (Berg and Black 1966) and soils of the area have been described by (Bockheim 1982; Bockheim and Ugolini 1972; Linkletter et al. 1973; Potter and Wilson 1983; Ugolini et al. 1973). More recently, weather stations with ground temperature probes have been installed in the lower and central parts of the main Beacon Valley along with strain gauges across polygon troughs (B. Hallett and R. Sletten, pers. comm). In addition rock glaciers, which are uncommon in the Dry Valleys, emerge out of Friedmann and Mullins valleys onto the floor of Beacon Valley.

The origin of the debris material on the floors of Beacon Valley and its side valleys remains unclear. Although it appears that at one time a tongue of the Taylor Glacier must have occupied the valley floor, there is no obvious moraine to support this supposition. In addition, recent drilling and ground penetrating radar (GPR) indicate that debris-laden ice lies below 2 – 3 m of ice cemented debris on the floor of Beacon Valley. The thickness of this ice is unknown because surface salts obscure GPR results (R. Sletten, pers. comm.) but it may be over 150 m thick (A Hubbard, pers. comm.). (Marchant et al. 1996; Sugden et al. 1995) dated volcanic ashes associated with this ice and have suggested that it is more than 8 Ma old.

Polygons on the floor of Beacon Valley have a 10-20 m diameter and 2 – 3 m height differential between trough and polygon centres. Although the diameter of the polygons is not uncommon, the large height differential is and may result from a long development period or the glacial ice core of the valley. The height differential of the polygons in the side valleys is less and does not appear to exceed 1 m. Adjacent to and along the southeast flank of the main valley floor, is a lateral strip that is either absent of polygons or has polygons with the least amount of relief in the area. Depth to ice cemented ground appears to be 40 – 60 cm throughout the area. In one of the rock glaciers, clear ice was found below the ice cemented ground at about 30 cm.

The activity of any single polygon or part of it may be reflected by the distribution of the material in the troughs. Parts of troughs are flat having been filled with sand while other parts are steep and rocky with angular cobbles and boulders. This angular material may be sorted or unsorted. On the active part of a polygon, clasts may roll off the steep sides and into the trough. Sorting of clasts in the trough may occur by what the center crack is able to accommodate. On the inactive part of a polygon, wind blown sand may accumulate in the trough. This observation suggests that polygon activity may be dynamic so parts of it are active while at the same time other parts are inactive.

A major problem apparent from the field work is to understand what controls the age of the surface and the relationship to polygon development in Beacon Valley. Alternatively, it may be the ice content below the surface that controls polygon development. Soil development and age may be more of a function of the material, aspect and moisture regime, rather than the depositional age of the material in which the soil is forming. The absence of recognizable glacial deposits in Beacon Valley may reflect the activity of the polygons which has destroyed the structure of the moraines making them unrecognizable.

Arena Valley

In contrast to Beacon Valley, Arena Valley has little polygonal ground and is mostly underlain by a bedrock of Ferrar Dolerite and Beacon Supergroup sediments. Elevations of the main valley floor are about 200 m lower that Beacon Valley and lie between 1100 and 1300 m. Winds, generally down valley, were 10 – 15 knots stronger than Beacon Valley during the field visit and probably averaged between 15 and 25 knots. Our camp was located at the western end (generally the leeward end) of a linear snow patch at the northern edge of Ashtray Basin (1130m;

S77º51.593’ E160º56.915’) and was selected for the snow patch and central location to the valley. Wind strength and duration at this location was about average for the valley floor.

Most soils in Arena Valley have developed directly on bedrock but in some areas they have developed on talus and scree which have slid off steep valley sides. Except for the terminal moraines marking the retreat of the Taylor Glacier at the mouth of the valley, there are no glacial deposits in the valley. Polygonal ground probably covers less than 10% of the area of the valley bottom and slopes, and appears to be restricted to talus and scree deposits. This would suggest that the lack of polygonal ground in Arena Valley is due mainly to the lack of loose material upon which it can develop. However, local climatic conditions cannot be excluded because most of the polygonal ground also appears to be in areas of increased moisture and snow accumulation. In addition, the overall windy nature of the valley may remove much of the moisture making polygonal ground more difficult to develop.

In addition to talus and scree, polygonal ground was also found to form on sand dunes climbing up the sides of the valley (sites AV-4-6). Pits in the terminal moraines of the Taylor Glacier, showed muds and silts with horizontal bedding that suggests small lakes or ponds originated from glacial meltwater.

Soils in Arena Valley should be relatively older than those in Beacon Valley because of the mobility of polygonal ground that would homogenize soils rather than promote horizonation. Therefore, soils in Arena should be more horizonated both chemically and physically than those in Beacon Valley. Most pavement surfaces in Arena are similar to that apolygonal ground which is found on the southeastern flank of Beacon Valley with well-sorted pebble sized and highly ventifacted pavement surface. The main question in Arena Valley is why there is such an absence of glacial deposits when the adjacent Beacon Valley has been so highly glaciated. In addition, why is polygonal ground absent from the few glacial deposits that are present in Arena Valley.

Pearse Valley

In contrast to Beacon and Arena valleys, the elevation Pearse Valley is much lower and ranges between 400 and 500 m MSL. Our camp was on an alluvial terrace located at the eastern edge of Lake House (325m; S77º42.101’ E161º26.924’) and was selected for its proximity to a source of water. Wind direction and strength seems highly variable throughout the valley and diurnal variations were common. During the field visit, winds did not exceed 20 knts and seemed strongest from 2 – 5 am. In general wind strength and duration were in-between those of Beacon and Arena valleys.

Pearse Valley contains mostly glacial deposits representing the retreat of the main Taylor Glacier and subsequent retreat of the lateral valley glaciers. As a result, the chemical development of the soils should reflect this Holocene deposition and contrast to the older soils in Beacon and Arena valleys. Polygonal ground covers 40 – 50% of the valley floor and slopes, however, this was difficult to estimate due to the lack of snow in polygon troughs.

About 10% of the valley floor is covered by sand from eolian deposition and this does not include numerous pockets of sand lodged in troughs of polygons and in other sheltered areas. Much of this sand is protected by a lag of 5 – 8 mm grannules and therefore is not mobile under winds of about 50 knts. Much of the sand probably came from stream systems draining meltwater from the retreating glaciers. The main sand dune, climbing the northeast slope of the valley apparently has brine flowing on top of ice cemented sand which accumulates in salt pond (dry on the surface) at the base of the dunes. Ice cemented samples from the dune and brine from approximately 50 cm deep in the salt pond were taken for chemical analysis.

Depth to ice cement and clear ice under moraines varies in the valley from 0.25 m to >1m and was encountered in every pit except PV-LAK1, the sediments of which may represent and old lake deposit. It is not clear what factors control the depth to ice cement but aspect and moisture regime do not seem to have a direct relationship. In addition, the degree of polygonal ground development does not appear to be related to the depth of the ice cement. For example, two pits were dug in the vicinity of PV-7, one in well developed polygonal ground and the other in poorly developed polygonal ground and ice cement was found at 25 cm in both pits.

Perhaps our most interesting find in Pearse Valley is the presence of clear ice in pits PV-1, 2, 3 & 6. This ice possibly represents and ice cored moraine which may have derived from the Schlatter Glacier. The surface of this ice is smooth and it is not clear how the contact between it and loose sand above can be so sharp. Why there is not ice cemented sand above, suggests the clear ice is ablating under the sand. Although the clear ice seems to have a limited extent, it may have a greater extent if it lies below ice cemented soil in other parts of the valley.

4 Publications

A preliminary report on the soil profile descriptions and profiling will be published as an Antarctic Research Centre Report in June 2002. This report will include much of the technical work on the drilling system, core logs and photographs, maps and cross sections. Copies of this report will be sent to Antarctica NZ.

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

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Webster Drilling Inc, NZ

6 References

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K049
2001/02

LOGISTICS REPORT

K049 Holocene Climate History from Coastal Ice
ANTARCTICA NEW ZEALAND 2001/02

Event Personnel :

Ms. Nancy Bertler	Antarctic Research Centre, Victoria University of Wellington
Prof. Peter Barrett	Antarctic Research Centre, Victoria University of Wellington
Mr. Alex Pyne	Antarctic Research Centre, Victoria University of Wellington
Mr. Tony Kingan	Webster Drilling,Wellington
Mr. Bruce Koçi	Ice Core Drilling Service, NSF University of Wisconsin, Madison
Ms. Nora Patterson	Victoria University of Wellington
Mr. Matt Hill	Victoria University of Wellington

*AIMS

Victoria Valley is the northernmost and largest of the McMurdo Dry Valleys, which lie within the Transantarctic Mountains and between the Ross Sea and the East Antarctic Ice Sheet. Differences in moisture and temperature of air masses originating from either the East Antarctic Ice Sheet, the rocky area of the Dry Valleys or the Ross Sea form a sensitively balanced climate system where they meet in the Victoria Valley. Therefore a climate record of the Victoria/Valley provides an ideal opportunity to study rapid, high frequency climate variations.

During the 1999/2000 and 2000/2001 seasons firn cores and snow pit samples were collected from Victoria Lower Glacier, Baldwin Glacier and Wilson Piedmont Glacier. Their chemical and isotopic signals confirm the climate sensitivity of Victoria Valley, and verify the good preservation of this record in the ice of the surrounding low altitude, coastal glaciers.

During the 2001/2002 field season a 180m core was recovered from Victoria Lower Glacier. The ice was expected to provide a climate record for the last 8,000 to 10,000 years. The site was chosen for its location and for the glaciological characteristics of the site, which were determined with ground penetrating radar and mass balance measurements.

In addition, snow samples were collected from the polar plateau to complete our database along a transect from the coast to the East Antarctic Ice Sheet. The comparison of the chemical and isotopic record contained in the snow and firn at sites along this transect will allow us to distinguish between input from local and distant air masses

*PERSONNEL

Name	Designation	Organisation	Departed Chch	Returned Chch
Ms Nancy Bertler	Principal Investigator	Victoria University	02 Nov 01	02 Jan 02
Prof. Peter Barrett	Science Supervisor	Victoria University	NA	NA
Mr Alex Pyne	Expedition Manager & Drilling Expert	Victoria University	*	20 Dec 01
Mr Tony Kingan	Drilling Expert	Webster Drilling	*	08 Dec 01
Mr. Bruce Koçi	Drilling Expert	USAP, ICDS	#	20 Dec 01
Ms Nora Patterson	Student Assistant	Victoria University	02 Nov 01	20 Dec 01
Mr Matt Hill	Student Assistant	Victoria University	02 Nov 01	24 Dec 01

* transferred on 16 Nov from K114 to K049

transferred on 29 Nov from US project to KO49 and transferred back to US project on 03 Dec

*PLANNING

- Communications with Antarctica New Zealand staff

  Antarctica New Zealand staff appears competent and helpful

- Provision of maps and aerial photographs

  N.A.

- Pre-season information

  The information received was timely and valuable.

- Medicals, documentation and flights to Antarctica

  We did not encounter any problems

CARGO

Cargo Item	Qty	Approx. Weight (if known)
GPS equipment	2	300 lb
Ice core processing equipment		200 lb
Snow sampling equipment		200 lb
Computer	1	20 lb

*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

- Availability and condition of equipment received

  The equipment requested from Scott Base was supplied in time and in good condition. This included one skidoo, one generator and field equipment. The skidoo had to be abandoned during the traverse from SB to Marble Point due to an engine failure. The quick re-supply of a new skidoo was appreciated.

- Field training

  The field training was helpful and appropriate. The additional crevasse rescue training was appreciated

FIELD TRANSPORT

- Vehicles

  Hugglands were used in three traverses to transport field and drilling equipment from SB to Marble Point and back (Fig.1).

Fig.1: First KO49 traverse to Marble Point

- Aircraft Operations

  All but one helicopter moves were done by HNO. We enjoyed the professionalism, friendliness and efficiency of the HNO staff. Dangerous cargo such as fuel barrels was handled in a very professional and safe manner. None of our loads got damaged or lost

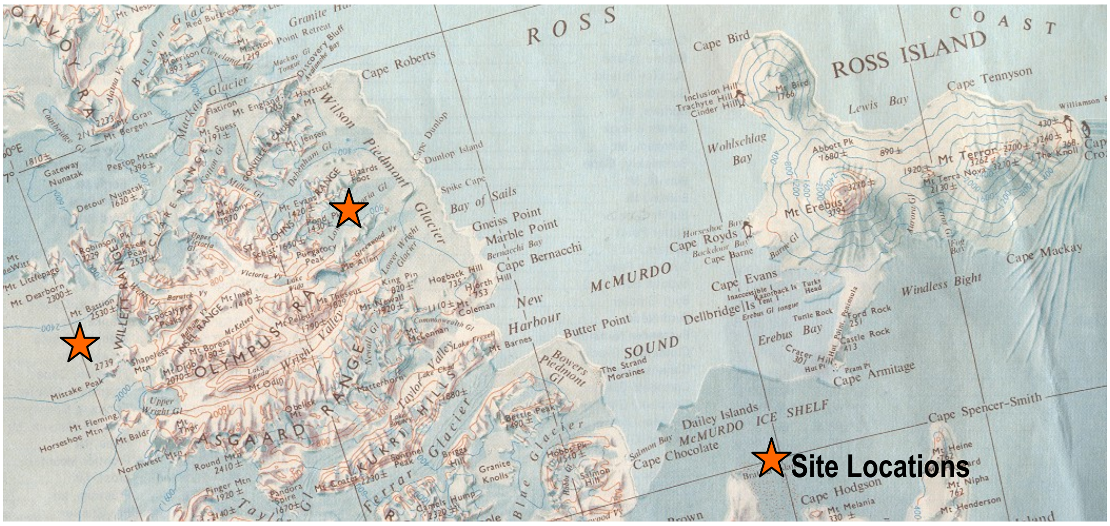
Fig.2: Drilling equipment arrives at Victoria Lower Glacier

*EVENT DIARY

Date	Main Activities and Location	Helo weights
02 Nov	Bertler, Hill and Patterson NZSB	
03/04 Nov	Hill and Patterson AFT	
05-08 Nov	Bertler, Hill and Patterson Equipment preparation at SB and BFC	
09 Nov	Bertler, Hill and Patterson Traverse to Marble Point with Huggland accompanied by Reid	
10 Nov	ICDS drill flown from Byrd Station to MCM	
10 Nov	Bertler, Hill and Patterson put in to Victoria Lower Glacier, camp set-up, drill site preparation, GPS base station installation and mass balance measurements	5500 lb with HNO
16–17 Nov	Pyne, Kingan and Koçi (ICDS driller) assemble, test and train on ICDS drill	
18 Nov	Pyne and Kingan traverse from SB to Marble Point with Huggland accompanied by Reid	
19 Nov	Pyne and Kingan put in at Victoria Lower Glacier	3500 lb with HNO
19 Nov	Pyne, Kingan, Bertler, Patterson and Hill set up of drill and test drill hole	
20 Nov	Pyne, Kingan, Bertler, Patterson and Hill, drilling commences	
23 Nov	Core pick up to Crary Laboratory	1920 lb by HNO
29 Nov	Koçi put in to Victoria Lower Glacier	300 lb by HNO
29 Nov	Core pick up to Cary Laboratory	1920 lb by HNO
03 Dec	Bertler, Patterson, and Hill to Marble Point waiting for weather to clear at Shapeless Mountain	1600 lb with US helo
03 Dec	Kingan to Marble Point for traverse to SB	5400 lb with US helo
03 Dec	Pyne and Koçi to Scott Base, core pick up to Crary Laboratory	2000 lb with US helo
04 Dec	Kingan traverse from Marble Point to SB with Huggland accompanied by Reid	
04 Dec	Bertler, Patterson and Hill put in at Shapeless Mountain location, camp set-up and collection of snow samples from snow pit	1600 lb with HNO
08 Dec	Bertler, Patterson, and Hill to Scott Base	1720 lb with HNO
08 Dec	Kingan RT NZ	

Date	Main Activities and Location	Helo weights
09 Dec	Bertler commences work on ice cores at Crary Laboratory	
20 Dec	Pyne, Patterson RT NZ	
24 Dec	Patterson RT NZ	
02 Jan	Bertler RT NZ	

EVENT MAP



*WEATHER

Weather observations have been made using a 'meteorology kit' from Scott Base.

