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This report is intended to fulfil the requirements of the Ross Dependency Research Committee (Scientific Achievements) and Antarctic Division, DSIR (Field Notes). The Report has also been prepared for the Council of Victoria University of Wellington, the University Grants Committee, and other organisations and individuals who have assisted the Expedition in the execution of its research programme. It is not a final publication of scientific results, and if reference is made to the Report, its interim nature should be made clear.

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SUMMARY OF VUWAE 30

VUWAE 30 saw the successful conclusion of field work for two programmes on the geology of the Transantarctic Mountains, uplift history from fission-track dating and a preliminary geochemical survey of granitoid rocks. Results from the fission track dating show that, in the McMurdo Sound region at least, uplift began only 50 million years ago. Results from the Beardmore area should be comparable and are awaited with interest. The granitoid study is providing the first geochemical database for these rocks, and reveals the importance of combining analytical data and field relationships in recognizing different intrusive phases.

The programme also included a detailed study of sediment processes in Ferrar Fjord, during which the pattern of sedimentation was found to be much different than expected. The source of the mud that floors the basins of McMurdo Sound remains a mystery. Attempts to recover sediment traps left in New Harbour and Granite Harbour by Rice University were also unsuccessful as they had been carried away by sea ice break-out. We are planning new ways of tackling both problems in the coming seasons.

Figure 1. Map of the McMurdo Sound region showing the area of operation of K042 and K043.

McMURDO SOUND SEDIMENT STUDIES (K042) - A. R. Pyne

Abstract

The CIROS 2 drill hole in Ferrar Fjord cored units of well sorted sand and laminated sand-mud "couplets", unusual lithologies within a glacial marine sequence. This season sea floor samples were taken near the outfall of two meltwater channels on the Ferrar Glacier snout to compare with the sediments cored in CIROS 2. The channels contain sorted and bedded sand "bars" and larger rock debris. Several debris covered bergy bits broken from the channel mouth were also present stuck in the sea ice at the glacier edge.

The seafloor samples collected were unbedded, poorly sorted sandy mud with dropped pebbles and sand lenses deposited by ice rafting processes. Apparently, sand from the channels becomes widely dispersed as it settles through the water column. Thus we have eliminated one possible source of well sorted sand, but have yet to explain the sorting in the CIROS 2 core.

Attempts to recover sediment traps left in New Harbour and Granite Harbour by Rice University were also unsuccessful as they had been carried away by sea ice break-out.

Introduction and Background

This programme is a continuation of our study of modern sediment in the McMurdo Sound region. We have collected over 80 seafloor samples and cores since 1980 which have been analysed and preliminary interpretations published (Barrett _et al_., 1983). Several questions remain unanswered about modern sedimentation processes on the floor of McMurdo Sound. We intended this season to attempt a programme of underwater photography, but realized the camera electronic componentry might not be completed in time this season's operation and informed Antarctic Division. A revised programme was proposed which would expand an accompanying sampling programme at the Ferrar Glacier snout (Fig. 1). The aim of this programme was to study the modern sedimentation regime at the snout for comparison with the upper sediments cored in the CIROS 2 hole (Barrett _et al_., 1985). CIROS 2 cored sands, and laminated muds for which we have yet to identify a modern example in the area.

Another aspect of the programme was to recover two sediment trap moorings on the Ferrar and Mackay Glaciers (Fig. 1) set by USARP party S-216 (Dr R. Dunbar) in cooperation with the VUW programme last season. S-216 was not funded for this season so K042 intended to recover and redeploy the moorings.

Preparation and inventory for the CIROS science programme was also carried out in anticipation of drilling in 1986.

Results from seafloor sampling

Sea floor samples were taken from the sea ice directly in front of two meltwater channels on the Ferrar Glacier (Fig. 2). The channels contain supraglacial sediment including sandy bedforms and coarser debris which could be deposited on the sea floor today. A grid pattern was established around the channel mouths in order to sample any areal changes of the sea floor sediments.

Samples were recoverd from depths between 257 m and 197 m (Table 1) and are all slightly sandy mud. No gross sediment differences between samples were observed in the field.

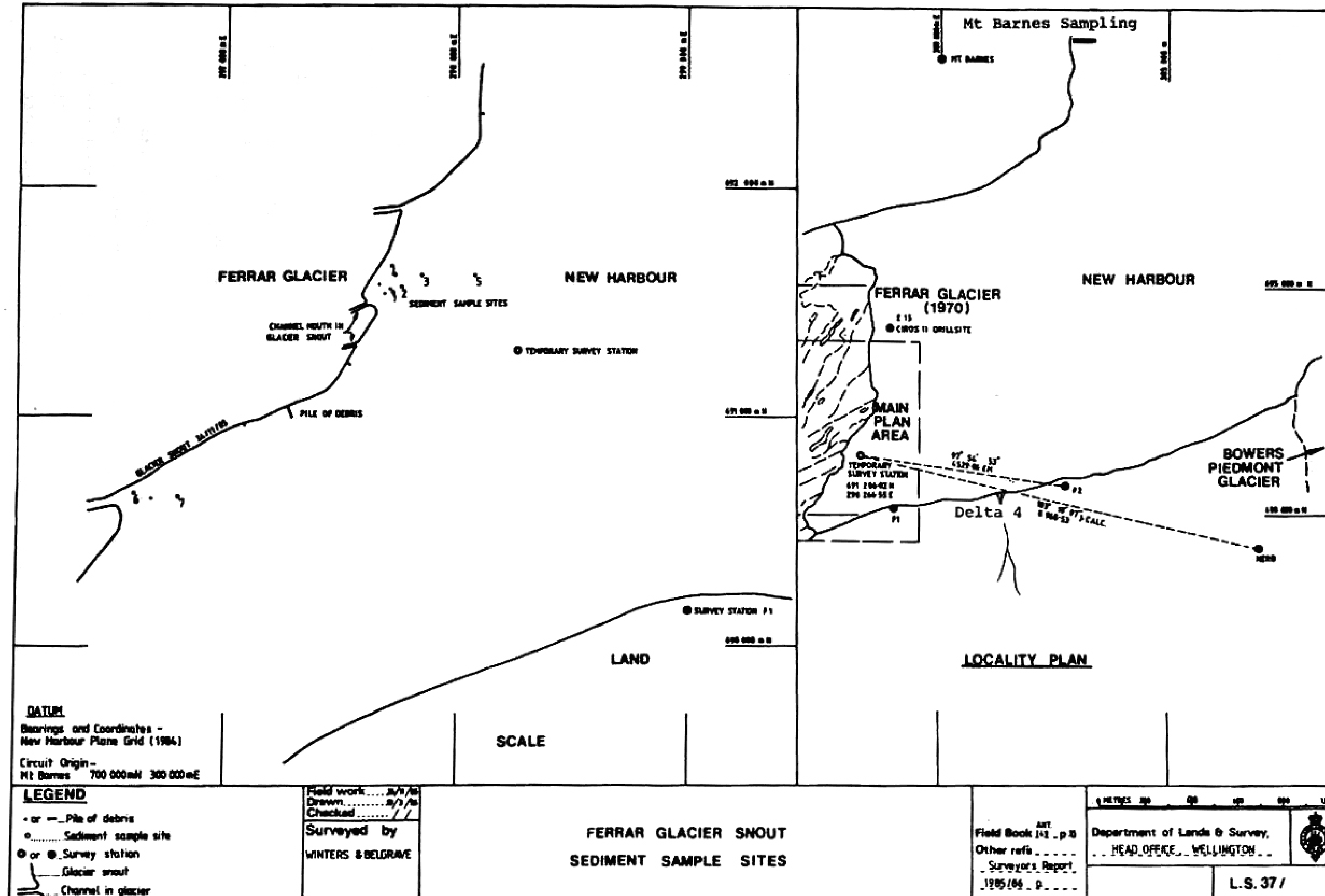

Figure 2. Sketch map of Ferrar Fjord showing sample sites.

Table 1. Seafloor samples collected in 1985

Location	Sample No. (Depth)	Lithology	Subsamples	Archive slab
Ferrar Glacier snout Channel 1; mouth of small meandering channel system (precise locations yet to be computed)	85-1 (248 m)	Mud-sandy sloppy	0-2 cm 10-18 cm	-
	85-2 (254 m)	Mud, sandy	0-5 cm 10-15 cm	-
	85-3 (255 m)	Mud, sandy	0-3 cm 25-30 cm	0-30 cm
	85-4 (247 m)	Mud, soupy Mud, sandy	0-3 cm 30-33 cm	0-35 cm
	85-5 (257 m)	Mud Mud, sandy, soft to firm	0-3 cm 25-30 cm 42-45 cm	0-30 cm 30-45 cm
Channel 2; mouth of large straight flat bottomed channel (precise locations yet to be computed)	85-6 (197 m)	Mud, sandy	0-5 cm 12-15 cm	-
	85-7 (200 m)	Mud, sandy	0-5 cm 20-22 cm	0-22 cm
Mt Barnes approx. 163°41.90'E,77°37.04'S	85-8 (100 m)	Sand	0-1 cm	-
	85-9 (60 m)	Sand, coarse	<1 cm	-
Delta 4, Ferrar Fjord south wall approx. 163°37.88'E,77°42.96'S	85-10 (100 m)	Sand, muddy and gravelly	0-2 cm	-
	85-11 (70 m)	Sand, coarse, pebbles	<1 cm	-

It does not appear that the meltwater streams deposit thick sand bodies on the sea floor like those drilled at CIROS 2. The change in position of the glacier edge is likely to have the effect of spreading any sand from the channels over a larger area. The glacier edge near the two meltwater channels was accurately surveyed this season to begin recording the ice edge changes and will be resurveyed in future years.

Debris covered "bergy bits" enclosed by sea ice were present in front of the two meltwater channels. The debris on these small pieces of glacier ice ranged from silt to a boulder up to 4 m long. These debris bergs have calved from the meltwater channel mouths and show that ice rafting of sediment is a process which occurs in Ferrar Fjord.

Sampling was also attempted in water less than 100 m deep at Mt Barnes and Delta 4 (Fig. 2) to compare with samples from deeper water in New Harbour. Small quantities of sandy sediment were recovered confirming that hard bottom conditions are present in these areas like many other shallow areas of McMurdo Sound. Different sampling techniques such as a grab or box corer will be required to sample these sea floor sediments in the future.

Results from Sediment Trapping

Sediment traps in McMurdo Sound and Granite Harbour have been deployed by parties from Victoria University of Wellington and Rice University, Houston, Texas. Short term deployments (maximum time site occupied 61 days to date) have been successfully recovered. Long term deployments (1 year or more) have been attempted by suspending traps from ice tongues but have not been successfully recovered to this date.

Rice University assisted by K042 deployed two four trap moorings anchored from the Ferrar and Mackay Glaciers in December 1985. The traps were deployed through holes cut in the sea ice within a few metres of the glacier fronts with the intention of recovering the moorings the following season.

