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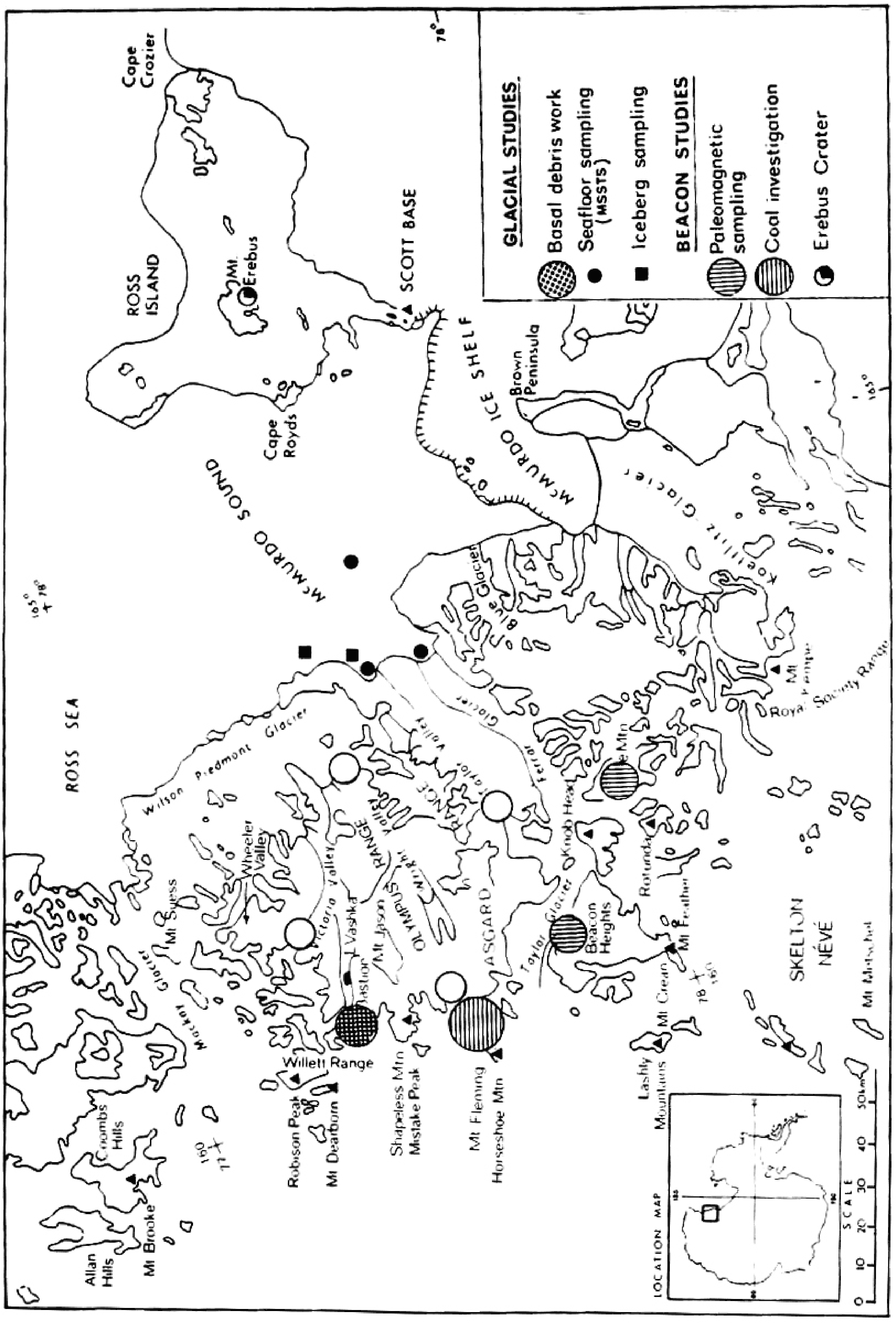


FIG. 1. The McMurdo Sound region, showing areas of activity for VUWAE 23.