Victoria Lower Glacier site S 77º 19' 48.365'', E 162º 31' 55.491'', 637m above sea level

Date	Time	T (ºC)	P (hPa)	Wind direction	Wind speed	Cloud cover	Cloud type	Visibility
14 Nov	10:30	-14.0	908	W	7	60%	High	Unres
14 Nov	20:50	-14.5	909	S	10	80%	Interm	Unres
15 Nov	10:26	-12.0	909	S	4	30%	High	Unres
15 Nov	19:00	-14.0	909	E	3	60%	High	Unres
16 Nov	10:20	-10.0	908	E	1	5%	High	Unres
16 Nov	21:07	-16.0	908	E	10	15%	High	Unres
17 Nov	10:05	-15.7	911	E	8	15%	High	Unres
17 Nov	20:40	-15.0	911	E	3	0%		Unres

Date	Time	T (ºC)	P (hPa)	Wind direction	Wind speed	Cloud cover	Cloud type	Visibility
18 Nov	10:45	-14.0	906	E	7	100%	Low	500m
18 Nov	20:20	-16.1	909	E	3	90%	Low	5km
19 Nov	09:00	-11.4	910	E	1	5%	Low	Unres
19 Nov	22:45	-16.1	911	E	3	10	Low/high	Unres
20 Nov	08:00	-15.0	914	E	1	5%	Interm	Unres
20 Nov	23:10	-9.0	913		0	5%	Interm	Unres
21 Nov	09:22	-11.0	911	E	1	10%	Low	Unres
21 Nov	22:45	-13.08	908	E	6	10%	Low	Unres
22 Nov	09:10	-11.8	906	E	3	5%	Low	Unres
22 Nov	22:56	-16.7	905	E	3	5%	Low	Unres
23 Nov	08:52	-8.0	904	E	1	5%	Low	Unres
23 Nov	23:00	-4.9	904	W	13	45%	Low	Unres
24 Nov	09:05	-9.9	905	E	3	100%	Low/high	2km
24 Nov	23:39	-11.0	904	E	4	90%	High	Unres
25 Nov	08:55	-2.0	904		0	10%	Low	Unres
26 Nov	14:23	-7.1	912	E	5	0		Unres
27 Nov	02:50	-13.07	905	W	3	0%		unres
27 Nov	15:13	-6.1	908	E	6	70%	Interm	Unres
28 Nov	15:21	-5.7	902	E	5	50%	High	Unres
29 Nov	02:43	-11.3	902		0	95%	High	Unres
29 Nov	12.17	-4.4	906	E	4	60%	High	Unres
30 Nov	02:36	-14.2	910		0	10%	High	Unres
30 Nov	12:08	-9.0	914	E	5	10%	Low	Unres
01 Dec	03:54	-9.2	907	E	1	10%	Low	Unres
01 Dec	13:27	-4.9	902	E	5	1%	Low	Unres
01 Dec	23:24	-13.2	898	E	6	2%	Low	Unres
02 Dec	11:49	-6.6	901	E	6	55	Low	Unres
02 Dec	22:22	-11.6	904	E	5	40%	Low/high	Unres
03 Dec	09:41	-7.4	904	E	4	60%	Low/high	Unres

Polar Plateau (near Shapeless Mtn) S 77º 21.092’, E 159º 52.226’, ~2400m above sea level

Date	Time	T (ºC)	P (hPa)	Wind direction	Wind speed	Cloud cover	Cloud type	Visibility
04 Dec	16:23	-19.4	737	S	17	5%	Low	Unres
05 Dec	17:56	-17.0	736	S	15	5%	Low	Unres
06 Dec	15:20	-19.2	730	S	12	70%	Low	Unres
07 Dec	20:34	-17.3	731	S	13	60%	Interm	Unres
08 Dec	08:15	-20.1	732	S	15	20%	Interm	Unres

*ACCIDENTS, INCIDENTS OR HAZARDS

NA

FIELD EQUIPMENT

- Field Clothing

  The issued field clothing was appropriate and functional. A proportion however was damaged (ripped zippers, lost buttons etc.) or had not been washed.

- Field Equipment

  The supplied field equipment was in good condition and very reliable.

- 20 person day ration box system

  The food boxes were well packed in terms of quantity and nutrition.

- Specific Field Equipment

  The allocated skidoos and generator were in good condition. One skidoo had to be abandoned after an engine failure during our traverse from SB to Scott Base. The quick supply of a new skidoo was appreciated

RADIO COMMUNICATIONS

- Suitability and effectiveness of the radio equipment

  The issued radio kits (VHF and HF) were very reliable and good condition

- Reception/transmission conditions and suitability of radio schedule timing

  Reception and transmission were generally good and the timing of the radio schedule convenient

- Scott Base's general efficiency during radio schedule

  Radio communication was mainly very efficient, professional and appreciated

SCOTT BASE AND ARRIVAL HEIGHTS LABORATORY FACILITIES

Facility	Use
Hatherton Geoscience Laboratory	
Q-Hut Laboratory benches	
Scott Base Wet Laboratory	
Scott Base Summer Laboratory	
Arrival Heights Laboratory	

COMPUTER FACILITIES

- Suitability and effectiveness of computer network: satisfying
- Quality, suitability and performance of public computers: satisfying

REFUGE AND RESEARCH HUTS

N.A.

*ENVIRONMENTAL IMPACT

*Sites Visited

Site name	Victoria Lower Glacier
Site location	S 77º 19’ 48.365’’, E 162º 31’ 55.491’’
Dates occupied	10 Nov to 03 Dec
Total days (or hours) at site	24 days
Maximum number of people at site	6
Total person-days (or person-hours) at site	107
Main activity undertaken	Ice Core Drilling

*Sites Visited

Site name	Polar Plateau (near Shapeless Mountain)
Site location	S 77º 21.092’, E 159º 52.226’
Dates occupied	04 Dec to 08 Dec 01
Total days (or hours) at site	5 days
Maximum number of people at site	3
Total person-days (or person-hours) at site	15
Main activity undertaken	Collection of snow samples from snow pit

Protected Areas Visited

N.A.

Interference

N.A.

Geological Material

Location	Victoria Lower Glacier
Specimen type	Ice
Quantity (kg)	4700 lb

Location	Polar Plateau (near Shapeless Mountain)
Specimen type	Snow
Quantity (kg)	120 lb

Chemicals

Chemical form	Isopropyl Alcohol
Quantity used	5 L
Location of use	Victoria Lower Glacier
Storage/release details of unused chemicals	

Explosives

N.A.

Importation

N.A.

Fig.3: Casing of the Victoria Lower Glacier Drilling hole

Equipment installed/left in field

The drilling hole at Victoria Lower Glacier has been cased and capped to preserve the hole for future measurements. The casing consists of a 2.50m long, 5'' diameter plastic tubing, capped with plywood. Once the measurements are completed the casing can easily be removed.

*Other environmental impacts

All activities were based on permanent ice surfaces. Environmental impacts were less than minor.

*Differences from original Preliminary Environmental Evaluation (PEE)

None

HISTORIC SITES

N.A.

PROTECTED AND MANAGED AREAS

N.A.

ANTARCTIC GEOGRAPHIC PLACE NAMES

N.A.

K049
2001/02

IMMEDIATE SCIENCE REPORT

K049 Holocene Climate History from Coastal Ice
ANTARCTICA NEW ZEALAND 2001/02

Event Personnel :

Ms. Nancy Bertler	Antarctic Research Centre, Victoria University of Wellington
Prof. Peter Barrett	Antarctic Research Centre, Victoria University of Wellington
Mr. Alex Pyne	Antarctic Research Centre, Victoria University of Wellington
Mr. Tony Kingan	Webster Drilling, Wellington
Mr. Bruce Koçi	Ice Core Drilling Service, NSF University of Wisconsin, Madison
Ms. Nora Patterson	Victoria University of Wellington
Mr. Matt Hill	Victoria University of Wellington

1 Popular Summary of Scientific Work Achieved

Victoria Valley is the northernmost and largest of the McMurdo Dry Valleys, which lie within the Transantarctic Mountains and between the Ross Sea and the East Antarctic Ice Sheet. Differences in moisture and temperature of air masses originating from either the East Antarctic Ice Sheet, the rocky area of the Dry Valleys or the Ross Sea form a sensitively balanced climate system where they meet in the Victoria Valley. Therefore a climate record of the Victoria/Valley provides an ideal opportunity to study rapid, high frequency climate variations.

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During the 2001/2002 field season a 180m core was recovered from Victoria Lower Glacier. The ice was expected to provide a climate record for the last 8,000 to 10,000 years. The site was chosen for its location and for the glaciological characteristics of the site, which were determined with ground penetrating radar and mass balance measurements.

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2 Proposed Programme

The 2001/2002 season focused on *'Holocene Glacial Ice – a Continuous Paleothermometer'*, the last of three dependent objectives addressed in this 3 year project.

The main emphasis of this year's field season was:

- To recover a 200m deep ice core from Victoria Lower Glacier
- To re-visit GPS mass balance devices
- To record further weather observations from Victoria Lower Glacier
- To collect high resolution snow samples from the polar plateau

3 Scientific Endeavours and Achievements

The last field season of our project: *Holocene Climate History from Coastal Ice* was interesting and successful. Two sites were visited: Victoria Lower Glacier and the Polar Plateau (near Shapeless Mountain).

Victoria Lower Glacier S 77º 19' 48.365'', E 162º 31' 55.491''

Mass Balance Measurements

Mass balance measurements provide valuable information on glaciological characteristics that are important for the interpretation of the ice core record. A GPS base station (Fig.1) was installed (S 77º 20' 38.109'', E 162º 35' 37.592'') to revisit and measure mass balance devices (coffee can device) at Victoria Lower Glacier (Fig.2). Coffee can devices are used to measure the horizontal and vertical displacement of anchors placed at shallow depths (10's of meters) in the glacier. While the horizontal flow indicates how 'active' the glacier is (how many cm/year the ice travels from its accumulation centre), the vertical change is the result of compaction and the mass balance of the glacier. The measurements can be used to calculate the net accumulation (or ablation) of the glacier in t/y. Three such mass balance devices have been installed at Victoria Lower Glacier during season 1999/2000 and 2000/2001.

Fig.1 GPS base station

Fig.2 Coffee Can Device

Ice Core Drilling

In order to collect, store and process a 200m core, a field ice core laboratory / clean room was excavated (Fig.3). In the process 90m^3 (≈20t) of snow were moved. The temperature in the storage compartments had to be kept below –20ºC, a temperature that guarantees that the chemical and isotopic characteristics of the cores are conserved. At a depth of 2.70m we reached this temperature, a remanent of the cold winter wave that travels from the glacier surface downwards.

Fig.3 Field Ice Core Laboratory

Once the preparation for the drilling was completed, the drilling crew and the ICDS/NSF supplied electromechanical drill were flown to Victoria Lower Glacier. The drilling system worked well and we reached a depth of 180m (Fig.4). The processing crew extracted the core from the core barrel in the field laboratory in order to avoid contamination. The cores were then cleaned from cuttings (Fig.5), packed in "layflat" tubing, measured (Fig.6), and finally logged (Fig.7) before stored in the 'freezer' compartments of the snow pit. The ice cores were flown out to the transitional ice core facilities at McMurdo Station.

Fig.4: Alex Pyne and Tony Kingan drilling at Victoria Lower Glacier

Fig.5: Nora Patterson cleaning ice cores

The core quality deteriorated somewhat below 50m, a depth that coincides with a sharp boundary in the ground penetrating radar profile. This indicates that the ice below 50m could be older than first assumed, which makes the air enclosed in the ice potentially very interesting. The ICDS head ice core driller, Mr. Bruce Koçi, visited us in order to discuss possibilities to improve the core quality. Although some progress was made, in order to recover core material that is suitable for air bubble analysis a wet drilling system (electromechanical drill with drilling fluid) will have to be employed for this in future. The quality of the recovered core is sufficient for the proposed water and dust analysis. At Crary Laboratory the cores were split and sent to New Zealand and our collaboration partner, Prof. Paul Mayewski in the USA.

Fig.6: Nora Patterson and Matt Hill processing ice cores

Fig.7: Nancy Bertler logging ice cores

The drill hole was cased and capped (Fig. 8) to preserve the hole for future measurements, such as borehole temperature, magnetic susceptibility, transmissivity of light amongst others.

Fig.8: Cased and capped drilling hole

Weather Observations

Basic weather observations have been recorded twice daily using a Scott Base meteorology kit. The measurements included: air temperature, wind direction, wind strength, air pressure, cloud cover and height and visibility.

Polar Plateau (near Shapeless Mountain) S 77º 21.092', E 159º 52.226'

Fig.9: Nora Patterson and Matt Hill excavating a snow pit

The climatic system of the Dry Valley area is complex. In order to interpret the climate record contained in the ice cores from Victoria Lower Glacier it is necessary to trace air mass trajectories and to distinguish between marine and continental influences. For this reason snow profiles have been sampled along a transect from the coast towards the East Antarctic Ice Sheet during the 2000/2001 season. To complete this transect a snow profile representative for the polar plateau has been sampled (Fig.9). The samples will be used to identify the characteristics of continental air masses and to quantify global dust input. The snow was sampled with 1cm resolution in 60ml HDPE Nalgene bottles (Fig.10). The snow profile temperatures will be compared with the measurements from Victoria Lower Glacier.