This season K042 were prepared to recover the two moorings, but in both instances although the anchor points were found the traps had broken out with the sea ice. The moorings would have remained intact if the sea ice breakout had not occurred at the glacier front like in 1982 at the Mackay Glacier. The probability of retrieving moorings anchored in this way is now considered unlikely after this season's experience.

These attempts show that for long term deployment to be successful, the moorings used must be unaffected by sea ice movement and breakout, and, to a lesser extent, ice tongue calving - ice berg movement. The need to measure sediment flux throughout the whole year still remains a major factor in the understanding of modern marine glacial sedimentation processes in this area and Antarctica in general.

Publication and future research

The Ferrar Glacier samples will form the basis of a BSc Honours thesis by David Kelly, who will compare the texture and mineralogy of glacier surface sediment and sea floor sediment to identify the sources of the latter. The results will be incorporated into a review paper by Barrett on modern sedimentation in McMurdo Sound.

We would like to continue work with Rice University to improve the recovery of sediment traps, the only satisfactory approach for finding out what is currently being deposited on the sea floor. A special design will be required to test the idea that most mud in the Ross Sea comes from density currents emanating from the major outlet glaciers.

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GRANITOID STUDIES, ST. JOHNS RANGE (K043) - K. Palmer and P. White

Abstract

An area of approximately 100 sq. km in the central St. Johns Range was mapped and 120 granitoid specimens specially sampled for geochemical analysis. The informally named Harker and Seinford Granites form with the Vida the bulk of the granitoids. The Harker is similar to the Vida but has a higher proportion of K-feldspar, a more uniform pink colour and larger grainsize. Chemical differences include higher SiO_2, K_2O and Rb and lower CaO, Sr and Ba. The Harker Granite intrudes the unfoliated, K-feldspar megacryst-bearing Swinford Granite. The field and limited petrographic and chemical evidence so far available indicates all three granites are I-types.

Gneisses and schists form a remnant basement screen between the Vida, and the Harker and Seinford Granites. Quartz-feldspar-biotite-hornblende paragneiss forms the bulk of the gneiss. Mignatites are developed locally. Of limited extent also, are granite, tonalite and feldspar orthogneisses containing euhedral feldspar phenocrysts. The lower grade rocks consist of quartzo-feldspathic and biotite schists, amphibolites, marbles and calc-silicates.

The gneiss and schists are intimately intruded by a series of ramifying granodiorite dykes. The extent to which these are either a contaminated marginal phase of the Vida, or a separate phase such as the Theseus Granodiorite can not yet be determined. Other dykes comprising at least five different types were mapped and include, pink K-feldspar porphyry, lamprophyre, basalt, granophyre and diorite varieties. Cross-cutting relationships were difficult to ascertain. However the basaltic dykes were considered to be the youngest and may be related to the dolerite sills.

Near Purgatory Pk. a 40m sequence of Altar Mountain Formation and Odin Arkose containing basal conglomerate, grits and sandstones with trace fossils was observed.

Background

Previous studies of granitoids in South Victoria Land have been mainly of a reconnaissance nature and associated with regional mapping (Gunn and Warren, 1962; Findlay, 1983). These studies outlined the gross distribution of granitoids and developed preliminary subdivision of the rocks into several plutonic suites. However granitoid nomenclature is still a problem in South Victoria Land for two reasons.

Firstly the early subdivision into red and grey granites has been carried over to the Irizar Granite and Larsen Granodiorite subdivision. Attempts have been made to lump together granitoids hundreds of kilometers apart. This was brought about by a tendency in the past to attempt to "correlate" various granitoids and was probably the result of early mapping carried out by geologists more versed in stratigraphy than igneous petrology. Granitoids should be mapped and named on a pluton basis, with several plutons comprising a batholith. The names Irizar and Larsen should be restricted to the plutons at the type localities.

Secondly the geological structure and outcrop distribution in South Victoria Land is such that many granitoid boundaries are not well defined because of ice and snow cover. Many granitoid plutons appear to grade in physical appearance and chemical composition from centres to margins. Margins in turn grade into high grade metamorphic rocks and in these areas delineating boundaries becomes very subjective indeed.

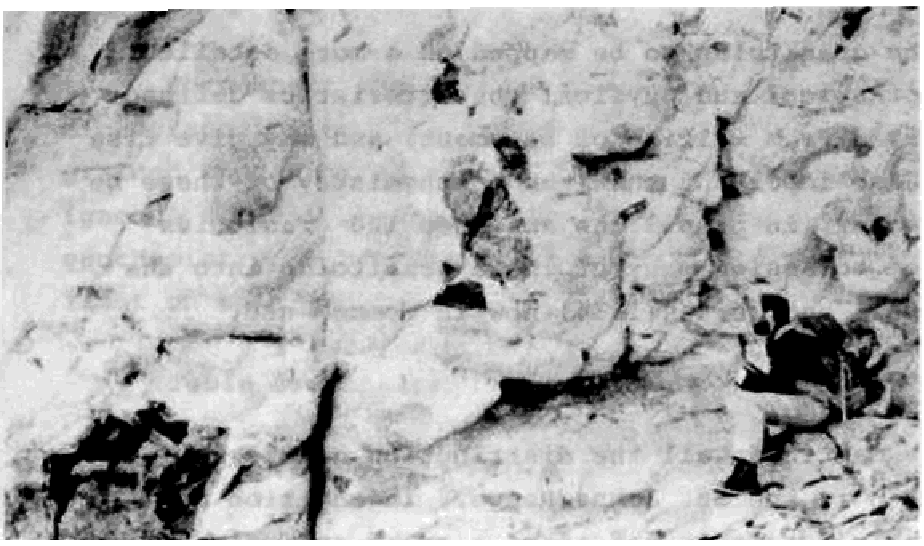

Plate 1. Numerous xenoliths in the contaminated marginal phase of the Vida Granite.

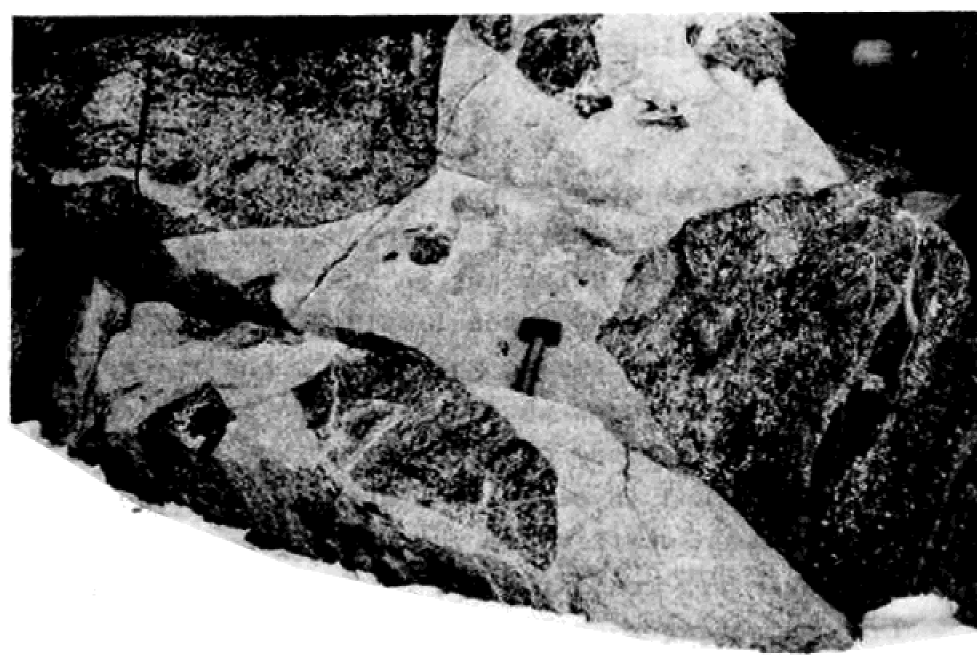

Plate 2. Angular blocks of gneiss in coarse-grained Harker Granite.

Plate 3. Sampling Vida Granite above Victoria Upper Glacier.

What is now required is for the granitoids to be mapped on a more detailed individual pluton basis and their geochemical and physical characteristics defined. Since many of the granitoids are derived from melting of basement, and may give rise to some of the numerous dykes it is also important that the geochemistry of these be studied too. In a regional study, Palmer (in prep.) has analysed 120 granitoids from South Victoria Land. It is hoped to assign many of these granitoids into the S- and I-type classification of Chappell and White (1974) now in common use.

Programme

Our principal objective was to map in detail the distribution of the various granitoids, gneisses, schists and dykes in the St. Johns Range. In addition a representative suite of samples suitable for major and trace element analysis was to be collected to enable petrogenetic relationships between the rock types to be established. To this end an area of over 100 sq. km was mapped and some 120 samples specially collected for analysis.

Results

Several granite bodies were mapped. However the extent to which some of them differ cannot be fully ascertained until detailed geochemical studies are carried out. The Vida Granite crops out in the SW of the area, its description conforming to that given by Allen and Gibson (1961). It is a grey but occasionally pink, fine to medium-grained biotite granite and has a subhedral granular texture. Blocks and xenoliths of schist have been incorporated and partly assimilated around the margins. Xenoliths can be seen sheared out producing intricate flow banding. This has occurred to such an extent that in places the granite is darker in colour and its composition appears to have been modified to that of a granodiorite or tonalite (Plate 1). Away from the margins mafic xenoliths and clots of biotite are not uncommon. At one location a large hornblende-bearing mafic xenolith some 4m across was noted. An analysis of the Vida Granite (Palmer, in prep.) from south of Lake Vida is provided in Table 2 and is particularly notable for the high level of Ba.

A further two granites outcrop extensively, to which the informal names Harker and Swinford Granite have been given after their occurrences on these mountains. The former is a Vida-like granite however it is pinker in colour, coarser-grained and hornblende is virtually absent. Two analyses of this granite from Pond Pk. (Palmer, in prep.) are provided in Table 2. Compared to the Vida, the Harker Granite is enriched in SiO_2, K_2O and Rb but is depleted in CaO, Sr and Ba. On Pond Pk. and the hills E of Purgatory Pk. bands of intense brick-red alteration occur, probably related to fracture zones. Similar effects have been described elsewhere in South Victoria Land (Craw and Findlay, 1984). The Harker Granite can be observed intruding gneiss and schist at a number of localities. On a ridge E of Schist Pk. angular blocks of gneiss can be seen surrounded by coarse-grained pink granite (Plate 2). On the ridge NE of Mt. Swinford, Harker Granite intrudes the Swinford Granite. This contact is marked by a fine grained chilled margin dipping at about 40 degrees to the SW.