PROGRAMME FOR VUWAE 23

Victoria University of Wellington Antarctic Research Centre submitted three scientific projects to RDRC for the March meeting. These projects were approved in their entirety and passed on to Antarctic Division.

The projects involved a wide range of scientific disciplines and eight investigators:

A. Glacial Sediment Studies

Final field season of a three year study of processes of entrainment, transport and deposition of debris in polar ice. Taylor Glacier is to be rechecked and a number of other areas searched for similar basal debris layers. A party is to work in the sea ice on the western side of McMurdo Sound sampling the sea floor and icebergs for sediment.

B. Beacon Studies

Samples to be collected at regular intervals through Devonian and Permian-Triassic Beacon strata for paleomagnetic measurements to establish a polar wander curve for south Victoria Land. A separate project entails a detailed study of the Permian coal measures at the head of the Dry Valleys.

C. Erebus Crater Studies

Further magnetic, seismic and usual observations of the activity in Mount Erebus crater to be made.

EXPEDITION MEMBERS

The main projects of VUWAE 23 were made up as follows:

A. Glacial Sediment Studies (EVENT 12)

Leader/Geologist	Peter Barrett	Reader in Geology, VUW.
Geological assistant	Philip Bentley	B.Sc. student, VUW.
Geologist	Paul Robinson	Ph.D. student, VUW.
Mechanic/assistant	Stewart Ross	Antarctic Division, DSIR.

B. Beacon Studies (EVENT 13)

Leader/Geophysicist	Chris Christoffel	Associate Professor in Physics, VUW.
Geophysical assistant	Peter Garden	B.Sc. (Hons) student, VUW.
Geologist	Alex Pyne	B.Sc. (Hons) student, VUW.
Geological assistant	Chris Mroczek	B.Sc. student, VUW.

C. Erebus Crater Studies (EVENT 5)

Geophysicist	Ray Dibble	Reader in Geology, VUW.

Applications for three students with geological and geophysical backgrounds were called for as field assistants, in May 1978. The Antarctic Research Committee at VUW selected Bentley, Mrozcek and Garden to fill these positions. Research by these three expedition members will be undertaken at VUW during 1979.

FINANCE, EQUIPMENT AND GENERAL PROVISIONS

Finance

A grant of $7859 from the University Grants Committee was used to pay for food, clothing, camping items, specialised scientific equipment, freight, travel and insurance. The University Council provided financial support for Bentley, Garden, Mroczek, and Pyne.

Equipment

Additions to the VUWAE stores were mainly scientific. Special equipment was necessary for both paleomagnetic and sea floor sampling. For paeomagnetic sampling the Physics Department's portable drill was used and ten drill bits were purchased. In addition a rock saw and jig were purchased for sample preparation in Wellington. Sea floor sampling was achieved with an A-frame and a McIntyre grab borrowed from the N.Z. Oceanographic Institute, who also lent us two current meters. Sub-sampling from the grab required the construction of two steel boxes 20 x 13 x 10 cm. Equipment constructed for cutting or working on holes in the sea ice included ice nets and heavy chisel points.

Expensive and specialised field provisions were supplied by Antarctic Division, the main items were: two sno-tracs, two motor toboggans, three sledges, five polar tents, four radio transceivers, three first aid kits, a chain saw and miscellaneous climbing equipment. Petrol and kerosene were also provided by Antarctic Division. Two motor-driven ice drills were borrowed from McMurdo Station.

Food

As for previous expeditions, VUWAE 23 were charged on a man-day basis for food while at Scott Base and in the field - a flat rate of $26 per person per week. No extras were purchased by VUWAE this year.

Clothing

Four sets of new windproof clothing were purchased. Down clothing and mukluks were repaired by Graeme Duncan.