Fig.10: Nancy Bertler collecting snow samples

4 Publications

BERTLER N., MAYEWSKI P., BARRETT P., SHULMEISTER J., PYNE A., DICKINSON W., KREUTZ K. (in prep): Antarctic Response to Solar Activity – A guideline for policy makers?

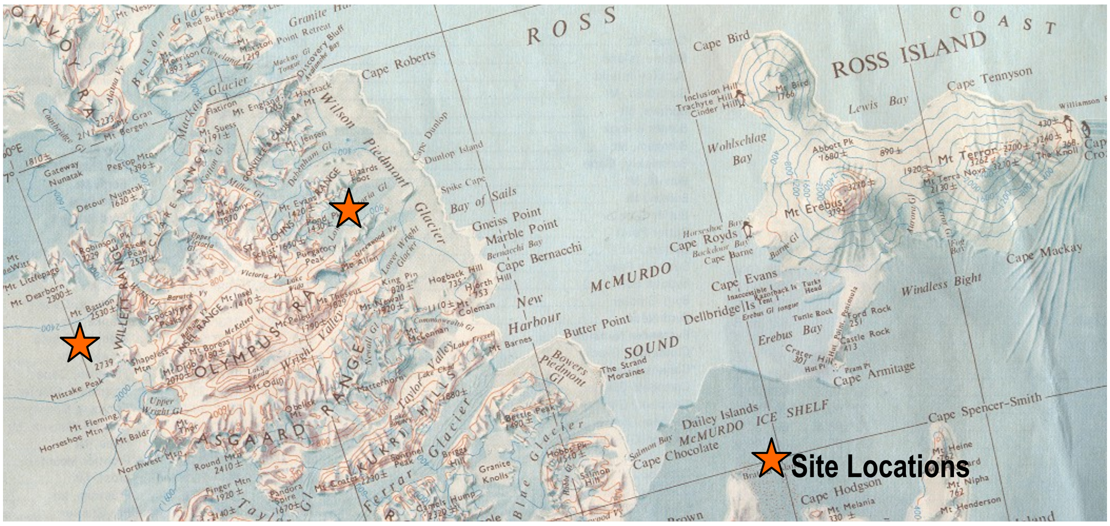
BERTLER, N. (in prep): Changes in Climate and Ice Cover of the South Victoria Land Coast over the last 10,000 years. PhD thesis. Victoria University of Wellington.

5 Acknowledgments

Many people were involved in the successful completion of this field season. Of particular note are:

- Peter Barrett, Alex Pyne, Jamie Shulmeister and Warren Dickinson for many useful discussions on scientific goals and field techniques
- Antarctic Research Centre, Victoria University for supporting this project
- Paul Mayewski for helpful discussions on ice core analysis and interpretation and for providing laboratory facilities in the United States
- Antarctica New Zealand for supporting this project
- NSF, Charlie Bentley and Bruce Koçi for supplying the drilling equipment and ice drilling expertise
- Webster Drilling for providing drilling expertise
- Scott Base staff, especially Jim Cowie and Keith Springer for logistical support
- Tim Haskell for providing freezer facilities in New Zealand
- Crary Laboratory for logistical and laboratory support at McMurdo Station
- FRST/PGSF for funding this project (grant VUW808)

EVENT MAP


ROSS
COAST
ROSS ISLAND
Cape Bird
Cape Tennyson
Lewis Bay
Wohlschlag Bay
Mt Erebus
Mt Terror
Cape Royds
Cape Barne
Cape Evans
McMURDO
SOUND
Windless Bight
Cape Mackay
Erebus Bay
Cape Armitage
Dellbridge Is
Dailey Islands
McMURDO ICE SHELF
Cape Chocolate
Cape Hodgson
Cape Spencer-Smith
Butter Point
New Harbour
Cape Bernacchi
Marble Point
Gneiss Point
Bay of Sails
Dunlop Island
Cape Roberts
Wilson Piedmont Glacier
OLYMPUS RANGE
ASGAARD RANGE
Wright Valley
Site Locations

K114
2001/02

LOGISTICS REPORT

K114: Geophysical investigations of the tectonic, sedimentary and volcanic history of the Victoria Land Basin: Site surveys for ANDRILL Project
ANTARCTICA NEW ZEALAND 2001/02

Event Personnel :

Dr T. Naish (Event PI)	GNS
Dr S. Bannister (Seismic leader)	GNS
Ms S. Thornton (Tech assistant)	GNS
Dr G. Wilson (Mag-Grav leader)	U of Oxford
Mr A. Clifford (Tech assistant)	U of Oxford
Ms K. Tinto (Student)	U of Oxford
Mr T. Jordon (Student)	U of Oxford
Dr J. Whitehead (Scientist)	U of Nebraska
Dr M. Lavelle (GPS scientist)	BAS
Dr D. Damaske (Aeromag leader)	BGR, Germany
Dr P. Moeller (Aeromag)	BGR, Germany
Mr A. Pyne (Drilling leader)	Victoria U of W
Mr R. Henderson (Seismic tech.)	Victoria U of W
Mr H. Horgan (Tech assistant)	Victoria U of W
Ms N. Balfour (Student)	Victoria U of W
Mr H. Caskey (Driller)	Webster Drilling
Mr T. Kingan (Driller)	Webster Drilling
Mr P. Moroney (Engineer)	Webster Drilling
Mr P. Rutland (Engineer)	Webster Drilling
Mr M. Collins (Mechanic)	Christchurch

*AIMS

The objectives of K114 were multifaceted and could be broadly split into 2 components: (1) geophysical surveys in New Harbour and on the McMurdo Ice Shelf, and (2) engineering work for the storage and maintenance of Cape Roberts camp and drilling systems to be used for the ANDRILL Project. Consequent the event was split-up into subevents:

K114P: Seismic shot hole drilling team (Pyne)
K114N: Seismic survey team (Naish)
K114W: Magnetic-gravity survey team (Wilson)
K114D: Aeromagnetic survey team (Damaske)
K114Webster: Installation of ANDRILL containers, CRP riser check (Rutland)

Our proposed scientific programme had two aims. Firstly, to accurately define the structural and stratigraphic architecture of the southern Victoria Land Basin in McMurdo Sound for the location of proposed ANDRILL Project drill sites. Secondly, to use this information to test and develop models of rift evolution and uplift of the Transantarctic mountains. Both objectives were to be achieved through an integrated geophysical survey involving a seismic reflection, ground-based gravity and magnetic measurements and an aeromagnetic survey. Collectively, the imaging/remote sensing of geological properties and Earth models derived from these techniques can provide information on the subsurface distribution, geometry and structure of (1) the basement floor of the basin, (2) rift-related and intraplate volcanoes, and (3) sediments infilling the basin.

Recent geological drilling, glacial geology and geophysical investigations demonstrate that understanding the evolution of sedimentary basins beneath the Ross Sea and Ross/McMurdo Ice Shelf is key to deciphering the evolution of the West Antarctic Rift, uplift of the Trans Antarctic Mountains (TAM) and Cenozoic ice cover history. The Victoria Land Basin has developed in response to the propagation of a rift system through west Antarctica and its sediments should record the mechanism and timing of uplift of the TAM together with its influence in Antarctic climate and ice sheet development.

This year, the programme acquired 40km of seismic reflection data in the New Harbour area and on the Ross/McMurdo ice shelf between Hut Point Peninsula and Ross Island. Three, 80 km line grids (New Harbour, Windless Bight/McMurdo Ice Shelf, Southern McMurdo Sound/McMurdo Ice Shelf) were traversed with magnetometer and gradiometer for gravity and magnetic measurements. An area of 5000km^2 was covered by a helicopter-borne aeromagnetic survey between Hut Point Peninsula, White Island and Minna Bluff/Brown Peninsula. Additionally differential GPS was used to estimate ice movement in the vicinity of proposed drill sites.

Our geophysical programme (of which year 1 is complete) is already providing information that can directly address some of the above issues. However, the value of this geophysical work will be fully realised once integrated with drill core records to be recovered by the ANDRILL project. Major progress has been made towards addressing the immediate goals of the research which are two-fold: (1) Use data to design a safe and successful drilling programme, and (2) to publish a geophysical account of the internal stratigraphic architecture of the Victoria Land Basin in southern McMurdo Sound region, particularly beneath the Ross/McMurdo Ice Shelf.

The research team lead by the Institute of Geological and Nuclear Sciences involved collaboration from the following institutes and countries:

- University of Oxford, UK. NERC-funded *"Evolution of Sedimentary Basins in Southern McMurdo Sound: Implications for Antarctic tectonic and climate history".*
- British Antarctic Survey, UK – use of seismic equipment
- University of Nebraska, USA – NSF-funded *"Seismic and stratigraphic data acquisition and integration for Cenozoic tectonic and paleoenvironmental analysis in McMurdo Sound"*
- Geological and Nuclear Sciences, NZ – FRST-funded *"Neogene Global Cooling – ANDRILL Site Survey Task"*
- Victoria University of Wellington, Antarctic Research Centre – Internal funding
- Bundesanstalt fuer Geowissenscaften und Rohstoffe, Germany

Webster Drilling and Exploration (Sub-contract)

*PERSONNEL

Name	Designation	Organisation	Departed Chch	Returned Chch
K114N				
T Naish	Event PI	GNS	11-Oct-01	20-Nov-01
S Bannister	Seismic Team Leader	GNS	11-Oct-01	20-Nov-01
M Lavelle	GPS Scientist	BAS	12-Oct-01	20-Nov-01
J Whitehead	Seismic scientist	U of Nebraska	11-Oct-01	5-Dec-01
R Henderson	Seismic technician	Victoria U of W	11-Oct-01	20-Nov-01
H Horgan	Seismic scientist	Victoria U of W	11-Oct-01	20-Nov-01
M Collins	Mechanic	Christchurch	11-Oct-01	20-Nov-01
N Balfour	BSc (hons) student	Victoria U of W	31-Oct-01	20-Nov-01
K114P				
A Pyne	Drilling Team Leader	Victoria U of W	11-Oct-01	Transferred to another event 15-Nov-01
T Kingan	Driller	Webster D & E	11-Oct-01	Transferred to another event 15-Nov-01
H Caskey	Driller	Webster D & E	11-Oct-01	20-Nov-01
K114W				
G Wilson	Gravity/Magnetics Team Leader	U of Oxford	26-Oct-01	29-Nov-01
S Thornton	Technical Assistant	GNS	26-Oct-01	29-Nov-01
A Clifford	Technical Assistant	U of Oxford	26-Oct-01	29-Nov-01
K114W(cont.)				
G Wilson	Gravity/Magnetics Team Leader	U of Oxford	30-Oct-01	Transfer to K114D
K Tinto	Student	U of Oxford	30-Oct-01	26-Jan-02
T Jordon	Student	U of Oxford	30-Oct-01	26-Jan-02
K114D				
D Damaske	Aeromag Leader	BGR, Germany	7-Jan-01	1-Feb-02
G Wilson	Data processing	U of Oxford	Transfer from K114W (Cont.)	1-Feb-02
P Moeller	Aeromag Tech	BGR, Germany	7-Jan-01	1-Feb-02

K114Webster				
P Moroney	Team leader	Webster D & E	24-Jan-02	10-Feb-02
P Rutland	Team leader	Team leader	24-Jan-02	10-Feb-02

*PLANNING

- **Application process:** Fine – no problems. Except for on-going issue of how to deal with science proposals with a multi-year, multinational, multifunded programme such as ANDRILL. However, this is being worked through.
- **Communications with Antarctica New Zealand staff:** Excellent
- **Provision of maps and aerial photographs:** No issues here
- **Pre-season information:** Logistics support allocations and information was very late. This was because of a change over to a new field operations manager and the size and complexity of K114. However, resources requested were eventually allocated and communication with Ant. NZ staff excellent.
- **Medicals, documentation and flights to Antarctica:** I have anumber of issues with the medical approvals: 1. The forms arrived too late. 2. The assessment of the forms was too late and left very little time for replacing team members who "failed". 3. I'm not convinced that the assessment criteria are consistent reasonable. Communication between Ant NZ "doctor" and event members or their doctor was very poor in the case of our "failed" team member.

Other comments: Although plenty of advance warning and information was provided on transport of explosives from ChCh to McM, a problem with compatibility of product with USAF codes was not anticipated and resulted in our explosives (Anzomex boosters) not being flown south. This would have jeopardised a significant part of the event had the USAP not been able to loan us replacement explosives. My feeling is that this problem could have been foreseen if Ant NZ movements staff had communicated more widely with USAF/USAP regarding requirements following approval of the dangerous goods flight negotiated by Julian Tangaere with NSF staff (Brian Stone) in June/July 2001. Moreover, as event leader I should have ensured that Orica Explosives had provided adequate documentation. Notwithstanding this the USAF code problem was not foreseen by any of the parties. This is because previously used ICI explosive product had USAF code approval.

CARGO

Cargo Item	Qty	Approx. Weight (if known)
Drilling system container	1	
Seismic recorder box	1	
Boxes of seismic detonators	2	
Equipment boxes	4	
Seismic cable pallet	2	

Other comments: I simply do not have all this information. You should have it on file. Gary Wilson and Webster Drilling and Exploration can provide remainder of information on request

*PREPARATIONS FOR THE FIELD

- Reception and planning for your event:

Our event was one of the first big events to be staged at Scott Base that season. The base engineering crew were fresh, but provided us with a good level of support. K114 N and P (seismic teams) included an experienced mechanic who had wintered in 1992 (Mike Collins) and new his way around ANT NZ equipment and Scott Base. Mike and the drilling team were able to prepare our equipment (primarily the Hagglunds with seismic gear and the drill rig), without any real demands on the time of the engineering staff. The only real pressure placed on the engineering staff was to provide space in the garage for staging vehicles and sledges. Jim Cowie and the Field Operations Officer did a good job at allocating resources to a complicated and multi-facetted event.

- Availability and condition of equipment received:

All resources requested were available. The Alpine skidoos were the oldest at Scott Base and consequently broke down in New Harbour on two occasions. We understand the reluctance to allow newer skidoos to do sea-ice work, but these skidoos did not break down due to mal-treatment. Polar tents were adequate as weather was generally good, however they were old and would not have held up well in a big storm.

- -Field training:

Fine

- Field party equipment 'shakedown' journey

Not required

- Delays at Scott Base, whatever the cause

Problem with explosives arriving from ChCh by USAF

Problem with surveying through the approach to the "white-out landing zone"

- Safety and Risk Management processes

Explosives transport and handling protocol was lodged with ANT NZ Operations Manager and followed out in the field. Each team had a nominated safety officer. Seismic operations were carried out to industry safety standards. Areas for sea-ice activities were carefully checked out by Alex Pyne. Webster Drilling members followed guidelines outlined in their safety manual for polar regions. All activities were carried out subject to the field operating guidelines adhered to by Antarctica New Zealand.