The Swinford Granite is less extensive than the previous two granites. It appears to intrude gneiss and schist at Mt. Swinford and extends NE across the glacier to the next ridge. The granite is particularly conspicuous because large, euhedral K-feldspar megacrysts are found throughout. It generally lacks foliation and contains numerous small mafic xenoliths and less common K-feldspar porphyry xenoliths.

Throughout the belt of gneiss and schist are freely ramifying dykes of microgranodiorite. It is not clear at this stage whether these represent the fine-grained contaminated margin of the Vida Granite or constitute an earlier phase of igneous activity, such as the Theseus Granadiorite. It is hoped that the detailed geochemistry to be carried out on the numerous specimens collected will shed some light on this problem.

Table 2. Analyses of granite and related rocks, Victoria Valley area, (after Palmer in prep.)

wt.%	1	2	3	4	5	6	7
SiO_2	72.90	75.14	74.37	64.53	66.85	64.25	61.47
TiO_2	.24	.18	.19	.25	.55	.63	.70
Al_2O_3	13.67	12.86	13.14	20.34	17.14	16.50	17.44
Fe_2O_3	.51	.30	.62	.17	.36	.82	.74
FeO	1.52	1.18	1.21	1.46	2.73	3.69	3.98
MnO	.02	.03	.03	.02	.04	.10	.07
MgO	.44	.22	.31	.72	.95	1.53	2.00
CaO	1.77	1.09	1.24	4.89	3.49	4.02	4.72
Na_2O	3.48	3.10	3.14	5.76	5.04	3.90	4.20
K_2O	4.36	5.23	4.89	1.58	2.18	3.69	3.08
P_2O_5	.05	.04	.04	.07	.17	.17	.20
Loss	1.07	.81	.71	.44	.69	.97	1.18
Total	100.03	100.18	99.89	100.23	100.19	100.27	99.78
ppm							
Ba	1170	475	434	404	1320	824	695
Ce	66	72	85	31	82	108	52
Cr	8	5	7	12	7	15	13
Cu	<2	<2	<2	<2	<2	5	<2
Ga	18	15	17	23	22	21	24
La	40	44	50	16	49	66	25
Nb	10	9	10	6	11	17	23
Ni	<2	<2	<2	5	<2	2	<2
Pb	25	28	29	24	12	23	17
Rb	123	158	162	53	52	151	150
Sc	2	<2	<2	5	6	9	9
Sr	311	158	173	961	814	431	494
Th	8	17	16	4	7	19	12
U	<2	<2	<2	<2	<2	<2	<2
V	8	5	8	21	24	48	45
Y	15	16	16	15	9	48	45
Zn	48	31	39	32	75	77	86
Zr	151	128	149	95	241	230	215

1. Vida Granite. 2,3. Harker Granite. 4. Theseus Granodiorite.
5. Granite Gneiss. 6,7. Gneiss.

Using the limited field, petrographic and chemical data presently available, the Vida, Harker and Swinford Granites would be classed as I-type. All of these granites are relatively unfoliated and show discordant cross cutting relationships with pre-existing rocks. Igneous xenoliths are common and hornblende is often present along with euhedral zircon, sphene and allanite. Muscovite, cordierite and garnet, minerals characteristic of S-types, are absent. The granites have high Na/K ratios. Thus it is thought that these granites are derived from the melting of pre-existing igneous rocks, rather than the melting of rocks which have undergone a sedimentary cycle.

Gneiss and schist, the metamorphic equivalents of the Meserve Member of the Hobbs formation, trend across the area in a NW-SE direction. They appear to remain as a screen of older basement between the Vida and Harker Granites. The schists are strongly deformed with all lithological layering transposed parallel to a dominant S2 foliation. Occasional F3 crenulation folds were noted, especially near the head of the Willis Glacier. This deformation is comparable to that observed by Korsch (1985) on Robertson Ridge. The schist lithologies are also comparable to those noted by Korsch, but the prevalence of amphibolites (metamorphic equivalents of basalts and andesites) throughout the sequence, not only here but elsewhere in South Victoria Land suggests that an island arc sequence is represented rather than a passive continental margin as proposed by Korsch. Several amphibolites were sampled during the present study and it is hoped that from their geochemical signature some evidence of their original tectonic setting can be obtained.

The belt of metamorphic rocks widens to the SE and around Purgatory Pk. gneiss becomes common. Paragneisses that appear to be simply higher grade equivalents of the schists, as well as orthogneisses occur in the sequence. Lenticles and stringers of migmatite are found in the paragneisses. The orthogneisses have been through a melting stage and are characterised by large euhedral feldspar crystals. In the Purgatory Pk. area they comprise granite, tonalite and feldspar gneisses. The feldspar gneiss consists almost entirely of K-feldspar and may represent an accumulation product of the granite, leaving a remainder of tonalite composition. These varieties are comparatively rare.

Ubiquitous dykes throughout the field area comprise the following types;

1) Black, basaltic dykes
2) Pink, K-feldspar porphyry
3) Lamprophyre
4) Granophyre
5) Medium-grained diorite
6) Aplite

The dykes range in width from a few cm (aplites) up to 10 or so metres (porphyry). A small (<50m across) body of quartz-feldspar porphyry was mapped 2km SE of Lanyon Pk. Only one diorite dyke was found, occurring as a N trending body some 5m wide at the end of the ridge NE of Lanyon Pk. Generally the dykes are subparallel so that cross cutting relationships were difficult to establish. Low rubbly outcrop in many cases did not contribute to this task. The basaltic dykes resemble the fine-grained margins of the dolerite sills and it is thought they are simply offshoots of these sills. Dykes other than these basaltic types appeared to be absent from the Harker Granite, suggesting that the dykes are related to the Vida Granite and are older than the Harker.

Small remnants of the Beacon Supergroup occur throughout the area generally only as a few meters preserved beneath the peneplain sill. About 2km NW of Purgatory Pk. however, some 40m of conglomerate, grits and sandstone are preserved, dipping at a low angle to the north. The base of the sequence is obscured by scree and snow, but well rounded cobbles (<20cm dia.) of quartz, quartzite and silicic volcanics (?) suggest a basal conglomerate resting on gneiss. Trace fossils occur in fine sandstone near the top of the sequence. Barrett and Webb (1973) describe similar sequences in the Wheeler Valley and at Mt. Suess and correlated them with the Altar Mountain Formation and the Odin Arkose. This is one of the most easterly occurrences of Beacon in the region.

Work has already commenced on drawing up a geological map of the area. Laboratory work on the rock specimens collected this season will commence as soon as they arrive at Victoria University of Wellington and will concentrate on:

1) The preparation of polished thin sections to enable electron microprobe analysis of minerals to be undertaken and the petrographic features of the various rocks to be described.

2) X-ray fluorescence analysis of the major and trace elements to allow further refinement of the petrological features above and to enable petrogenetic affinities to be determined.

Whole rock and mineral analytical data will be presented in a Victoria University of Wellington Geology Department publication.

Recommendations

More work is required in South Victoria Land to further distinguish S- and I-type granitoids. Boundaries between these types elsewhere in the world are of fundamental tectonic importance. Detailed geochemical studies are however required in this respect. Further work on granites without taking this into account will only add further to the present confused nature of South Victoria Land basement studies. A future promising line of research stems from observations and preliminary sampling of the amphibolites within the Koettlitz Group. Study of immobile trace element concentrations may enable the pre-metamorphic tectonic characterisation of the unit in a manner analogous to Pearce and Cann,(1973) and Grapes and Palmer, (1984).

Acknowledgements

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FISSION TRACK STUDIES (K044) - P. G. Fitzgerald

Abstract

Sampling of granitoid rocks to determine the Late Mesozoic and Cenozoic uplift history of the Transantarctic Mountains was extended to the Beardmore Glacier region this season. Apatite fission track dating at the University of Melbourne will be used to determine uplift rates across the mountain range and position of faults at the mountain front. Samples were collected from both the north and south side of the lower Beardmore Glacier. Topographic features attributed to faulting here are an eastwards decrease in summit heights and the presence of escarpments, especially visible on the northern side of the Beardmore Glacier. Other areas sampled were the Queen Elizabeth and Miller Ranges on the inland side of the Transantarctic Mountains.

Introduction and Background

This was the last year of a Ph.D. study to determine the uplift history of the Transantarctic Mountains using fission track dating. The study of mountain uplift using this technique requires sampling at regular intervals over significant elevation ranges in order to gain information representing the greatest possible time period. Previous seasons have concentrated in southern Victoria Land but all field work this season was conducted out of the U.S. deep-field camp in the Beardmore Glacier area (84° 00' 13.897"S, 164° 24' 42.226"E). Two areas were visited from here; the coastal region around the mouth of the Beardmore Glacier and further inland in the Miller and Queen Elizabeth Ranges. The main field objective was the collection of samples to determine uplift rates and measure vertical displacement across faults. Sampling for fission track studies is limited to those rocks which contain uranium-enriched minerals. This study is looking mainly at apatite which is common in granitic rocks which in the Beardmore Glacier area outcrop mainly along the coast but make up a large proportion of the Miller Range and also occur as isolated plutons elsewhere.

Previous work in Victoria Land (Gleadow and Fitzgerald, 1984; Fitzgerald and Gleadow, 1984) have shown a two-stage uplift history for the Transantarctic Mountains. Prior to about 50 Ma uplift could be interpreted as a steady 15 m/Ma but at 50 Ma this changed dramatically to about 100 m/Ma. This period of "slow uplift" prior to 50 Ma has now been reinterpreted as an uplifted 'partial annealing zone' (Fitzgerald and Gleadow, 1985), the "slope" of 15 m/Ma indicating not an "uplift and erosion" rate but representing an artifact of the thermal profile prior to uplift. Preliminary results for samples collected off the eastern end of the Kukri Hills and basement cored in the CIROS 2 drillhole (Barrett, 1985) in New Harbour are presented here (Fig. 3). The 'break in slope' which is clearly recognizable at about 50 Ma represents the base of the uplifted 'partial annealing zone' (Fitzgerald and Gleadow 1985, Gleadow and Fitzgerald in prep.). This marks the start of uplift of the Transantarctic Mountains. Apatite fission track ages from wells in the Otway Basin in southeastern Australia show the base of the 'partial annealing zone' lies at a temperature of 125°C (Gleadow and Duddy, 1981). Prior to uplift this probably lay close to a depth of 4 km below sea-level, calculated from an estimated paleo-landsurface elevation of 150 m above sea-level, a paleo-geothermal gradient of 30°C/km and a mean annual surface temperature of about 0°C at that time. The geothermal gradient of 30°C/km is taken from the DVDP-6 drillhole at Lake Vida (Decker and Bucher, 1982), which although some 40 km inland from the Transantarctic Mountain Front is thought to be representative of the situation at the start of uplift when a normal continental gradient probably existed, at least for the shallow depths being discussed here. The mean annual temperature of 0°C is an estimate and takes into account that the East Antarctic Ice Cap did not exist at that time (Hayes et.al., 1975). The 'break in slope' of the graph now lies at an elevation

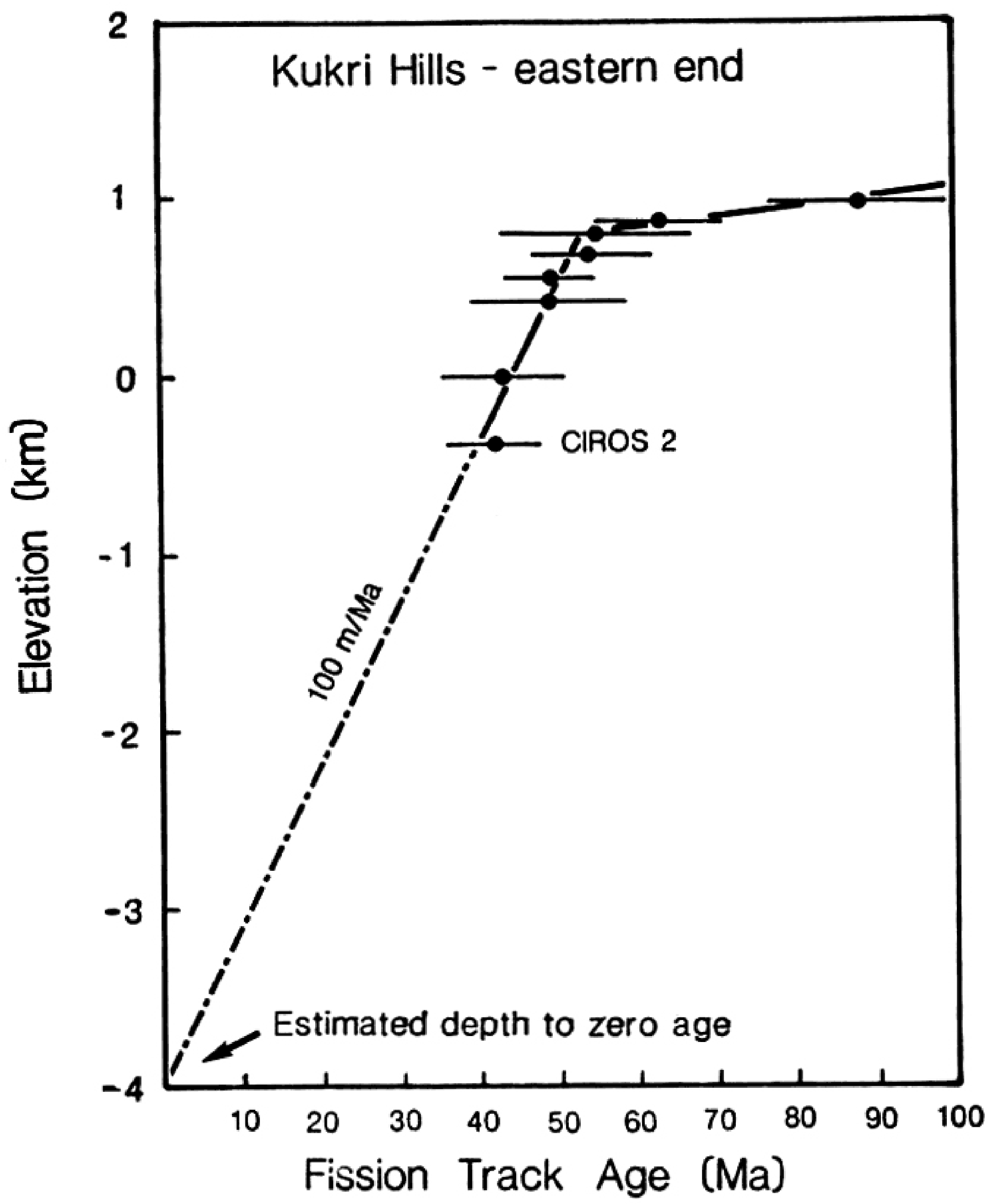

Figure 3. Model for the uplift history of the Transantarctic Mountains based on a vertical sampling profile from the eastern end of the Kukri Hills, southern Victoria Land, and including a sample of basement gneiss from the CIROS 2 drillhole. The 'break in slope' in the graph at about 50 Ma marks the start of uplift of the mountains, giving an average uplift rate since that time of approximately 100 m/Ma. Errors plotted for the apatite ages are two standard deviations, for the elevations ±10 m.

of about 900 m which means that in the 50 Ma, 4.9 km of uplift has occurred at an average rate of approximately 100 m/Ma.

DVDP 8 and 10, two holes drilled in New Harbour near the Transantarctic Mountain Front have geothermal gradients of 60°C/km (Decker and Bucher, 1982). This higher gradient is considered to be a result of the higher heat flow present in the Dry Valleys - Ross Island area due to the present day extensional regime that is manifested by the presence of the McMurdo Volcanics.

It is also worth noting that the position of the vertical sample profile used to determine an uplift rate on the mountain front in relation to the point of maximum uplift is important. Profiles lying to the east of the point of maximum uplift in southern Victoria Land have been down faulted relative to it. Hence any uplift rate calculated from these will be a slight underestimate but still well within any error limits, given the assumptions made to calculate the uplift rate. Errors for ages less than 50 Ma are large compared to the change in elevation (Fig. 3) between successive samples. Errors in ages older than 50 Ma are small compared to a change in elevation, a difference of a few hundred metres producing a significant age difference. This is an important point when generating artificial reference planes using apatite fission track ages as it is necessary to take samples from higher elevations to guarantee an age of over 50 Ma. In southern Victoria Land, near horizontal sills of dolerite within the basement can be used as reference surfaces to determine the amount of displacement across faults at the Transantarctic Mountain Front. The dolerite sills in the Beardmore Glacier area do not outcrop at the coast, hence the need for horizontal sampling traverses to confirm the position of faults suspected from analogy with other parts of the Transantarctic Mountains and from topographic evidence. To the south of the Beardmore Glacier at Cape Surprise a fault with 5 km of displacement downthrown to the east has been recorded (Barrett, 1965).

Geological Setting

The geology of the field area consists of PreCambrian and Lower Palaeozoic folded metasedimentary rocks. The oldest unit, the Nimrod Group, is at least 1000 Ma old and is made up of schist, gneiss, marble and dolomite. This is overlain unconformably by the mainly terrigenous sediments of the PreCambrian Beardmore Group. These in turn are overlain unconformably by Cambrian carbonates of the Byrd Group. Numerous granitic plutons of the Granite Harbour Intrusives have intruded these three group (Gunner, in press). These basement rocks are unconformably overlain by the Devonian-Triassic Beacon Supergroup which is composed of glacial, alluvial and shallow marine strata. These are intruded by numerous sills of the Jurassic Ferrar Dolerite which in places passes upwards into the Kirkpatrick Basalt. Sample localities are shown in Fig. 4.

Fieldwork in the Lower Beardmore Glacier Area

A vertical sampling profile of 1150 m was taken in the Mt Ida-Granite Pillars area lying just to the north of Beardmore Glacier. A horizontal sampling traverse collected by helicopter was taken from Mt Hope westwards to The Cloudmaker. In this area the only indication of faulting across the Transantarctic Mountain Front is given by topography: the decrease in height of the mountains in the form of a number of generalised benches and the presence of scarps, e.g. the large scarp formed by the east face of Mt Elizabeth and possibly the west wall of The Gateway. Samples were taken on each suspected fault block in order to determine relative displacements across the mountain front.

On the southern side of the Beardmore Glacier, a partially completed vertical profile of 900 m was taken off Cleft Peak. Positions of suspected NE striking faults are not as obvious here as on the northern side of the glacier, the relief is generally more rugged and granitic rocks are not exposed as far to the east. Nevertheless, a horizontal sampling traverse from Mt Robert Scott west to Mt Patrick was taken.

Fieldwork in the Miller and Queen Elizabeth Ranges

The Miller Range lies on the inland side of the Transantarctic Mountains and is an uplifted block of granitic and metamorphic rocks. Grindley (1967) worked on the geomorphology of the Miller Range and observed three high level glacial erosion surfaces. He calculated that these represented an uplift of about 1600 m since the onset of Antarctic glaciation, assumed at that time to be the early Quaternary. However, the Cenozoic glaciation of the Antarctic continent is now thought to have begun 25 Ma ago (Hayes et al., 1975) which gives an average uplift rate of approximately 64 m/Ma. This allows us the opportunity of testing the fission track method against direct geological observations and so a vertical sampling profile of 800 m was taken off MacDonald Bluff, from spot height .2440 to the level of the Marsh Glacier. Moody