Other comments:

FIELD TRANSPORT

- Vehicles: In general no issues. However, inadequate heavy plant was allocated by ANT NZ engineering to tow the New Harbour camp back to Scott Base. A D3 was sent while the D6 sat idol at Scott Base. There was no adequate explanation for this. The return trip was 22hrs in duration. It raised a number of safety issues for personnel driving the D3 and the accompanying Hagglunds. Mike Collins our mechanic had to relieve the ANT NZ plant operator who fell asleep in the D3. This placed undue stress on my team members who had just finished a physically demanding period of field work and placed all concerned in a dangerous situation
- Aircraft Operations: Helicopter operations - HNZ excellent and really helpful, some

problems arose from miscommunication regarding aeromag survey requirements in advance. This could have been solved by earlier communication between GSW and pilots rather than backwards and forwards between several people - a sort of pre event brief in NZwould have been good. But I realise the final planning for this happened very late in the season and all problems were quickly solved on ice. But we could have ensured a more functional operation by sorting this out earlier. No blame on any party just an observation that a pre-brief in NZ to work through requirements would have helped.

Major Issue with USAF over transport of Orica explosive product that could have jeopardised season (see above). However, we are very appreciative of the efforts made by Jim Cowie and Julian Tangaere that enabled fieldwork to continue. Particularly we are indebted to USAP "master blaster" for providing replacement product.

- Ship Operations: N/A

Other comments:

***Event Diary**

K114 Naish	
11-Oct-01	ChCh-Scott Base
12-Oct-01	Seismic gear set up in Hagglunds, Horgan, Henderson, Collins and Whitehead field training
13-Oct-01	Seismic gear set up in Hagglunds, Horgan, Henderson, Collins and Whitehead field training
14-Oct-01	Seismic gear set up in Hagglunds, and field supply set-up.
15-Oct-01	Finalise preparations at Scott Base
16-Oct-01	Receive explosives from USAP magazine
17-Oct-01	Set-up sledge train and depart for New Harbour, 7 hours travel then camp set-up
18-Oct-01	Camp set up, and line surveying
19-Oct-01	Shot testing
20-Oct-01	Shot test and continue line flagging and surveying
21-Oct-01	Seismic survey, electronic problems due to cold – slow progress
22-Oct-01	Seismic survey, electronic problems due to cold – slow progress
23-Oct-01	Seismic survey, electronic problems due to cold – slow progress
24-Oct-01	Seismic survey
25-Oct-01	Finish NHS-1 and pack up, move to NHS-2
26-Oct-01	Seismic survey
27-Oct-01	Seismic survey
28-Oct-01	Seismic survey
29-Oct-01	Finish shooting NHS-2
30-Oct-01	Pack-up seismic gear and camp, Naish to Scott Base by helo.
31-Oct-01	D3 train to move camp back to Scott Base. Some gear left for K114W
1-Nov-01	Day off, Naish and Bannister begin flagging MIS-1

2-Nov-01	Preparation of camp for relocation to MIS-1, Windless Bight, Surveying and flagging of the seismic line.
3-Nov-01	Relocation to Windless bight camp by tractor train and camp set-up
4-Nov-01	Seismic survey
5-Nov-01	Seismic survey
6-Nov-01	Seismic survey
7-Nov-01	Seismic survey
8-Nov-01	Camp-bound by bad weather
9-Nov-01	Dig out camp, survey continues
10-Nov-01	Camp-bound by bad weather
11-Nov-01	Seismic survey filmed for National Geographic
12-Nov-01	Seismic survey of MIS-1 completed
13-Nov-01	Pack up gear and return to Scott Base
14-Nov-01	Pack up gear
15-Nov-01	Pack up gear
16-Nov-01	Pack up gear, Naish and Lavelle help K114W GPS with surveying and flagging of the grav/mag lines
17-Nov-01	Pack up gear, Naish and Lavelle help K114W GPS with surveying and flagging of the grav/mag lines
18-Nov-01	Naish and Lavelle help K114W GPS with surveying and flagging of the grav/mag lines
19-Nov-01	K114N await flight home

K114 Pyne	
11-Oct-01	ChCh-Scott Base
12-Oct-01	Antarctic field training H Caskey/Rig set-up
13-Oct-01	Antarctic field training H Caskey/Rig set up
14-Oct-01	Rig set-up
15-Oct-01	Rig test
16-Oct-01	Receive explosives from USAP magazine
17-Oct-01	Set-up sledge train and depart for New Harbour, 7 hours travel then camp set-up
18-Oct-01	Camp set up, drill test, and survey line
19-Oct-01	Shot testing
20-Oct-01	Shot test and begin production drilling of shots holes, 38 holes completed
21-Oct-01	56 holes completed, NHS-1 completed
22-Oct-01	Flag and survey, NHS-2 completed
23-Oct-01	80 production holes completed
24-Oct-01	34 holes and NHS-2 completed
25-Oct-01	Mark out mag/grav survey lines for K114W
26-Oct-01	Mark out mag/grav survey lines for K114W
27-Oct-01	New Harbour to Scott Base
28-Oct-01	Day off
29-Oct-01	Gear up rig and transport to Windless Bight
30-Oct-01	Gear up wannigan and food
31-Oct-01	Relocate south of White-out landing zone

1-Nov-01	Drilling trials and DV visit
2-Nov-01	10 production holes drilled
3-Nov-01	22 production holes drilled
4-Nov-01	10 production holes drilled
5-Nov-01	22 production holes drilled
6-Nov-01	22 production holes drilled
7-Nov-01	26 production holes drilled
8-Nov-01	Camp-bound by bad weather
9-Nov-01	Dig out camp, 17 holes drilled
10-Nov-01	Camp-bound by bad weather
11-Nov-01	30 holes drilled, filmed for National Geographic
12-Nov-01	Finish drilling Line MIS-1, 36 holes completed
13-Nov-01	Pack up gear
14-Nov-01	Pack up gear
15-Nov-01	Kingan to another event. Caskey waits for flight from Scott Base - ChCh
K114 Wilson	
24-Oct-01	Wilson, Thornton, Clifford delayed ChCh
25-Oct-01	Wilson, Thornton, Clifford delayed ChCh
26-Oct-01	Wilson, Thornton, Clifford ChCh-Scott Base
27-Oct-01	Field Preparations, Thornton and Clifford field training
28-Oct-01	Field Preparations, Thornton and Clifford field training
29-Oct-01	Equipment testing
30-Oct-01	Equipment testing
31-Oct-01	Finalise preparations at Scott Base
1-Nov-01	Calibrate equipment to Scott Base base stations, field put in to New Harbour
2-Nov-01	GPS and gravity base station set up, begin magnetics and gravity survey line 1
3-Nov-01	establish ice movement positions, magnetics and gravity survey line 1
4-Nov-01	establish ice movement positions, magnetics and gravity survey line 2
5-Nov-01	magnetics and gravity survey line 2
6-Nov-01	magnetics and gravity survey line 3
7-Nov-01	magnetics and gravity survey line 3 partial day only due to bad weather
8-Nov-01	magnetics and gravity survey line 4
9-Nov-01	magnetics and gravity survey line 4
10-Nov-01	camp bound by bad weather
11-Nov-01	reoccupy ice movement positions, take skidoo to marble point, camp pack-up and return to Scott Base
12-Nov-01	Rest Day
13-Nov-01	Field preparations, Helicopter reconaissance over ice shelf
14-Nov-01	Field preparations
15-Nov-01	Calibrate equipment to Scott Base base stations, field

	put in to Windless Bight, set-up gravity base station
16-Nov-01	magnetics and gravity survey line 1
17-Nov-01	magnetics and gravity survey lines 1 and 2
18-Nov-01	magnetics and gravity survey lines 2 and 3
19-Nov-01	magnetics and gravity survey lines 3 and 4
20-Nov-01	magnetics and gravity survey lines 4 and 5
21-Nov-01	reoccupy ice movement positions
22-Nov-01	Camp pack-up and return to Scott Base
23-Nov-01	Immediate processing of base station data
24-Nov-01	Immediate processing of base station data
25-Nov-01	Immediate processing of base station data
26-Nov-01	magnetics and gravity survey HPP-1 line
27-Nov-01	Immediate processing of base station data, pack-up
28-Nov-01	Immediate processing of base station data, pack-up
29-Nov-01	Wilson, Thornton, Clifford await flight to NZ
K114W cont...& D	
30-Dec-01	Wilson, Tinto, Jordan ChCh-Scott Base
31-Dec-01	Field Preparations, Tinto and Jordan field training
1-Jan-02	Field Preparations, Tinto and Jordan field training
2-Jan-02	Equipment testing
3-Jan-02	Calibrate equipment to Scott Base base stations, field put in to Black Island, crevasse investigation
4-Jan-02	GPS and gravity base station set up, establish ice movement positions
5-Jan-02	magnetics and gravity survey line A
6-Jan-02	magnetics and gravity survey line B
7-Jan-02	magnetics and gravity survey lines B and C
8-Jan-02	magnetics and gravity survey lines C and D
9-Jan-02	magnetics and gravity survey lines E, F and G, Damaske and Moeller ChCh-Scott Base
10-Jan-02	reoccupy ice movement positions, camp pack-up, establish Pegasus Road magentic base station
11-Jan-02	magnetics and gravity survey line 4
12-Jan-02	camp bound by bad weather
13-Jan-02	reoccupy ice movement positions, take skidoo to marble point, camp pack-up and return to Scott Base
14-Jan-02	Rest Day
15-Jan-02	Set-up for Aeromag survey
16-Jan-02	Aeromag survey, magnetic base station download
17-Jan-02	Aeromag survey
18-Jan-02	Aeromag survey affected by weather
19-Jan-02	Aeromag survey affected by weather
20-Jan-02	Helicopter support of gravity survey, Magnetic base station download, Aeromag survey affected by weather
21-Jan-02	Aeromag survey
22-Jan-02	Aeromag survey affected by weather
23-Jan-02	Aeromag survey affected by weather
24-Jan-02	Aeromag survey

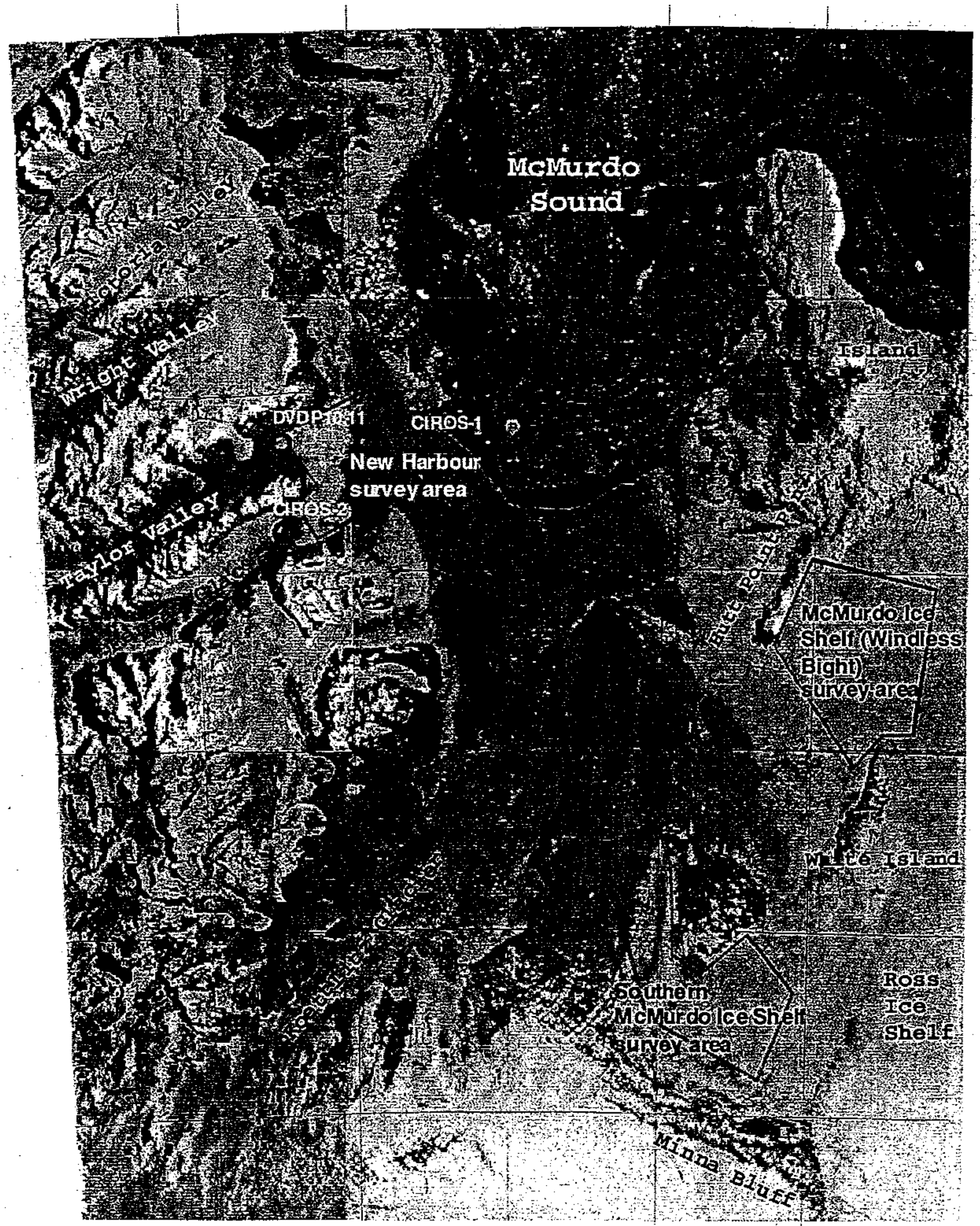
25-Jan-02	Aeromag survey affected by weather
26-Jan-02	Aeromag survey affected by weather, Tinto and Jordan return to NZ
27-Jan-02	Aeromag survey, magnetic base station collection and download
28-Jan-02	Aeromag survey
29-Jan-02	Magnetic base station collection and download Equipment Pack-up
30-Jan-02	Immediate Data Processing, Equipment, pack-up, Moeller returns to NZ
31-Jan-02	Immediate Data Processing
1-Feb-02	Damaske and Wilson retrun to NZ
K114 Webster	
22-Jan-02	Travel to Christchurch.
	Kit-up at Antarctica NZ.
23-Jan-02	Check-in @ 0700.
	Board C130 and get to end of runway.
	Flight aborted due to weather on ice.
	Afternoon working on Webster
	Drilling equipment in Christchurch.
24-Jan-02	Check-in @ 0700.
	Fly to Scott Base arrive 1800.
25-Jan-02	Scott Base orientation.
	Meeting with Jim Cowie.
	Overview of CRP equipment with
	Jim and electrician.
	Sled with riser by D6 to workshop.
	Empty sled to near workshop.
	Remade pipe mouse.
	Test riser pipes : 8 lengths.
26-Jan-02	Pipe dope from Cape Roberts gear.
	Test riser pipes : 40 lengths.
	: need more sponge bungs for riser
27-Jan-02	Test riser pipes : 22 lengths.
	Discussion with Gary re magnetisation.
28-Jan-02	*Antarctic Field Training.*
29-Jan-02	*Antarctic Field Training.*
	Back to Scott Base by 1100.
	Finish testing 5.5m riser pipes : 11 lengths
	Use D6 to arrange sleds.
	Two sleds with half of pipes on each.