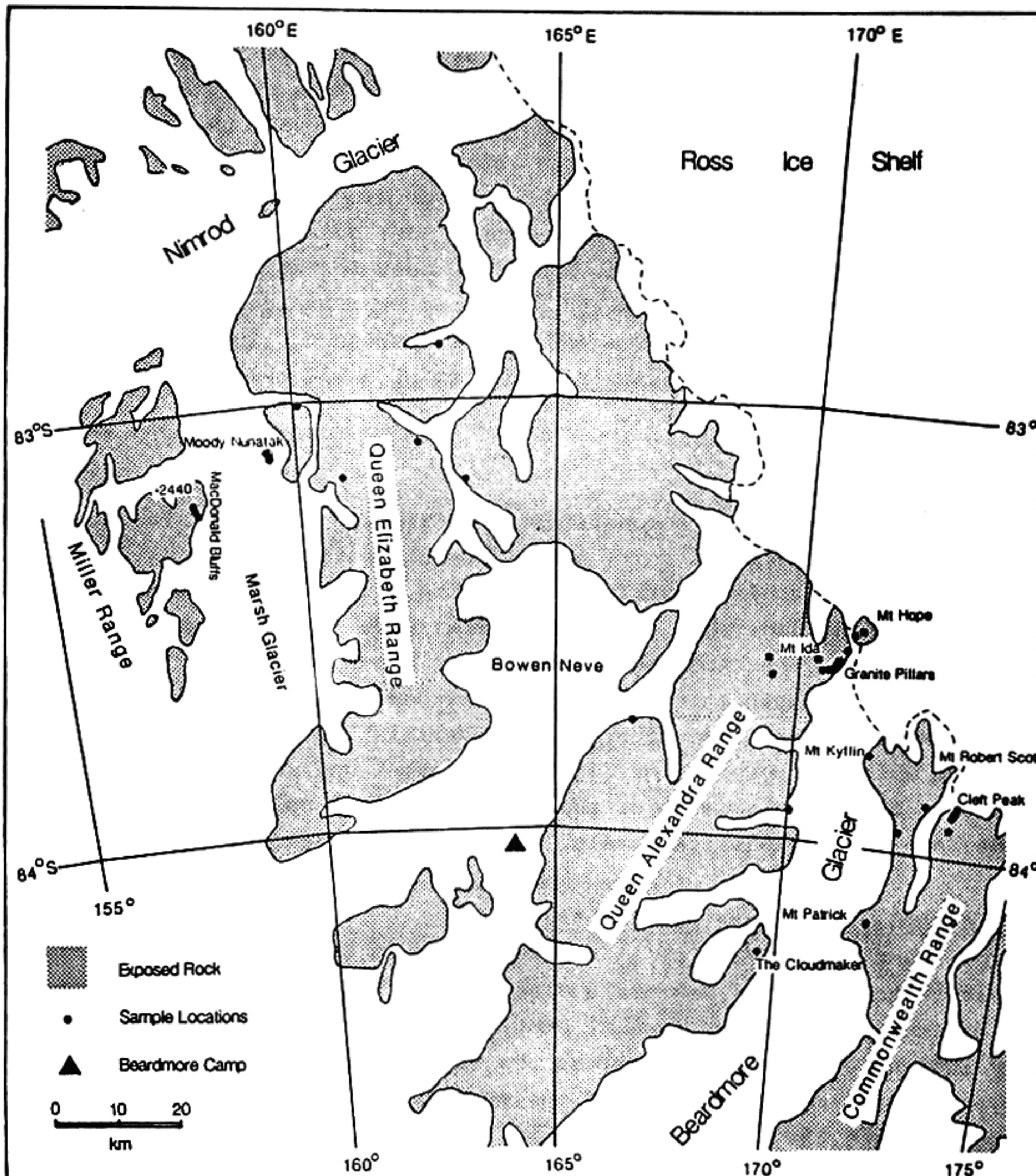

Figure 4. Map of the Beardmore-Nimrod Glacier area, showing localities samplied for fission track dating studies this season.

Nunatak, lying across the Marsh Glacier was sampled as were various localities in the Queen Elizabeth Range to determine displacement across faults lying between here and the Miller Range (Grindley and Laird, 1969).

Publication and Future Research

Samples collected in the Beardmore Glacier region this season will be processed and dated at the fission track laboratory at Melbourne University. This completes for the time being the fission track study of the Transantarctic Mountains that was begun in 1981/82 by Gleadow working in Victoria Land (Gleadow, in Barrett, 1982). It is hoped that results of this study will be presented at the Fifth International Symposium on Antarctic Earth Sciences to be held in Cambridge, 1987.

Acknowledgements

We would like to thank John Splettstoesser, the NSF representative at Beardmore Camp as well as pilots and crews of VXE-6 based there, for helping to make this a successful and enjoyable season. Our thanks also to Peter Cresswell, OIC of Scott Base, and his staff.

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FIELD NOTES

McMURDO SOUND SEDIMENT STUDIES (K042) - A.R. Pyne

Field Preparations

The K042 party spent a total of 9 days at Scott Base for survival training (2 days) and to prepare field and specialist seafloor sampling equipment.

Three ski trailers for toboggans were designed and built at Victoria University of Wellington. These were sent air cargo to Scott Base and reassembled in the garage during the first two days. Two trailers were dedicated for general scientific equipment including echosounder and generator and sampling equipment. The third trailer with wider skis and extended draw bar carried an 11 foot aluminium drill mast, 12" diameter ice aagers and hydrographic winch with 1200m of 5mm diameter wire cable.

This new equipment increased the speed and ease of sampling sea ice, proved the suitability of this type of toboggan operation and feasibility of new "up hole" equipment for sea floor photography in the future.

Equipment wintered in Antarctica was checked and some items that had been used for CIROS retrieved from Butter Point. The location and preparation of the equipment stored at Scott Base was time consuming. A separate secure store for our scientific equipment would greatly reduce time spent in preparations at Scott Base and help in planning future programmes.

The McMurdo Biolab was visited on two occasions to organise equipment for retrieval of the Rice University sediment traps. Dr Ted Delaca's party working in Explorers Cove (New Harbour) offered diving assistance to retrieve the traps if necessary.

Narrative

Butter Point Camp was used as a base to carry out the field work in New Harbour. K042 commuted by toboggan to sampling areas at the Ferrar Glacier Snout, Mt. Barnes and "Delta 4" on the south side of Ferrar Fjord.

The sea floor was sampled in front of two large surface channels on the Ferrar Glacier Snout. The heavy drilling and sampling equipment was moved to each site and a polar tent set up to provide shelter for the day's operation. Seven closely spaced cores were obtained from these two areas, averaging 2 cores per day. The samples were returned to camp each evening together with parts of the coring equipment for cleaning and reassembly. Sampling at Mt. Barnes and Delta 4 was in water depths of less than 100m. Hard seafloor substate prevented penetration with the sphincter cover in these areas but some relatively undisturbed samples were still obtained.

Another part of the K042 programme was to retrieve sediment traps at the Ferrar Glacier (and New Harbour) and MacKay Glacier (Granite Harbour) set by Rice University (S-216) the previous season. The sediment strings were anchored to the snout of each glacier and had been deployed through a hole drilled in the sea ice at the glacier edge. We found the anchor points intact although both had undergone considerable strain and some meltout. The lines of both traps however, were broken at about the point the lines would have passed through the sea ice.

It was disappointing not to be able to retrieve the traps for which we had spent time preparing , transporting drilling gear and explosives to Granite Harbour and arranging for USARP divers if necessary.

Lands and Survey surveyors provided precise location of sampling sites and the glacier edge for the Ferrar Glacier samplings. The calving crevasse in the Bowers Piedmont Glacier near Butter Point Camp was also mapped. K042 also assisted the surveyors during the measurement of control trigs along the coast and sea ice monitoring off Cape Roberts.

Transport

Toboggans:

Two Grizzly toboggans (SM051 and SM053) were used by K042 primarily on the sea ice and generally gave few problems. SM051 and SM053 each travelled about 910 and 950 km respectively. The variator belts were changed once on SM053 and twice on SM051. The fuel filter was replaced on SM053 and had to be cleaned (only partly successful) on SM051. Only one new disposable filter was available from Scott Base. Two-stroke fuel was mixed at 35:1 in the field from bulk 44 and 12 gallon drums. Fuel was mixed in the field because some of our equipment required MOGAS only.

Toboggan SM051 was fitted with a precision odometer for surveying on the sea ice. We also installed a 12V plus via the back light to run the echosounder from the toboggan battery. We found this to be very convenient and saved carrying an extra battery specifically for the echosounder.

Daily maintenance of the toboggans included; checking gearbox oil, variator bolts and most importantly the running gear. The nyloc nuts on the running gear are liable to come loose with several days use. This can only be prevented by careful daily checks for which we used a ramp and snow pit at Butter Point.

The few mechanical problems we encountered with the toboggans are attributable to dirty fuel which appears to be a common problem for many field parties. Fuel contamination could be eliminated by:

1) Providing quality fuel containers which are less likely to rust internally. Plastic containers designed specifically for petrol would be a satisfactory alternative.

2) Providing drum pumps with fuel filters attached.

3) Providing sufficient new in line disposable filters for the toboggans. We estimate that these filters should be changed between 300 and 500 km. The dirty filters cannot be successfully cleaned in the field.

Routes and Sea Ice:

K042 followed bulldozed roads on the sea ice between Scott Base, Butter Pt and Marble Pt. We followed the surveyors inshore tracks between Marble Pt and Dunlop Island; deviating offshore to check sea ice conditions on the way to Cape Roberts and returned on the surveyors route which was quicker. Several seasons travel between Marble Pt and Cape Roberts have shown that the sea ice is generally better within 1 km of the coast. Some rough ice can be expected on the north side of Gneiss Pt around Dunlop Island, off the Debenham Glacier ice tongue and near Cape Roberts.

Ferrar Fjord this season contained about 30% rough ice up to 0.5 m high including multi-year sea ice plates and a snow cover about 100 mm thick. Travel was generally easy but slow. This is very different to the 1984-85 season when the Fjord contained very smooth ice, less than 10% rough ice without any "permanent" snow cover.

In New Harbour rough ice again occurred in the central harbour with much multi-year ice in Explorers Cove. The sea ice was generally smooth on the south side of the harbour near the Bowers Piedmont Glacier. We often travelled on the Piedmont between Butter Pt and Trig Herb when commuting into the Ferrar Fjord. This route was smooth, snow covered and without observed crevasses.

The sea ice offshore between Butter Pt and Cape Roberts was quite rough with ice block walls 3-4 m high in places. Several adjoining leads were found from Dunlop Island to Cape Roberts for travelling. However the route was circuitous in places.

The sea ice in Granite Harbour was very smooth on the south side and inner harbour. Low rough ice occurred in the central harbour and on the northern side.

Sea ice this season was about 3 m thick in Ferrar Fjord, New Harbour, 0.5 m thicker than in 1985. Sea ice in other parts of western McMurdo Sound seemed also to be thicker, and by a similar amount. The distribution of pressure ridges, rough and smooth ice, however, was similar to that observed previously.

Helo Operations:

No helo time was allocated to K042 however three flights involved K042 personnel which were charged to separate events. These flights were well coordinated by Peter Cresswell at Scott Base and enabled the planned tasks to be carried out successfully.

1) Scott Base ⟶ Butter Pt ⟶ Scott Base.
(Pyne and Dawkings retrieve equipment from Butter Pt. Afternoon operation only).

2) Butter Pt ⟶ Seismic Drill site ⟶ Butter Pt
(Pyne to photograph granite core at drill site, return with surveyors to Butter Pt. Full day operation).

3) Butter Pt ⟶ Cape Roberts
(MacPherson and Kelly assist survey party helo operation).

Explosives

Explosives were drawn from the CIROS cache at Butter Pt to use for sediment trap recovery and other sea ice work. No explosives were used and were returned to Butter Pt.

Radio Communications

Communication was generally good with Scott Base on HF frequencies. K042 used the morning sked which was efficiently handled from Scott Base. The Labgear radio gave no problems which was a pleasant surprise considering the age of the equipment.

UHF communication is now good on the sea ice between Cape Roberts and Scott Base. We would have preferred UHF sets for our sea ice operation particularly when we needed to communicate with other parties working with us, e.g. surveyors. It would have also enabled easier operation between our two toboggon parties while surveying and sampling.

<u>Weather</u>

Detailed weather logs were not kept, but poor weather days are noted in the Itinerary (Appendix I). Generally the weather was cooler and windier than previous seasons at this time of the year and area. This did not stop our work but slowed down the operation of our equipment on some days.

We had hoped to observe glacier melt streams in flow, but these showed no sign of flow by December 6 and would have required at least another week of warm and sunny conditions.

<u>Remote Stations</u>

Butter Pt Camp:

Butter Pt camp was used by K042 while working in the New Harbour area. Our equipment required periodic maintenance and cleaning which was easily done at Butter Pt rather than at tent camp at the sampling sites. We were also hesitant about camping in the Ferrar Fjord in light of the CIROS 2 storm the previous season. A similar storm occurred in the area this season on December 5, the day we finished work in the Fjord.

The commuting time from Butter Pt to sample sites was about an hour. We do not consider this time excessive because we were able to leave earlier from Butter Pt than a tent camp giving us more work time each day.

Cape Roberts Hut:

The Cape Roberts Hut was used by K042 and surveyors while working in the Granite Harbour area. It is a very suitable hut for messing and as a lab. There are several empty or part empty 44 gallon drums at the site. Most of these are an old (US?)-fed cache prior to 1981.

Cape Roberts Hut @ 30 November 1985:

2 x 20 man-day food boxes (some food items also under bench)

Mogas	1.5 x 44 gal 1 x 12 gal	<u>78 gals</u> (estimate)
DFA		80 gals (estimate)
Kerosene		10 gals (estimate)

Science equipment assorted - VUW.

<u>Itinerary for Sea Floor Sedimentation Studies (K042)</u>

November	3	Pyne, MacPherson, Kelly to Christchurch.
	4	Pyne, MacPherson, Kelly, Dawkings on flight returned to Christchurch
	5	Pyne, MacPherson, Kelly and Dawkings to Scott Base.
	6	Began sssembling equipment (two toboggon ski trailers completed and winch trailer begun) in garage. Calibrated odometer on Grizzly tobotton SM051.
	7	Continued assembly and fitting of winch-drilling trailer.
	8	Dawkings, MacPherson and Kelly on day 1 of survival course. Pyne continued preparation of equipment.
	9	Pyne joined K042 for day 2 of survival training.
	10	Equipment preparation in morning. Visited Biolab at McMurdo in afternoon to check on equipment for sediment trap recovery.
	11	Equipment preparation continues.

November 12 Field equipment checked. Pyne and Dawkings to Butter Pt (opportunity helo) to retrieve equipment stored at Butter Pt (afternoon).

13 Equipment preparation continues. Pyne meet with P. Cresswell (OIC) and G. Varcoe to discuss implications of calving crevasse at Butter Pt near CIROS camp.

14 Preparation of equipment.

15 Loaded sledges in morning. Left for Butter Pt in afternoon.

16 Maintenance checks of toboggons in the morning. Snow and weather closed in this afternoon.

17 Travelled to Ferrar Snout and found sediment trap mooring. Set up grid on sea ice in front of the snout for sea floor sampling. Return to Butter Pt via Explorers Cove.

18 Moved drilling and sampling equipment to Ferrar Glacier Snout.

19-21 Sea floor sampling at site 1. Five cores retrieved.

22 Moved sampling equipment south along snout to site 2. Recovered two cores.

23 MacPherson, Kelly and Dawkings worked in Ferrar Snout channel, returned sampling equipment to Butter Pt.

Pyne to DVSP drill site to photograph granite core and sample for Dr D. Craw (Otago University).

24 Pyne, Kelly, Belgrave and Winters (L & S surveyors) to Ferrar Snout to survey sampling sites and snout terminus.

Surveyed calving crevasse at Butter Pt in evening. MacPherson and Dawkings prepare equipment for move to Cape Roberts.

25 MacPherson, Kelly assisted surveyors with helo close support surveying from Trig Herb (New Harbour) to Mt Marston (Granite Harbour) finishing at Cape Roberts.

Pyne and Dawkings with toboggons from Butter Pt to Cape Roberts.

26 Surveying sea ice east of Cape Roberts. Maintenance checks of toboggons and equipment.

27 Party (6) to MacKay Glacier Snout to find sediment trap. Couldn't find Glacier snout anchor. Returned to Cape Roberts via New Glacier snout and Cape Geology. Very cloudy, light snow with little wind in the inner harbour.

28 Poor weather, tenth day at Cape Roberts.

29 Surveyors to Scott Base by helo in afternoon. K042 to MacKay Glacier. Found sediment trap anchor but traps again lost.

30 K042 Cape Roberts to Butter Pt. Six hour trip on good route. Scott Base personnel (work team and seal collectors) arrived at Butter Pt late evening.

December 1 Maintenance check of Toboggons with Scott Base mechanic assistance. Moved sampling equipment to sampling line at Mt Barnes. Two "Footsteps of SCott" people stayed the night at Butter Pt.

2 Sampled at Mt Barnes and moved equipment to south side of Ferrar Fjord at Delta 4. Footsteps people manhauled to Explorers Cove.

3 Snowing and windy. Stayed at Butter Pt for office day. Pyne worked on CIROS lab plan. Enquiry from Cresswell to Pyne of ice conditions for late season tractor train. Pyne confirmed good ice conditions with only problems directly off Marble Pt and sea ice transit ramp to Marble Pt airport.

4 Sampled at Delta 4, returned equipment to Butter Pt.

5 Ferrar Snout. Photographed and sampled superglacial debris. High winds and blowing snow in late afternoon and evening.

6 Packed up equipment and returned to Scott Base. Equipment cached for cargo train returning to Scott Base via Butter Pt. Camera electronics arrived Scott Base for testing.

December 7 Packed equipment for return to New Zealand and winter storage at Scott Base including moving VUW equipment in hangar. Testing camera electronics but couldn't stabilise in Scott Base science lab.

8 Pack remaining equipment and samples. Camera still not functioning.

9 Pyne checked repaired Scott Base microscope parts damaged at CIROS 2 drillsite and finalised work plan for Ken Woolfe while at Scott Base. Pyne, MacPherson and Kelly return to Christchurch.

10 Pyne attends debrief and CIROS discussion with Jim Barker at Antarctic Division.

GRANITOID STUDIES, ST JOHNS RANGE (K043) - K. Palmer and P. White

Narrative

After two days delay Palmer and White arrived at Scott Base at 1930 on December 29. On December 30 Palmer and White commenced snowcraft and survival training primarily under the tuition of Dawkings, returning on December 31. Woolfe was involved in Scott Base duties. Field gear was checked, sorted and moved to the helipad the following day. Due to a lack of serviceable helicopters on January 2 the planned move was postponed. Palmer and White visited McMurdo and Scott's Hut in the morning and all members of the party were engaged in duties around Scott Base during the afternoon.

On January 3 the helicopter arrived and we were transported to camp 1 near Lanyon Pk, arriving at 1530, after aerial photography of the Ferrar Glacier and refuelling at Gneiss Point. Later in the afternoon Palmer and White enthusiastically inspected outcrops SE of the camp. The next day the party traversed ridges NW of the camp, below Lanyon Pk. On January 5 in strong winds and blowing snow, ridges to the S were ampped and sampled. The following day the ridge SE of camp was examined and the party returned to camp down a ridge to the E. On January 7 a long traverse was undertaken northward to the main ridge overlooking the Miller Glacier. After rounding the end of the ridge Palmer and Dawkings returned directly to camp whilst White and Woolfe carried on round to the SW, linking up to the area examined three days previously. On January 4 the party crossed over the saddle SW of camp and traversed the valley side NE of Victoria Upper Glacier. Palmer and White returned over the saddle S of Lanyon Pk and mapped the ridge down to camp. Woolfe and Dawkings returned via Lanyon Pk. January 9 saw the party climbing Mt Swinford and traversing the NE ridge, returning by various routes around the E side of Mt Swinford.

On January 10 with a hasty departure brought about by the early arrival of the helicopter we moved to camp 2, 2 km NE of Schist Pk. Unfortunately the helicopter was not carrying our resupply items, the most important of which was food. We had only a few odd items of food left, our two original food boxes, along with rock samples and rubbish had been left at camp 1 for retro to Scott Base. After spending most of the day on the radio the problem was finally sorted out and our resupply arrived late in the afternoon. On the following day the party climbed the ridge immediately W of the camp and headed N mapping granite to the summit of Mt Harker. The next day we headed S on the same ridge to the summit of Schist Pk. On January 13 Dawkings returned to camp 1 to retrieve reading glasses left during our hasty departure. The rest of the party crossed over to the Willis Glacier and mapped the ridges around its head, rendezvousing with Dawkings in the afternoon. Palmer, who at this stage was suffering a painful pressure point on his right foot returned directly to camp with Dawkings. White and Woolfe continued NE along the ridge and returned to camp around the N face of Mt Harker. Strong winds on the ridges combined with light snow and exhaustion of the party necessitated January 14 being a tent day. On January 15 ridges to the SE were examined with Palmer and Dawkings returning down the ridge directly S of camp, White and Woolfe continued round toward Schist Pk. January 16 involved a long tramp toward ridges in the vicinity of Mt Evans with the following day being confined to the tents.

January 18 saw the arrival of the helicopter for the move to camp 3. After some problems jamming all our gear in, and at the insistence of the crew all our retro as well. This included food boxes, several bags of rock samples, rubbish and to the crewman's consternation a leaking bag of human waste. We landed at McWhinnie Pk to check out granite we had observed from a distance some days earlier. The new camp was located some 2 km N of Purgatory Pk. After setting up camp the weather closed in, with heavy snow and low visibility, two days were spent in the tents. With the return of fine weather we climbed the hill immediately S of the camp and descended to the plateau area overlooking the Victoria Lower Glacier, returning to camp over Purgatory Pk. With time running short, on January 22 we split into two parties. White and Dawkings headed for the plateau area and returned up the ridge between Purgatory Pk and the Packard Glacier. Palmer and Woolfe examined ridges W of the camp. The following day the Schultz Glacier was crossed and the W ridge of Pond Pk was followed to the summit. The E ridge was then descended to the granite contact. Palmer and White carried out a relatively detailed examination of the area SW of the camp on January 24.

On January 25 the party departed by helicopter for Scott Base, with a detour to Granite Harbour where some aerial photography of granite outcrops on the southern shore was undertaken. The morning of January 26 was occupied with sorting, cleaning and packing gear and the entire party departed for Christchurch at 2200. Upon arrival early the following morning, the party was debriefed, Palmer and White proceeded to Wellington, Woolfe to Nelson.

Transport

A shortage of air transport, both fixed wing and helicopter appeared to be more of a problem this season than those previous. This effected the project in two ways. The party was put in the field late and pulled out early due to rescheduling of Hercules flights to and from New Zealand. Further delays were experienced because of a lack of serviceable helicopters. We would have liked to spend one or two days longer at the first camp. It was not possible however to reschedule the move although we gave two days' notice.

On moving to the second camp we were put down without any resupply of food, or for that matter any of the items we had requested some days earlier. Although by no means in dire straits it did require the rest of the day and considerable radio communications with Scott Base to remedy the situation. One worrying aspect of the helicopter moves was that the crews had difficulty finding us at the new camps. In both cases the crews seemed to think we were still at the initial campsite.