	Test riser shorts : 19 lengths.
30-Jan-02	Clear site for containers.
	Sort out gear for New Zealand.
	Move floats to try and look at mud.
	Mud count impossible without
	container totally emptied.
	Check containers for shipping
	to New Zealand.
	Check with Alex exact requirements.
	Unload augers and batteries from
	Webster Drilling equipment.
	Repack Webster Drilling gear.
31-Jan-02	Get all equipment up to top
	container site.
	Go through CRP containers with Gary.
	Drill holes and set pile pins.
	Used Scott Base compressor.
	Inspect internal tie downs in NZ
	containers with US loadmaster.
01-Feb-02	Unload CRP walkway and pull stays.
	Stack against NZ containers for
	onloading onto 40' turnaround
	container coming on the boat.
	Make and secure lids for all boxes
	inside the containers.
	Mark out post heights for container
	stands with SB carpenter and level.
	Cut posts to length and weld to
	anchor plates.
	Meeting with Jim Cowie about siting
	of the rod sleds.
02-Feb-02	Move rod sleds up to Cape Roberts gear
	Attempt to lift Emily shed with loader and
	prepare for shipping - too heavy need crane
	Load stairway and walkway for McMurdo.
	Start unloading Alaners
03-Feb-02	*McMurdo look around.*
	Skiing in afternoon.
04-Feb-02	Unload 40' container of polystyrene
	for septic tank.
	Move container over to CRP area and
	load Longyear mast and support beams.
	Secure inside of container with binders.

	Clean dirt off Emily base.
	Attempt to move mud container for
	inventory - too heavy.
	Assist unloading beer container.
	Assist unloading meat and veg container.
05-Feb-02	Remove batteries from CRP generators
	and charge up.
	Test and fix mobile Herman heater.
	Assist unloading containers from ship.
	Set up welder and gas at workshop
	container.
	Set up angle iron container base.
	Weld up base while testing generators.
	Princess Anne visit meeting.
06-Feb-02	After loader washdown clean cold porch.
	Finish welding container frame.
	Put away all gear.
	Clean up container site.
	Unload container with sewerage plant
	frames and take to site.
	Hot water rig container up to CRP site.
	Shift mud container forward with D6.
	Check out 6m HQ and NQ rods.
	: need stripping down to 3m lengths
	: threads need to be doped
	: corner towing hitch on mud container
	needs straightening and welding
	ANDRILL containers arrived.
	Trip to Cape Evans in evening.
07-Feb-02	Pick up dunnage from CRP and SB
	container sites with motorbike and trailer.
	Unload ANDRILL containers.
	Can not lift ANDRILL containers onto
	frame - need crane (booked for Monday)
	Princess Anne arrives.
08-Feb-02	Continue unloading containers.
	Dope up NQ inner tubes.
	Assist moving lathe.
09-Feb-02	Stack some CRP gear in ANDRILL
	container.
	Scott plaque unveiling.
	Unload rest of containers.
	Finish stacking CRP gear.

	Move drill pipe to bottom.
	Scott Base dinner for HRH.
10-Feb-02	Fly to Christchurch.
	Moroney to Wellington.
	Rutland stays in Christchurch.

EVENT MAP



*WEATHER
Great

*ACCIDENTS, INCIDENTS OR HAZARDS
NIL

FIELD EQUIPMENT
Field training - ensure an element of use of clothing etc properly is included. Building a shelter and travel is only a small component of what we require for safe operations in the field.

Field staging was very awkward and difficult - I understand Ant NZ is addressing this but it needs restating that this is a top priority.

Field equipment and food. Different groups have different requirements - better liaising with groups prior to deployment would help ensure this is better adapted to different groups.

RADIO COMMUNICATIONS

- Communications - some comms operators were very good, some not. The not so good ones made things difficult. But we would suggest that the SB ops manager get on the radio for a daily scheduled with parties to keep updated with operations and requirements and it is much easier to communicate this with SB ops rather than comms operators that do not understand the environment and requirements.

SCOTT BASE AND ARRIVAL HEIGHTS LABORATORY FACILITIES

Facility	Use
Hatherton Geoscience Laboratory	Great to have an office allocated for duration
Q-Hut Laboratory benches	NA
Scott Base Wet Laboratory	NA
Scott Base Summer Laboratory	NA
Arrival Heights Laboratory	NA

COMPUTER FACILITIES

- Excellent given band limitations

REFUGE AND RESEARCH HUTS

Refuge/research hut name	
Overall condition	
Scale and condition of provisions	

Suitability of location	
Unnecessary equipment or rubbish/debris in the area	

Other comments:

*ENVIRONMENTAL IMPACT

*Sites Visited

Site name	New Harbour sea-ice
Site location	See Map
Dates occupied	17th-Oct to 11th-Nov
Total days (or hours) at site	25
Maximum number of people at site	14
Total person-days (or person-hours) at site	150
Main activity undertaken	Geophysical surveys of sub-sea ice

Protected Areas Visited

Protected Area name	N/A
Date of entry	
Total time spent in area	
Maximum number of people in area	
Total person-days (or person-hours) at area	
Comments on condition or management of area	

Interference

Species	N/A
Location	
Dates or periods of collection or disturbance	
Total number or quantity removed, restrained or disturbed	
Nature of interference	

Geological Material

Location	N/A
Specimen type	
Quantity (kg)	

Chemicals

Chemical form	N/A
Quantity used	
Location of use	
Storage/release details of unused chemicals	

Explosives

Date used	19th to 29th of Nov

Location of use	3-13 kms east of Taylor Valley on sea ice and 15 to 25 kms east of Ferrar Valley on sea ice in New Harbour
Explosive type	Orica licensed Anzomex PPP primers and seismic detonators
Size of charge (kg)	3 x 0.4kg PETN ANZOMEX PPP primers per shot
Number exploded	650

Importation

Name of species/substance	N/A
Location(s) taken to	
Quantity released	
Returned to New Zealand?	

Equipment installed/left in field

Type of equipment/marker installed	N/A
Location of installation/left in field	
Size of items left in field	
Number of items left in field	
Date of intended retrieval	

***Other environmental impacts**
NIL

***Differences from original Preliminary Environmental Evaluation (PEE)**
No significant differences

*ENVIRONMENTAL IMPACT

***Sites Visited**

Site name	McMurdo/Ross Ice Shelf between Scott Base and White Island
Site location	See Map
Dates occupied	3rd to 26th Nov
Total days (or hours) at site	23
Maximum number of people at site	10
Total person-days (or person-hours) at site	161
Main activity undertaken	Geophysical surveys of sub ice shelf

Protected Areas Visited

Protected Area name	N/A
Date of entry	
Total time spent in area	
Maximum number of people in area	
Total person-days (or person-hours) at area	
Comments on condition or management of area	

Interference

Species	N/A
Location	
Dates or periods of collection or disturbance	
Total number or quantity removed, restrained or disturbed	
Nature of interference	

Geological Material

Location	N/A
Specimen type	
Quantity (kg)	

Chemicals

Chemical form	N/A
Quantity used	
Location of use	
Storage/release details of unused chemicals	

Explosives

Date used	4th to 13th of Nov
Location of use	5-25 kms east of Crater Hill on Ross/McMurdo ice Shelf
Explosive type	Orica licensed Anzomex PPP primers and seismic detonators
Size of charge (kg)	10x 0.4kg PETN ANZOMEX PPP primers per shot
Number exploded	2000

Importation

Name of species/substance	N/A
Location(s) taken to	
Quantity released	
Returned to New Zealand?	

Equipment installed/left in field

Type of equipment/marker installed	N/A
Location of installation left in field	
Size of items left in field	
Number of items left in field	
Date of intended retrieval	

*Other environmental impacts
NIL

*Differences from original Preliminary Environmental Evaluation (PEE)
No significant differences

*ENVIRONMENTAL IMPACT

***Sites Visited**

Site name	McMurdo Ice Shelf between Brown Peninsula/Black Island and Mt Discovery/Minna Bluff
Site location	See Map
Dates occupied	4th to 13th Jan
Total days (or hours) at site	9
Maximum number of people at site	4
Total person-days (or person-hours) at site	36
Main activity undertaken	Geophysical surveys of sub ice shelf

Protected Areas Visited

Protected Area name	N/A
Date of entry	
Total time spent in area	
Maximum number of people in area	
Total person-days (or person-hours) at area	
Comments on condition or management of area	

Interference

Species	N/A
Location	
Dates or periods of collection or disturbance	
Total number or quantity removed, restrained or disturbed	
Nature of interference	

Geological Material

Location	N/A
Specimen type	
Quantity (kg)	

Chemicals

Chemical form	N/A
Quantity used	
Location of use	
Storage/release details of unused chemicals	

Explosives

Date used	N/A
Location of use	
Explosive type	
Size of charge (kg)	
Number exploded	

Importation

Name of species/substance	N/A
Location(s) taken to	
Quantity released	
Returned to New Zealand?	

Equipment installed/left in field

Type of equipment/marker installed	N/A
Location of installation left in field	
Size of items left in field	
Number of items left in field	
Date of intended retrieval	

***Other environmental impacts**
NIL

***Differences from original Preliminary Environmental Evaluation (PEE)**
No significant differences

HISTORIC SITES

Historic site name	
General observations on site condition	

Other comments:

PROTECTED AND MANAGED AREAS

N/A

ANTARCTIC GEOGRAPHIC PLACE NAMES

Location of Feature	Type of Feature	Proposed Name

K114
2001/02

IMMEDIATE SCIENCE REPORT

K114: Geophysical investigations of the tectonic, sedimentary and volcanic history of the Victoria Land Basin: Site surveys for ANDRILL Project

ANTARCTICA NEW ZEALAND 2001/02

Event Personnel:

Dr T. Naish (Event PI)	GNS
Dr S. Bannister (Seismic leader)	GNS
Ms S. Thornton (Tech assistant)	GNS
Dr G. Wilson (Mag-Grav leader)	U of Oxford
Mr A. Clifford (Tech assistant)	U of Oxford
Ms K. Tinto (Student)	U of Oxford
Mr T. Jordon (Student)	U of Oxford
Dr J. Whitehead (Scientist)	U of Nebraska
Dr M. Lavelle (GPS scientist)	BAS
Dr D. Damaske (Aeromag leader)	BGR, Germany
Dr P. Moeller (Aeromag)	BGR, Germany
Mr A. Pyne (Drilling leader)	Victoria U of W
Mr R. Henderson (Seismic tech.)	Victoria U of W
Mr H. Horgan (Tech assistant)	Victoria U of W
Ms N. Balfour (Student)	Victoria U of W
Mr H. Caskey (Driller)	Webster Drilling
Mr T. Kingan (Driller)	Webster Drilling
Mr P. Moroney (Engineer)	Webster Drilling
Mr P. Rutland (Engineer)	Webster Drilling
Mr M. Collins (Mechanic)	Christchurch

1 Popular Summary of Scientific Work Achieved

The objectives of K114 were multifaceted and could be broadly split into 2 components: (1) geophysical surveys in New Harbour and on the McMurdo Ice Shelf, and (2) engineering work for the storage and maintenance of Cape Roberts camp and drilling systems to be used for the ANDRILL Project. This report summarises the immediate results of year 1 of our 2-year geophysics programme. Our multinational team (UK, USA, Germany and NZ) undertook seismic reflection, aeromagnetic, ground-magnetic and gravity surveys to image the structure and geometry of key sedimentary depocentres and associated volcanoes in the Southern McMurdo Sound sector of the Victoria Land Basin. The interrelationship of the volcanoes and sediments, the geometry of the sedimentary sequences and the response of the sedimentary basin to loading by volcanic cones are all features that will be used to elucidate the nature of the Southern McMurdo Sound sector of the "West Antarctic Rift" and the mechanism for uplift of the associated Transantarctic Mountains. A key motivation of this work is to identify the best possible locations for stratigraphic drill holes proposed as part of the ANDRILL Project. Immediate scientific goals were to gain new knowledge of the development of the Victoria Land Basin and the adjacent Trans Antarctic Mountains, and to understand the relationship between volcanism and sedimentation in the vicinity of Ross Island and Minna Bluff. In terms of ANDRILL drill site location this new data has identified thick sedimentary sequences under the McMurdo Ice Shelf between Ross and White Islands and in New Harbour suitable for addressing ANDRILL Project science objectives. Specifically, the ANDRILL science objectives focus on gaining an understanding of past behaviour of the East Antarctic Ice Sheet and Ross/McMurdo Ice Shelf and their role on global climate processes. Key results from this season's work include:

(1) Identification of up to 1 km of sediment under the McMurdo Ice Shelf, in the "moat" east of Ross Island that has accumulated in the last 5 million years.
(2) Up to 500m thickness of sediment beneath the floor of the Taylor Valley in New Harbour.
(3) Imaging of the distribution volcanic and igneous rock beneath the McMurdo ice shelf.
(4) An understanding of the timing and nature of deformation associated with volcanic loading of the crust and its effect of stratigraphic geometry.
(5) New insights into the basement structure of the southern Victoria Land Basin.
(6) New estimates of bathymetry under the McMurdo Ice Shelf and in New Harbour
(7) Greatly improved understanding of the water depth, stratigraphy and rates of ice movement likely to be encountered at proposed ANDRILL drill sites.

2 Proposed Programme

Our proposed scientific programme had two aims. Firstly, to accurately define the structural and stratigraphic architecture of the southern Victoria Land Basin in McMurdo Sound for the location of proposed ANDRILL Project drill sites. Secondly, to use this information to test and develop models of rift evolution and uplift of the Transantarctic mountains. Both objectives were to be achieved through an integrated geophysical survey involving a seismic reflection, ground-based gravity and magnetic measurements and an aeromagnetic survey. Collectively, the imaging/remote sensing of geological properties and Earth models derived from these techniques can provide information on the subsurface distribution, geometry and structure of (1) the basement floor of the basin, (2) rift-related and intraplate volcanoes, and (3) sediments infilling the basin.

Recent geological drilling, glacial geology and geophysical investigations demonstrate that understanding the evolution of sedimentary basins beneath the Ross Sea and Ross/McMurdo Ice Shelf is key to deciphering the evolution of the West Antarctic Rift, uplift of the Trans Antarctic Mountains (TAM) and Cenozoic ice cover history. The Victoria Land Basin has developed in response to the propagation of a rift system through west Antarctica and its sediments should record the mechanism and timing of uplift of the TAM together with its influence in Antarctic climate and ice sheet development.