Communications

We were provided with a Labgear radio, although a Compak had been initially requested. 2773 kHz was used for all communications (which were generally excellent) with Scott Base. On only one occasion was relay through Vanda necessary. The change of evening sked time to 2015 instead of 1815 was a good move as it enabled us to get back to camp in time for the sked on every occasion. There was only one minor problem that involved a loose wire in the battery pack. The pack was replaced on the following resupply.

Weather

Weather conditions were generally fine during the time spent in the field. The main exception being two days of quite heavy snow (18 cm total) with accompanying low visibility (100-200 m) but no wind. One or two other days had winds strong enough to make conditions on exposed ridges unpleasant especially when combined with light snow. Most of the other days were calm and sunny. Meteorological recordings were made at 0800 and 2000 and relayed to Scott Base during the radio skeds. Highest temperature measured was -3°C and the lowest -17°C. The weather forecasts which we requested on several occasions proved to be of little use, inevitably the weather on the following day was the complete antithesis of that forecast.

Field equipment

Most field equipment was satisfactory. All members of the party complained about the wool-lined leather boots. Although the boots stood up to the conditions, they are far from ideal. We all suffered from blisters and or painful pressure points, especially when they were used with crampons. Surely a lighter boot constructed of modern materials could be found. Sunglasses provided by Antarctic Division for the field assistants were particularly unsuitable. They were so dark it was not possible to readily distinguish between rock, ice or snow. The woollen finger gloves wear through after a few days of handling rocks. Thinner dacron gloves would perhaps be more suitable for geological work.

There still appears to be problems with the food boxes if earlier reports are anything to go by. There is still insufficient "Refresh" provided, there should be at least 10 packets/box. There are too many salty soups and sauces, and less than a third of the 1.5 kg bag of sugar would be adequate. The bulky container of salt is also far more than required. Too many dry biscuits are provided and the dry Army ration biscuits should be replaced with some sort of ordinary sweet biscuits. Much to the helicopter crewman's distaste we found the thin blue plastic garbage bags unsuitable for human waste, they leak even when two are used. A thick heavy duty bag is required.

Itinerary for K043

December	29	Palmer and White arrive Scott Base
	30-31	Palmer and White attend snowcraft and survival course
January	1	Check and sort field gear and move to helipad
	2	Helo cancelled, all party involved in Base duties
	3	Helo to camp 1, near Lanyon Pk. Aerial photography of Ferrar Glacier on way and refuelling stop at Gneiss Pt
	4-9	Geological mapping and sampling
	10	Helo move to camp 2 near Schist Pk. Resupply delayed
	11-13	Geological mapping and sampling
	14	Tent day, wind and light snow
	15-16	Geological mapping and sampling
	17	Tent day, wind and light snow
	18	Helo move to camp 3 near Purgatory Pk. Land at McWhinnie Pk on way to check geology
	19-20	Tent days, heavy snow and low visibility
	21-24	Geological mapping and sampling
	25	Helo return to Scott Base with aerial photography of Granite Harbour on way
	26	Sorting, cleaning and packing gear. Party depart for Christchurch 2200.

Days at Scott Base	5
Travel	4
Work days	15
Tent days	4
TOTAL	28

FISSION TRACK STUDIES (K044) - P. Fitzgerald

Narrative

Fitzgerald and Woolfe flew from Christchurch to McMurdo on November 20. The morning of November 21 was spent busily preparing field gear for transportation to Beardmore Camp (84°00'13.897"S, 164°24'42.226"E) before departing on a condensed survival course in the ice-fall. Friday, November 22, we checked personal gear in at Hill Cargo, McMurdo Station, for transportation to Beardmore on a C-130 flight that day, this flight later being cancelled due to mechanical problems with the aircraft. We arrived in Beardmore on a fuel flight the following day, our cargo arriving that night on a later flight, although we did not find most of it until the Monday morning. Sunday, November 24, was spent arranging field logistics and field gear preparation which continued on into Monday. We left Beardmore Camp at 1500 hours on Tuesday, November 26, putting in a camp just west of Granite Pillars before doing close support in the Eastern Queen Alexandra Range, sampling Mount Hope, the Gateway, Cape Allen and the summit of Mount Ida. We were unable to make radio contact with any station upon put-in and the helo left us with their AN/PRC-90 VHF radio. Construction of 10' radio masts solved this problem and communications from Granite Pillars was always excellent after that. A helo returned the following day and picked up the VHF radio. November 27 and 28 we worked on spot height .1363 and Granite Pillars but only managed 1 hour's work on Friday, November 29 owing to bad weather. Nevertheless, we managed to complete just about all desired work at this camp. Snow and poor visibility continued Saturday, Sunday and Monday. We had originally planned a move to Mount Kyffin on Saturday, November 30 for a two day camp but had cancelled this request. This was because upon closer examination from Granite Pillars, the outcropping granite at Mount Kyffin on which we wished to take a vertical sampling profile contained no horizontal component. It was therefore deemed unsuitable for our purposes.

Despite not being on the helo schedule for Tuesday, December 3, bad weather elsewhere enabled a change in the schedule allowing us close support in the Queen Alexandra Range. The helo arrived 1440 hours and we sampled spot height .1810, Mount F.L. Smith, Sirohi Point and The Cloudmaker before proceeding to the fuel cache at Lhasa Nunatak. Returning to Granite Pillars to pick up the camp, we returned to Beardmore Camp, sampling Threshold Nunatak en route, and arriving back at 1900 hours.

Wednesday, December 4, we packed rocks and repaired the radio aerial before bad weather elsewhere in the Beardmore region presented us with another opportunity flight leaving Beardmore Camp at 1700 hours, and we put in a camp on the Krelling Mesa in the Miller Range. Despite blustery conditions the next day, we worked on top of the Mesa and around spot height .2440 before descending to the Marsh Glacier via a gully just to the south of .2440, completing a vertical sampling profile of 800 m. The samples were left at glacier level before ascending the bluffs back to the Mesa to encounter 40-50 knot southerly winds and blowing snow. We dug the tent out, repaired the radio aerial and secured the camp before spending an uncomfortable night in the gale. Unfortunately, a strong gust in the night propelled the radio off the kitchen box and onto a primus. After repairing the aerial again in the morning, we discovered that the flight of the radio had proved fatal and it had ceased to function. Bad weather on December 6 kept us confined to the tent. Good weather on December 7 and also the knowledge that we had now missed two radio skeds prompted us to break camp and await "rescue". The helo duly arrived at 1200 hours and since we had achieved our immediate objective, we returned to Beardmore Camp, our camping gear remaining. This remaining gear plus the rock cache at the base of MacDonald Bluffs was picked up on Sunday, December 8 by a helo checking the fuel dump at Moody Nunatak just across the Marsh Glacier.

Monday, December 9, was spent at Beardmore Camp packing rocks and gear. On the Tuesday we were put in for 1.5 hours at Moody Nunatak and took a 400m vertical sampling profile off the north ridge and west face. This was followed by close support in the Queen Elizabeth Range, sampling granites from Bartrum Plateau, Haven Hill, spot height .2790, Mount MacBain and the Fazekas Hills. Wednesday, December 11, was spent at Beardmore camp and on Thursday we did close support in the eastern Commonwealth Range sampling granites at Mount Patrick, Celebration Pass, Mount Kyffin and Mount Robert Scott, before being put in at Cleft Peak for 5.5 hours and returning to Beardmore at 1620 hours. Scheduled C-130 flights to McMurdo on December 13 and 14 were both cancelled. No flying on Sunday December 15, but on Monday we returned to McMurdo. The C-130 flight to Christchurch on December 17 was cancelled, but on the following night Fitzgerald departed McMurdo, arriving in Christchurch on the morning of December 19. Woolfe remained at Scott Base to join up with K043.

Transportation

Transportation to Antarctica was by RNZAF C-130 Hercules. Flights into and out of Beardmore Camp were on board VXE-6 ski-equipped C-130 Hercules as was the return to New Zealand.

Helicopters

K044 was allocated 20 helo hours for use out of Beardmore Camp. These were not included in the NZ allocation for the 1985/86 season. A total of 18.6 hours were used in the following way:

1985	November 26 Put-in camp Granite Pillars. Close support Eastern Queen Alexandra Range (4 stops)	2.2 hours
	December 3 Close support Queen Alexandra Range (4 stops) Pick-up Granite Pillars camp. Return to Beardmore with one close support stop en route	4.4 hours
	December 4 Put-in camp Krelling Mesa, Miller Range	1.8 hours
	December 7 Pick-up from Krelling Mesa, Miller Range Return Beardmore	1.1 hours
	December 8 Pick-up camp and rock cache, Miller Range Return Beardmore	2.2 hours

December 10
Close support Moody Nunatak (1.5 hours ground time)
and Queen Elizabeth Range (5 stops) 3.8 hours

December 12
Close support Commonwealth Range (5 stops)
and Cleft Peak (5.5 hours ground time) 3.1 hours

TOTAL 18.6 hours

Without a doubt, the ability of a field party to liaise directly with the person controlling helicopter operations as well as pilots and crew makes for a more efficient use of helicopter time. A substantially greater amount of work was accomplished this season than had originally been planned. It is appreciated that for NZ field parties this situation is only likely to occur at deep field camps of similar nature to the Beardmore. This situation was aided by the fact that a well organised two person field party is easier to accommodate on flight schedules and resulted in two of our first three helo moves being "opportunity flights"; a result of bad weather elsewhere and changes in flight schedules. Our pick-up from the Miller Range was also an opportunity flight, but it resulted from failure of our radio, and as the work planned had been finished we returned to Beardmore Camp.

Communications

The Berg Field Centre at McMurdo provided us with a Southcom International Inc. Patrolfone Model SC-120, the radio usually supplied to USARP field parties. The radio was tested at Scott Base and again at Beardmore Camp before deployment in the field. KO44 skedded with Beardmore Camp at 0730 hours on 4770 KHZ each day in the field with an optional 2100 hours sked at night. Beardmore relayed our field status to McMurdo Sideband each day. Communications with Scott Base were on 5400 KHZ on a casual basis, the Southcom normally being used when at Beardmore Camp due to poor aerial orientation of their main radio.

On our put-in to Granite Pillars on November 26 we were unable to make contact with any station on any frequency and were left with a AN/PRC-90 VHF radio. Joining bamboo poles together to elevate the aerial 10' above the ground solved this problem and communications with all stations after this were excellent. On the night of December 5 in the Miller Range a violent southerly storm blew the radio off the kitchen box onto a primus and it ceased to function. The same storm shredded the aerial in numerous places and it was noticed that even on a new aerial with this braided wire construction that fraying and eventual breaking occurred much more frequently than aerials with plastic coating.

On day trips into the field an AN/PRC-90 VHF radio was taken for communications with helos. Our Southcom radio was returned to McMurdo Station for repair after the Miller Range trip and was then returned to Beardmore Camp for use by other parties.