This year, the programme acquired 40km of seismic reflection data in the New Harbour area and on the Ross/McMurdo ice shelf between Hut Point Peninsula and Ross Island. Three, 80 km line grids (New Harbour, Windless Bight/McMurdo Ice Shelf, Southern McMurdo Sound/McMurdo Ice Shelf) were traversed with magnetometer and gradiometer for gravity and magnetic measurements. An area of 5000km^2 was covered by a helicopter-borne aeromagnetic survey between Hut Point Peninsula, White Island and Minna Bluff/Brown Peninsula. Additionally differential GPS was used to estimate ice movement in the vicinity of proposed drill sites.

Our geophysical programme (of which year 1 is complete) is already providing information that can directly address some of the above issues. However, the value of this geophysical work will be fully realised once integrated with drill core records to be recovered by the ANDRILL project. Major progress has been made towards addressing the immediate goals of the research which are two-fold: (1) Use data to design a safe and successful drilling programme, and (2) to publish a geophysical account of the internal stratigraphic architecture of the Victoria Land Basin in southern McMurdo Sound region, particularly beneath the Ross/McMurdo Ice Shelf.

The research team lead by the Institute of Geological and Nuclear Sciences involved collaboration from the following institutes and countries:

- University of Oxford, UK. NERC-funded *"Evolution of Sedimentary Basins in Southern McMurdo Sound: Implications for Antarctic tectonic and climate history"*.
- British Antarctic Survey, UK – use of seismic equipment
- University of Nebraska, USA – NSF-funded *"Seismic and stratigraphic data acquisition and integration for Cenozoic tectonic and paleoenvironmental analysis in McMurdo Sound"*
- Geological and Nuclear Sciences, NZ – FRST-funded *"Neogene Global Cooling – ANDRILL Site Survey Task"*
- Victoria University of Wellington, Antarctic Research Centre – Internal funding
- Bundesanstalt fuer Geowissenscaften und Rohstoffe, Germany
- Webster Drilling and Exploration (Sub-contract)

3 **Scientific Endeavours and Achievements**

<u>Objectives</u>

Undertake an integrated seismic, gravity and magnetic survey on seasonal sea-ice in New Harbour and the McMurdo Ice Shelf between Hut Point Peninsula-White Island-Black Island-Minna Bluff-Brown Peninsula (Fig.1) in order to:

1. Accurately define the structural and stratigraphic architecture of the Victoria Land Basin southern in McMurdo Sound for the location of proposed ANDRILL Project drill sites.

2. Test and develop models of rift evolution and uplift of the Transantarctic Mountains.

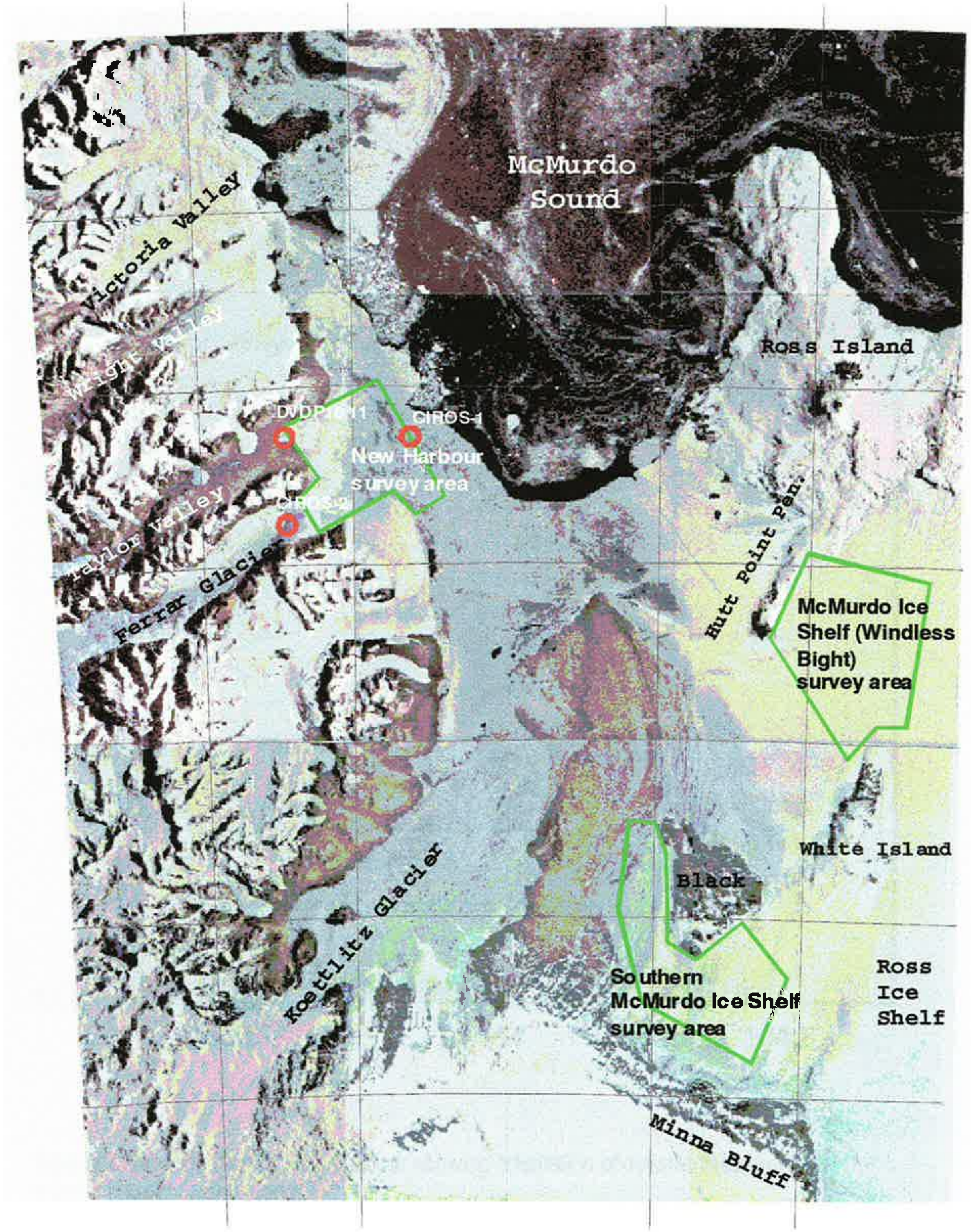


Figure 1. Composite Landsat image of southern McMurdo Sound showing the Transantarctic Mountains, Dry Valleys, southern McMurdo Sound volcanoes, and the major survey areas for the K114 01/02 field season.

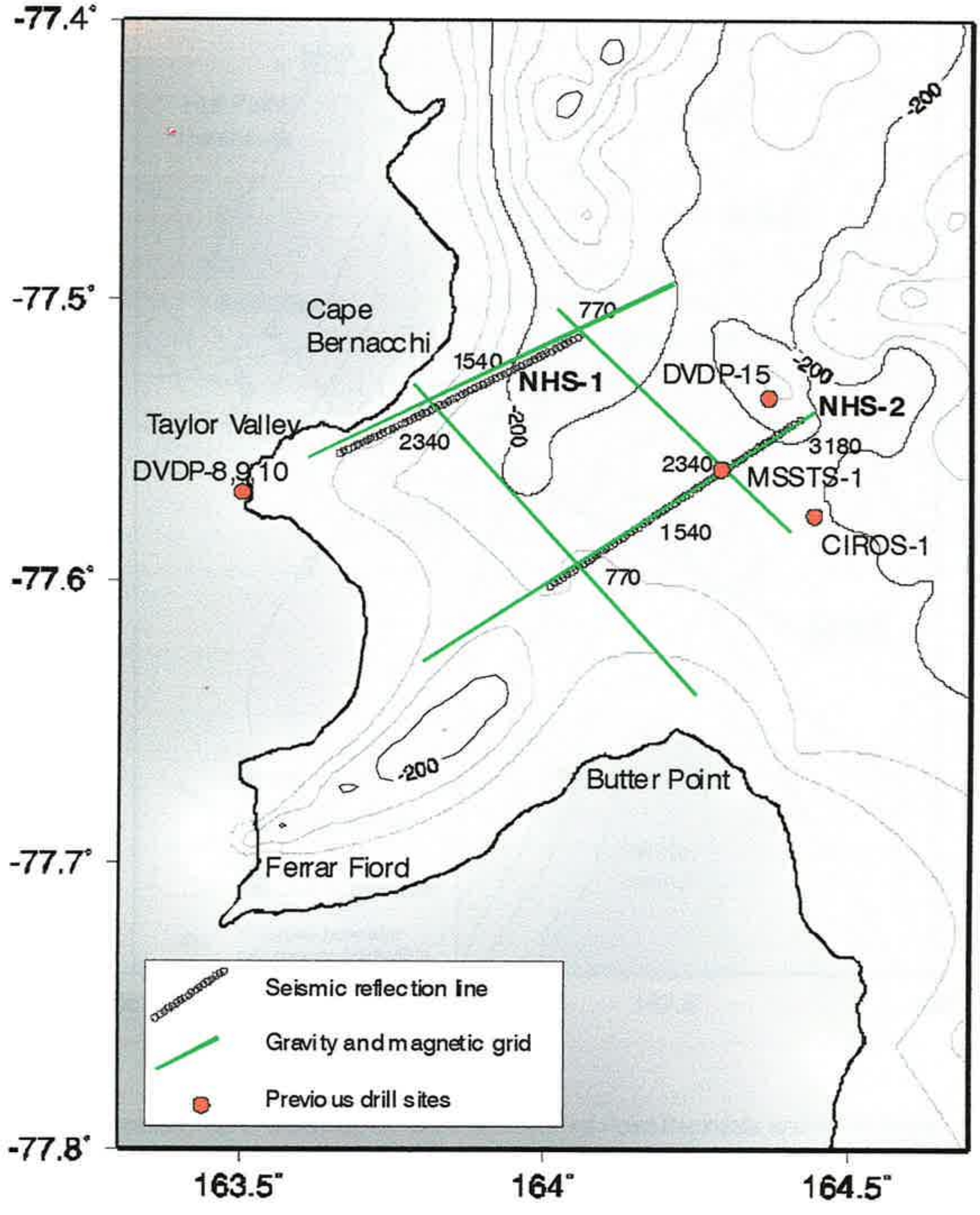


Figure 2. Location map of New Harbour showing orientation of seismic lines and the gravity/magnetic survey grid.

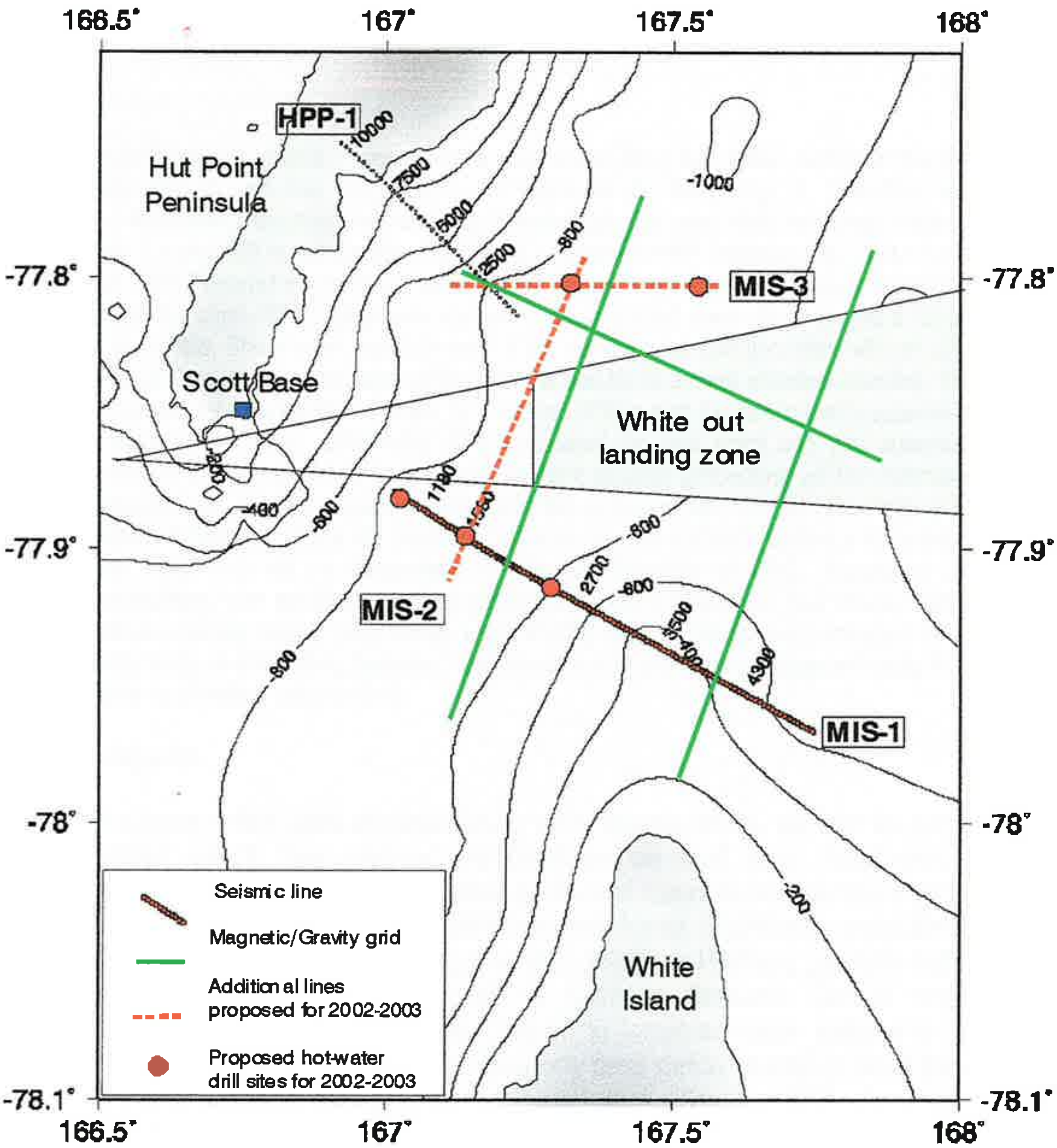


Figure 3. Location map of McMurdo ice Shelf between Hut Point Peninsula and White Island showing orientation of seismic line and the gravity/magnetic survey grid. Also shown are the proposed positions of hot-water drill sites and seismic lines to be acquired during the 2002-2003 season.

Methodology

Seismic

Multifold, normal-incidence seismic measurements were made along two, 10km profiles in the New Harbour region (Fig. 2) and one 19km line in the McMurdo Ice Shelf (Fig. 3). The data were recorded on a 48-channel Bison digital recording seismograph (On loan from the British Antarctic Survey). Shots, 1 every 100 m, consisting of 1.2 kg (3 x Anzomex PPP Primers) and 3.2-4.0 kg (8-10 x Anzomex PPP Primers) of explosive were placed at 5m below sea-ice in New Harbour and 18m depth in the ice shelf. 40 Hz geophone receivers will be placed every 50-m to give a 12 fold geometry for the profile. Shots were placed in front of the spread in off-end geometry with an offset range of 100 to 2450 m. Geophones were drilled into the sea-ice to ensure effective coupling. Shot hole drilling operations carried under contract by Webster Drilling and Exploration with supervision provided by Alex Pyne (VUW). Differential GPS was used for shot point and peg surveying. Preliminary processing was carried out in the field and more detailed processing will be undertaken back at Geological and Nuclear Sciences using *Claritas* software and Oxford University using *Promax* software. Processing of the ice shelf line will form part of a Natalie Balfour's B.Sc.(hons) dissertation at VUW, and will be supervised by Stephen Bannister at GNS. Acquisition and processing parameters are summarised in a preliminary report (Bannister and Naish, 2001). Procedures utilised involve muting noisy traces, optimum filter and deconvolution parameters will be chosen following tests on interactive displays of shot records. Pre-stack traces balanced using AGC. Velocity analysis by constant velocity stack.

Gravity and Magnetics

Gravity and magnetic data were acquired along each seismic profile, as well as over a selected detailed grid in New Harbour and McMurdo Ice shelf sites. Additionally, a reconnaissance trip led by Gary Wilson acquired gravity and magnetic records over a grid in Southern McMurdo Sound on the ice shelf between Minna Bluff-Black Island-Brown Peninsula. Gravity measurements were acquired with a Lacoste-Romberg geodetic meter. Magnetic measurements were acquired with a Barringer Research GM122 proton magnetometer. Gravity measurements were "tied-in" to temporary base stations in the survey region which themselves were tied to the gravity base station located as Scott Base. The seismic, gravity and magnetic data were positioned using differential GPS. Some sites were re-occupied and their position measured over several weeks (by GPS to dcm accuracy) to establish ice movement rate and direction. The gravity and magnetic data were reduced in the field Smoothed data were gridded using minimum curvature techniques. The data were then modelled using both indirect (e.g. line integral) and direct (e.g. matrix inversion) techniques. Particular emphasis was placed on the determination of the geometry of the gravity and magnetic basement and, hence, the distribution of the sedimentary depocentres and the rim thicknesses of volcanic islands of the Ross archipelago.

Aeromagnetics

A helicopter-borne aeromagnetic survey was carried out over the McMurdo Ice Shelf using an optically pumped Cs-magnetometer housed in a "bird" flown 25 m below the Helicopters New Zealand Bell 212. Survey flights operated from McMurdo Station with an average duration of 3 hours. Navigation was by GPS waypoint and a 500m-spaced E-W line grid was flown at a 300m dropped elevation (Fig. 4). Grid tie lines were flown N-S at the same dropped elevation but with a 2.5 km spacing. Total field and 3 dimensional position was collected on-board and processed against two proton magnetometer base stationed positioned on the Pegasus road and behind Black Island, respectively. Standard post processing was applied to all flight lines (repositioning of flight paths, diurnal variation removal, IGRF correction and levelling). The resulting magnetic anomaly data was then gridded by applying a weighted averaging procedure.

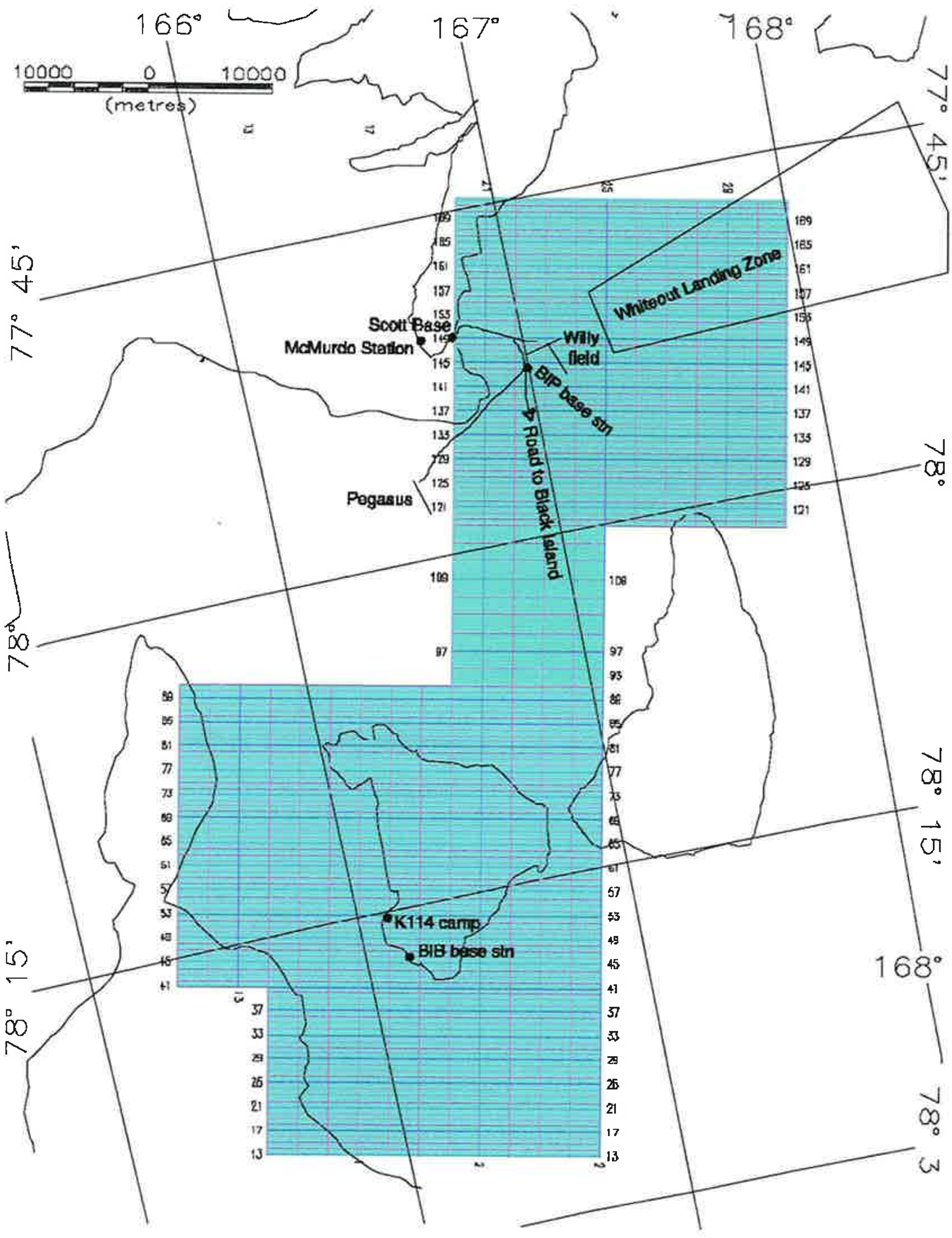


Figure 4. Flight line plan for the K114 aeromagnetic survey.

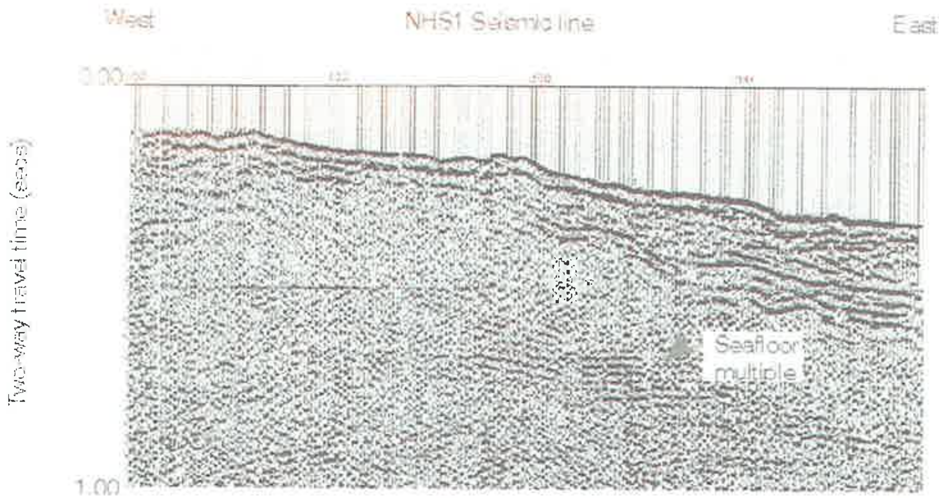


Figure 5. Brute stack of the NHS-1 seismic line.

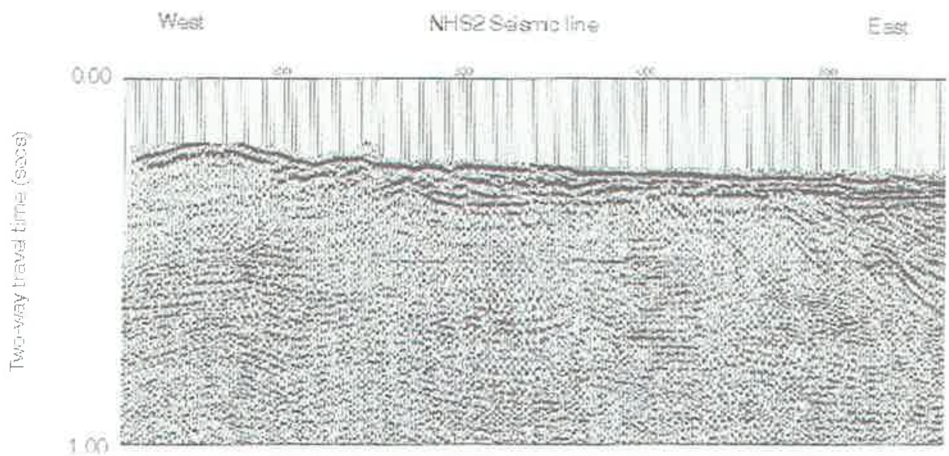


Figure 6. Brute stack of the NHS-2 seismic line.

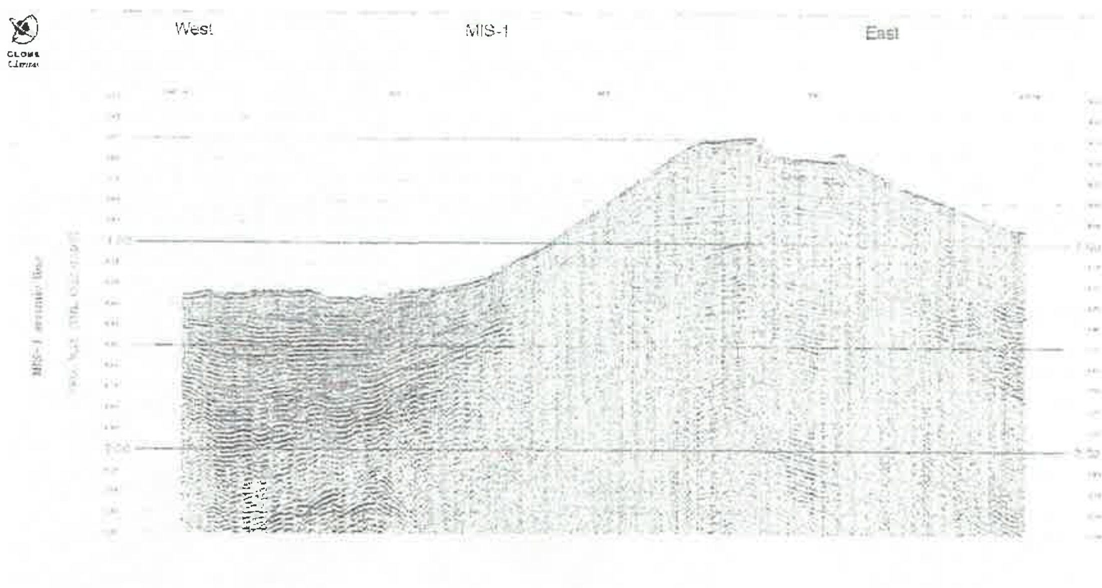


Figure 7. Brute stack of the MIS-1 seismic line.

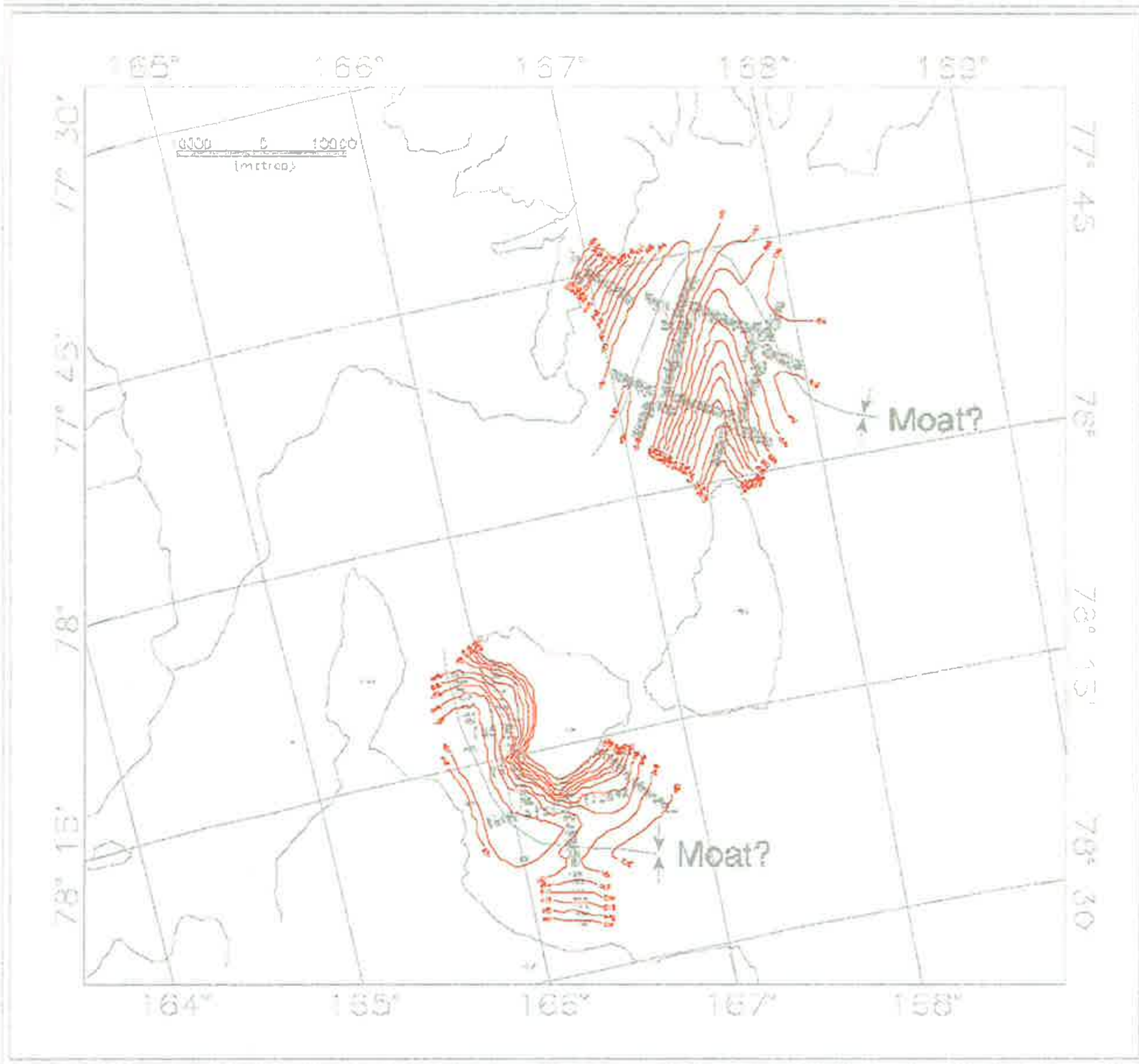


Figure 8. Gravity anomaly map for the McMurdo Ice Shelf gravity surveys with the moat axes and White Island ridge extension indicated.