Weather

Generally the weather in the Beardmore Glacier area was good, however, at both field camps we suffered bouts of bad weather. At Granite Pillars we spent four days in the tents due to localised low cloud and snow reducing visibility to less than

100 metres. This seems to be a common occurrence at localities adjacent to the Ross Ice Shelf. In the Miller Range we weathered a short storm with blowing snow and winds of between 40-50 knots with occasional stronger gusts.

Field Equipment

All field equipment supplied performed satisfactorily. Being the only NZARP party operating out of Beardmore Camp, it was very noticeable the better quality of field clothing compared to standard USARP issue. Two further recommendations concerning equipment are made. Primus spares should include new burner heads, not only used ones from previous seasons. All field parties working above 200m or at latitudes greater than 80°S in the Transantarctic Mountains should be issued with double climbing boots which are much warmer than the standard issue and are much safer on steeper slopes, especially when using crampons.

Itinerary for K044

1985		
November	20	Fitzgerald, Woolfe fly Christchurch to Antarctica
	21	Preparation of field gear, survival course
	22	Flight to Beardmore Glacier deep field camp cancelled
	23	Fitzgerald, Woolfe fly from McMurdo to Beardmore Camp
	24-25	Sorted gear and finalised field logistics
	26	Close support Eastern Queen Alexandra Range. Put-in camp at Granite Pillars
	27-28	Work and sample areas of Granite Pillars and spot height .1363
November December	29- 2	Bad weather causes helo delay
December	3	Close support Queen Alexandra Range. Return to Beardmore Camp
	4	Pack rocks. Put-in camp Krelling Mesa in the Miller Range
	5	Work and sample MacDonald Bluffs and spot height .2440
	6	Bad weather
	7	Return Beardmore Camp. Gear left in Miller Range
	8	Sunday at Beardmore. Helo picks up gear and rock samples from Miller Range
	9	Beardmore Camp
	10	Put-in at Moody Nunatak for 1.5 hours. Close support Queen Elizabeth Range
	11	Beardmore Camp
	12	Close support Eastern Commonwealth Range. Put-in at Cleft Peak for 5.5 hours
	13-14	C-130 flights to McMurdo cancelled
	15	Sunday at Beardmore
	16	Fitzgerald, Woolfe fly Beardmore to McMurdo
	17	Scott Base
	18	Fitzgerald returns NZ, arriving December 19

Scott Base	3 days
Travel	6 days
Days in field - work	7 days
- bad weather	5 days
Beardmore Camp - close support	2 days
- downtime	6 days
Total days in Antarctica	29 days

APPENDIX I VUWAE CARGO

CARGO TO ANTARCTICA

K042 SEA FLOOR SEDIMENTATION

1.	1.21 m^3	(Winch & equipment)		est.	650 kg	
2.	1.3 m^3	(Scientific equipment)		est.	500 kg	
3.	0.3 m^3	(Corer & parts)		est.	80 kg	
4.	0.75 m^3	(Ladder mast & skis)		est.	100 kg	
5.	0.35 m^3	(Camera housing)		est.	145 kg	
6.	0.04 m^3	(Camera electronics)		est.	15 kg	
7.	0.2 m^3	(Fragile hand carry)		est.	60 kg	
	4.15 m^3		sub total			1550 kg

K043 GRANITE STUDIES

K044 FISSION TRACK DATING

1.	0.47 m^3	(Science equipment)		est.	130 kg	
			sub total			130 kg

K041 CIROS SCIENCE

Ship cargo January 86.

1.	0.65 m^3	(Core saw & parts)		est.	250 kg	
2.	0.72 m^3	(Science equipment)		est.	250 kg	
	1.37 m^3		sub total			500 kg
			TOTAL			2180 kg

CARGO FROM ANTARCTICA

K042 SEA FLOOR SEDIMENTS

1.	0.2 m^3	(Science equipment)			46 kg	
2.	0.24 m^3	(Corer & parts)			151 kg	
3.	0.27 m^3	(Camera housing & parts)			161 kg	
4.	0.71 m^3	(Science equipment)			186 kg	
5.		(Camera tripod)		est.	20 kg	
6.	2x0.07	(Frozen samples)		est.	60 kg	
			sub total			624 kg

K043 GRANITE STUDIES

1.	0.44 m^3	(equipment & samples)			191 kg	
2.		(14 sacks samples)			279 kg	
			sub total			470 kg

K044 FISSION TRACK DATING

1.		(8 sacks samples shipped directly to Melbourne)		est.	200 kg	
			sub total			200 kg
			Total			1294 kg

NOTES Movement of cargo to Antarctica was efficient with all cargo at Scott Base when required. The return of cargo from Scott to NZ was disappointing. K042 cargo including frozen samples were ready for shipment on 9 December 1985 but arrived by ship nearly three months later.

APPENDIX II

K043 - ST JOHNS RANGE, SOUTH VICTORIA LAND - WEATHER RECORD

		3-1-86	4-1-86	-	5-1-86	-	6-1-86	-	7-1-86	-	8-1-86	-
Date		3-1-86	4-1-86	-	5-1-86	-	6-1-86	-	7-1-86	-	8-1-86	-
Time	local	1900	0930	1900	0800	2000	0800	2000	0800	2000	0800	2000
	GMT	0700	2130	0700	2000	0800	2000	0800	2000	0800	2000	0800
Location	Lat.	77°16'S	-	-	-	-	-	-	-	-	-	
	Long.	161°47'E	-	-	-	-	-	-	-	-	-	
Elevation		950 m	-	-	-	-	-	-	-	-	-	
Wind	mean dir.			N	S	SW		NE	N	SE		
	mean speed	0	-	2	10-15	20-25	0	3-4	1	5	0	
Visibility		50 km	-	-	40 km	-	50 km	-	-	-	-	
Weather phenomena						Blowing snow, light						
State of sky		SCT	SKC	-	-	-	SCT	-	BKN	-	SKC	SKC
C	Lowest cloud											
L	Amount/type	1/Sc					3/As	1/As	5/Cs	1/Ac		
O	Height	5000'					10000'	10000'				
U	Other clouds											
D	Amount/type							1/Cs		4/Cs		
S	Amount/type											
Temperature		-7	-6	-6	-3	-4	-3	-3	-2	-4	-2	-2
Past weather and remarks						Snow plumes on peaks		Stable		Cloud increase		

		9-1-86	-	10-1-86	11-1-86	-	12-1-86	-	13-1-86	-	14-1-86	-
Date		9-1-86	-	10-1-86	11-1-86	-	12-1-86	-	13-1-86	-	14-1-86	-
Time	local	0800	2000	2000	0800	2000	0800	2000	0800	2000	0800	2000
	GMT	2000	0800	0800	2000	0800	2000	0800	2000	0800	2000	0800
Location	Lat.	77°16'S	-	77°18'S	-	-	-	-	-	-	-	-
	Long.	161°47'E	-	162°05'E	-	-	-	-	-	-	-	-
Elevation		950 m	-	1200 m	-	-	-	-	-	-	-	-
Wind	mean dir.		SW	W		SW		W			SE	S
	mean speed	-	3	1	0	1	0	1	0	-	5	5
Visibility		-	-	-	-	50 km	-	-	-	-	-	30 km
Weather phenomena							Localised mist					Passing light snow showers
State of sky		-	-	-	-	SCT	BKN	SCT	-	BKN	-	-
C	Lowest cloud											
L	Amount/type					1/St	6/St	1/As	1/As	7/Ac	1/Ac	6/Sc
O	Height					6000'	6000'	12000'				6000'
U	Other clouds											
D	Amount/type						3/As				3/As	
S	Amount/type										6/Cs	
Temperature		-2	-4	-7	-5	-9	-5	-11	-4	-10	-7	-8
Past weather and remarks			OVC St, Sc to North			OVC valleys and Ross Sea area	OVC in valleys to north					

"-" indicates unchanged from previous reading.

		15-1-86	-	16-1-86	-	17-1-86	-	18-1-86	-	19-1-86	-
Date		15-1-86	-	16-1-86	-	17-1-86	-	18-1-86	-	19-1-86	-
Time	local	0800	2000	0800	2000	0800	2000	0800	2000	0800	2000
	GMT	2000	0800	2000	0800	2000	0800	0200	0800	2000	0800
Location	Lat.	77°18'S	-	-	-	-	-	-	77°20'S	-	-
	Long.	162°05'E	-	-	-	-	-	-	162°18'E	-	-
Elevation		1200 m	-	-	-	-	-	-	1050 m	-	-
Wind	mean dir.		SW		NE		NW	NW	W	E	NE
	mean speed	0	5	0	2	0	3	2-3	1	5	2
Visibility		50 km	-	-	30 km	20 km	50 km	-	-	200 m	200 m
Weather phenomena				Haze	Occas. v.light snow	Light snow				Mod.- heavy snow	Mod. snow
State of sky		SCT	BKN	SKC	OVC	-	SCT	BKN	-	X	X
C	Lowest cloud										
L	Amount/type	1/Sc	6/Sc		8/St	8/St	3/Sc	6/As	1/Sc		
O	Height		6000'		6000'						
U	Other clouds										
D	Amount/type		2/Cs				1/As		3/As		
S	Amount/type						2/Cs		5/Cs		
Temperature		-5	-4	-5	-7	-9	-7	-4	-7	-10	-10
Past weather and remarks										Snow lying	Snow 12 cm last 12 12 hrs

Date		20-1-86	-	21-1-86	-	22-1-86	-	23-1-86	-	24-1-86	-	25-1-86
Time	local	0800	2000	0800	2000	0800	2000	0800	2000	0800	2000	0800
	GMT	2000	0800	2000	0800	2000	0800	2000	0800	2000	0800	2000
Location	Lat.	77°20'S	-	-	-	-	-	-	-	-	-	-
	Long.	162°18'E	-	-	-	-	-	-	-	-	-	-
Elevation		1050 m	-	-	-	-	-	-	-	-	-	-
Wind	mean dir.	E	SW		SW		S	S	SW		NE	
	mean speed	5	3	0	4	0	1	2	3	0	2	0
Visibility		-	20 km	50 km	-	-	-	-	-	-	20 km	50 km
Weather phenomena		Light-mod. snow									Patches fog and diamond dust	
State of sky		X	OVC	BKN	-	-	-	-	SCT	SKC	BKN	-
C	Lowest cloud											
L	Amount/type		1/St	5/Cs	7/Sc	6/Ci	5/As	7/As	1/As		7/St	5/As
O	Height											
U	Other clouds											
D	Amount/type		1/Sc									
S	Amount/type		8/As									
Temperature		-13	-12	-10	-8	-8	-11	-9	-12	-11	-12	-11
Past weather and remarks		Snow 4 cm last 12 hours	Total amt snow 18 cm									

"-" indicates unchanged from previous reading.

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