McMurdo Sound magnetic anomaly map

Univ. Oxford
BGR

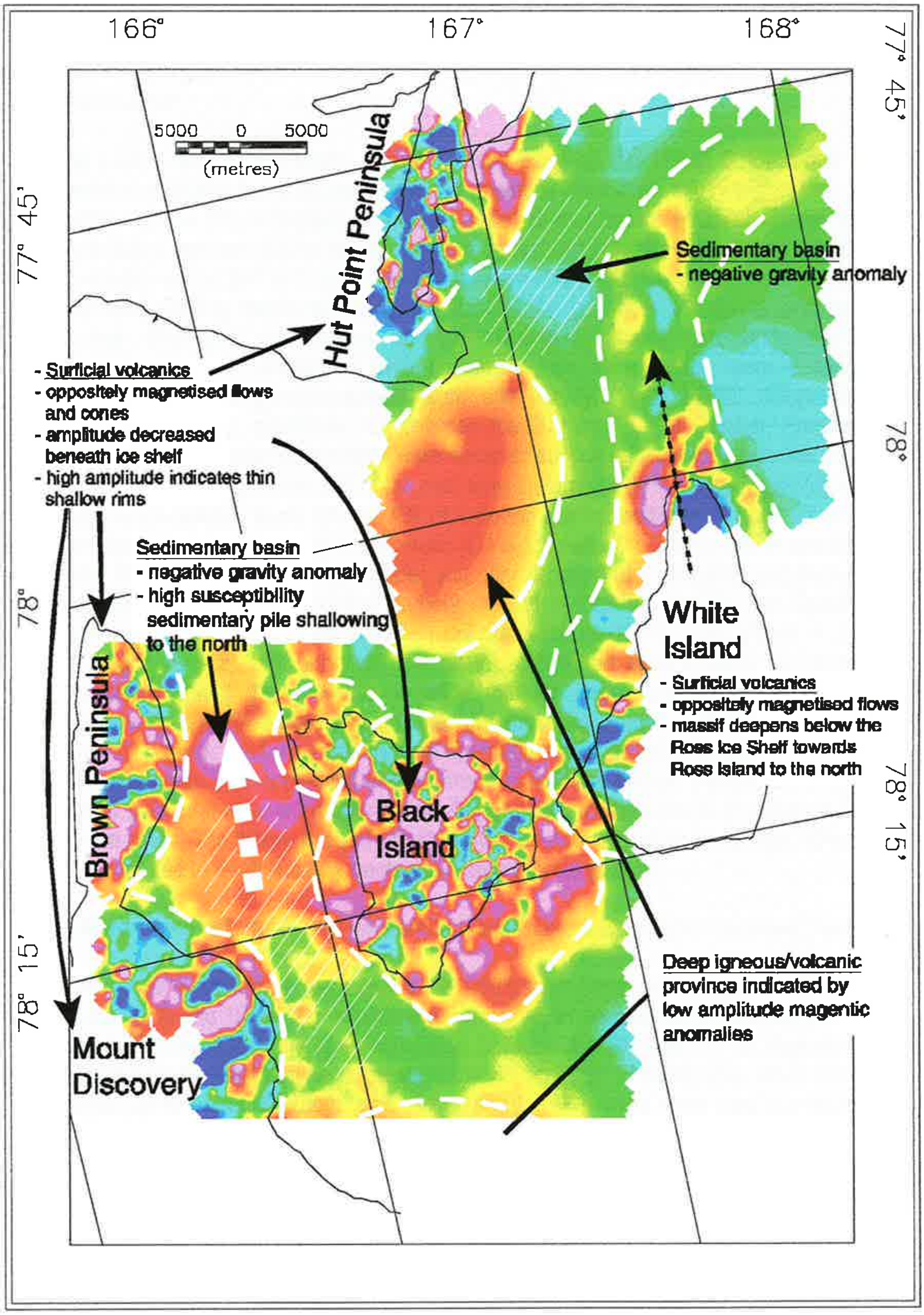


Figure 9. Magnetic anomaly map from the aeromagnetic survey. Strong red colours indicate large positive magnetic anomalies and strong blue colours indicate large negative magnetic anomalies. Preliminary interpretations are indicated on the figure and in the text.

Field Operations

The event operated as 4 "tiger teams" with clear objectives – seismic team (K114N), drilling team (K114P) gravity and magnetics team (K114W), aeromagnetics team (K114D).

New Harbour

The seismic and drilling teams arrived at Scott Base on the 11th of October and after a period of preparing the drilling and seismic systems at Scott Base left by tractor train to New Harbour on the 17th of October. Following a series of shot tests to establish charge size and depth below sea-ice, drilling operations were carried out in New Harbour from the 20th until completion on the 24th of October. 120 shots were drilled and loaded. All were successfully detonated. Drilling teams surveyed and flagged the grid lines for gravity and magnetic surveys. Shot and peg surveys and ice movement surveys were undertaken using UNAVCO provided differential GPS equipment. Ice survey sites were subsequently reoccupied by the gravity/magnetic team and surveyed with NERC differential GPS equipment. Seismic operations ran between the 20th and 30th of October. Progress was initially slow as operations systems were streamlined, but primarily because the shot firing electronics did not perform well in the cold temperatures (<-20°C). The return trip to Scott Base of the seismic team, on the 30th of October was incredibly slow (took 22 hours) as inadequate plant was used to tow the train (D3 bulldozer). The gravity and magnetics team arrive at Scott base on 26th of October and after a period of preparation and base station measurements deployed for New Harbour on 31st of October. A GPS and Gravity base station was established at the DVDP-11 drillsite in the mouth of Taylor Valley. A 20km by 20km grid (Fig. 2) was surveyed around the predefined seismic lines. Surveying was undertaken during the afternoon to early morning hours local time as base station measurements at Scott Base had indicated that these were times of optimum stability of the ambient magnetic field. This timeframe of operation meant returning to camp between 2 and 5 am and made field operations quite onerous as this was always the coldest time of day. Gravity measurements were time consuming and difficult because of vibrations within the sea ice cover. The magnetics and gravity survey was completed on November 10th and the team returned to Scott Base by tractor train towed by Hagglunds.

McMurdo Ice Shelf, Hut Point Peninsula to White Island & Black Island to Brown Peninsula

After 4 days at Scott base re-supplying the drilling team began setting up and test drilling on the ice shelf. The 19km long seismic line was surveyed and shot holes and pegs flagged in stages. Operational drilling was completed between the 2nd and 12th of November. The seismic survey was completed between the 6th and 13th of November. Shot tests were carried out to establish charge size. Although 10 PPP primers were used per shot it was decided that an optimal charge size of 8 primers would be used in future surveys. The coupling of source and receiver was excellent due to extension spikes on geophones and shot placement at 18-20m depth. Source was high-frequency and a high-resolution producing high-frequency record with 5m resolution to 1.5 seconds (see Bannister and Naish, 2002 for details). After a helicopter reconnaissance to locate any crevasses in the study area and establish a safe operating environment, the magnetics and gravity team deployed out to the McMurdo Ice Shelf camp. A local gravity base station was established at the camp and six days of surveying saw a 20km by 20km grid (Fig. 3) of magnetic and gravity measurements. Again, surveying was undertaken during the afternoon to early morning hours local time. Gravity measurements were much more straightforward as the Ice Shelf provided a very stable surveying platform. The K114 camp was returned to Scott Base by tractor train, and an additional gravity and magnetics survey undertaken over Hut Point peninsula from Scott Base. K114W redeployed to NZ in early December.

On December 30th K114W deployed a second time to undertake a reconnaissance survey of the southern McMurdo Ice Shelf between Black Island and Brown Peninsula, Mount Discovery and Minna Bluff (Fig. 1). A camp and GPS and gravity base station was established on the SW corner of Black Island. Over an 8-day period ice movement was monitored by GPS and a preliminary gravity survey was undertaken by snowmobile. The weather was fine and unseasonably warm and large melt ponds and lakes developed over much of the McMurdo Ice Shelf preventing a complete survey and making travel extremely slow and difficult. Because of this, a few critical additional gravity measurements were made later in January from helicopter. From January 12th, K114D began the aeromagnetic survey as outlined above. Survey flights were undertaken in the evening and early morning hours, the window of stable ambient magnetic field behaviour was between 4pm and 2 am local time. Flying began as soon as the helicopter had completed its daytime flying often this was quite late (7-9pm) which sometimes only allowed a single flight each night. The survey flights departed and returned to the McMurdo helicopter pad and required hand launching and catching of the magnetometer "bird" beneath the helicopter. In late January, unusual weather including low cloud cover and ice shelf fog prevented flying on many occasions. The survey was delayed and not completed until January 30th. Navigational GPS data was hand entered by the pilot for each day which was time consuming. A more streamlined system needs to be employed for and future helicopter-borne aeromagnetic surveys.

Immediate Results

New Harbour Seismics

Figure 5 shows an example of the brute stack (preliminary data) form the NHS-1 line. The seafloor is seen to dip down to the east reaching a maximum water-depth pf c. 340m at the eastern end of the line. A brute stack of the NHS2 data (Fig. 6) shows a seafloor high at the western end of the line at about c. 180m depth with the sea-floor depth increasing to c. 280m to the east. Sub-seafloor strata dip east. The quality of the seismic data is not as good as "normal" land-seismic data, but is the best expected given the complex physical (ice-water-sediment interface) environment. It is widely acknowledged that flexure of sea-ice significantly complicates the seismic arrival pattern. Major noise arrivals include: large amplitude sea-floor multiples, airwave arrivals, side scatter reflections of local valley topography, and a multiple due to either a very low velocity layer below the sea-floor, or else a complex P-SV converted wave. Sedimentary reflections are visible at the eastern ends of both of the New harbour lines, with stacking velocities of 1800 m/s and above the multiple, up to 0.4ms.

McMurdo Ice Shelf Seismics

Figure 7 shows the brute stack of the data. At the north-western end of the line the data is similar to that observed by Bannister (1993) and Melluish et al. (1995) from the Hut Point peninsula seismic line (HPP-1; Fig. 3). The seafloor is relative flat for 4000m and rises from c. 900m to the SE, to less than 320m depth over the northern bathymetric extension of White Island, before deepening again to 660m at the end of the line. High-frequency sedimentary reflections with up to 5m resolution are visible to 1.5 s below the sea floor. Sea floor multiples are observed for most of the seismic line. These multiples become a problem only at the SE end of the line.

McMurdo Ice Shelf Gravity

Figure 8 illustrates the gravity anomalies measured in the survey areas between Ross and White Islands and South and West of Black Island, respectively. Both surveys indicate the presence of "moats" associated with the respective volcanic loads. A deep moat is indicated subparallel to and with its axis 10km East of Hut Point Peninsula. It shallows towards Ross Island and then deviates east over a ridge representing a 30km northwards extension of White Island. A similar, but shallower moat is indicated west and south of Black Island encompassing an oxbow shaped basin between Black Island and Mount Discovery. A shallow sea floor is indicated to the south of Black Island with a 10km northward extension of Minna Bluff beneath the McMurdo Ice Shelf and additional volcanic edifices on the sea floor between Black Island and Minna Bluff.

McMurdo Ice Shelf Aeromagnetism

Figure 9 illustrates the corrected and partly levelled magnetic anomaly map acquired during the January aeromagnetic survey. The map is annotated to indicate initial interpretations. Strong red colours indicate strong positive magnetic anomalies, and strong blue colours indicate strong negative magnetic anomalies. The high frequency anomaly patters Brown Peninsula, Mount Discovery, Black Island, White Island and Hut Point Peninsula indicate strongly magnetised normal and reversed volcanic flows at or near the surface. Reduced intensities and slightly extended wavelengths north of White Island indicate similar flows but progressively deeper below the ice shelf. The magnetic anomaly profiles indicate that the Black Island volcanic massif is centred 10km further SW than the current topographic expression of Black Island. The northern peninsula of Black Island is clearly indicated as a separate but smaller volcanic massif that may extend beneath the ice shelf to the North. Large magnetic anomalies beneath the ice shelf to the north of Minna Bluff and between Black Island and Hut Point Peninsula indicate deep but strongly magnetic igneous or volcanic provinces. Between Brown Peninsula and Black Island a strong positive magnetic anomaly indicates a substantial volume of volcanic sediments close to the surface of the ice shelf.

4 **Publications**

Bannister, S & Naish, T., 2002. ANDRILL Site Investigations, New Harbour and McMurdo Ice Shelf, Southern McMurdo Sound, Antarctica. Institute of Geological and Nuclear Sciences report 2002/01. 24p

Proposed publications include:

1. Wilson G. S et al. (in prep). Initial results from gravity and magnetic surveys.
2. Wilson et al. (in prep) and Bannister et al. (in prep) Papers to be submitted to international journal
3. Results will be incorporated into the ANDRILL Science Logistics Implementation Plan.
4. BSc(hons)Thesis at VUW (Natalie Balfour)
5. BSc(hons) Thesis University of Oxford

5 Acknowledgements

Funding support is acknowledged from NERC (Wilson), NZFRST (Naish and Bannister), NSF (Harwood and Whitehead), BGR (Damaske), British Antarctic Survey (Lavelle) and VUW Antarctic Research Centre (VUW Students and Pyne). Logistical support was provided by Antarctica New Zealand. We also acknowledge the support of our home institutions.

Ed King, British Antarctic Survey (BAS), is kindly thanked for his advise and support in loaning and operating the seismic recorder. BAS management is thanked for its support of the project. Webster Drilling and Exploration are thanked for their professional drilling services. Charlie O'Reilly (GNS) is thanked for his help in setting up seismic equipment. Antarctica New Zealand staff in Christchurch and Scott Base are thanked for their considerable effort and support. Special acknowledgement is made to Jim Cowie for handling K114 – an event that kept increasing in size and complexity, which because of his operational management has extremely successful.