STRUCTURE OF THE EXPEDITION

Glacial Sediment Studies (Event 12)

Oct 21-Nov 11 Completion of Taylor Glacier programme with visits to several other Dry Valleys glaciers

P. Robinson	
S. Ross	DSIR assistant

Nov 18-24 Preliminary bathymetric survey for MSSTS drill site NE of Butter Point

P. Robinson		
P. Bentley		
S. Ross	DSIR mechanic/assistant	
H. Höfle	Glacial geologist)	West
D. Grund	Geophysics technician)	Germany

Nov 25-Dec 6 Two drill sites 15 km NE of Butter Point and 4 km E of DVDP10 selected and sampled. Seismic survey completed by Event 10 (L. McGinnis & K. Power

P. Barrett	
P. Bentley	
S. Ross	DSIR mechanic/assistant
G. Lees	DSIR technician/assistant
H. Höfle)	West
D. Grund)	Germany

Dec 7-13 Sampling snout of Ferrar Glacier attempted. Gravity traverse at mouth of Taylor Valley completed.

P. Bentley	
S. Ross	DSIR mechanic/assistant
H. Höfle	West Germany
A. Burt	DSIR technician/assistant

Beacon Studies (Event 13)

Nov 17-24 Preliminary survey of Mount Bastion sequence for both paleomagnetic and coal studies

P. Barrett
D. Christoffel
P. Garden
C. Mroczek
A. Pyne

Nov 25-Dec 4 Completion of Mount Bastion work

D. Christoffel
P. Garden
C. Mroczek
A. Pyne

Dec 5-14 Paleomagnetic sampling at Beacon Heights

D. Christoffel	
P. Garden	
A. Richards	DSIR assistant

Dec 15-18 Paleomagnetic sampling at Table Mountain

D. Christoffel	
A. Richards	DSIR assistant
K. Williams	DSIR assistant

Dec 6-15 Reconnaissance of Mount Fleming for coal studies

A. Pyne
C. Mroczek

Dec 16-Jan 14 Mapping and coal studies in Mount Fleming area

A. Pyne	
C. Mroczek	
P. Bentley	
H. Höfle	West Germany
S. Ross	DSIR assistant

<u>Erebus Crater Studies (Event 5)</u>

Dec 10-31 Acclimatisation at Fang for 2 days followed by 3 weeks work in summit area

R. Dibble	Geophysicist (VUW)
W. Giggenbach	Geochemist (DSIR)
H. Tazieff	Vulcanologist (France)
C. Fink	Surveyor (Lands & Survey)
C. Monteath	DSIR field leader
R. Thompson	DSIR assistant

SCIENTIFIC ACHIEVEMENTS

Transport of glacial debris (Paul Robinson)

A week in late October 1978 marked the end of sedimentological and glaciological field work for the Taylor Glacier project. Paul Robinson and Stewart Ross (DSIR) made an early season trip to Taylor Glacier (Plate I) to complete the englacial sediment sampling and to observe englacial structures before the 'melt' began. This was followed by two weeks (Oct 28-Nov 11) investigation of dry valley alpine glaciers (Rhône, Sykes, Albreich and Sandy) and two outlet (?) glaciers (Wright Upper and Victoria Upper). Comparisons of the englacial sediment texture, ice structures and the products of deposition indicate that the mechanisms of debris incorporation for these glaciers differ from those of Taylor Glacier. Rhône, Sykes, Albreich, Sandy, Wright Upper and Victoria Upper (Plate II) Glaciers contain various types of glacial debris, but none show the strong basal character of Taylor Glacier.

Taylor Glacier sediment ranges in sizes from clay through to large boulders, and is presently depositing this boulder-clay (or till). The percentage of sediment on the ice ranges from less than 1 to 60 per cent, and this, together with the various sediment grain size textures, gives a good indication of the modes of debris incorporation. The predominant process for Taylor Glacier sediment entrainment appears to be basal regelation. This probably occurs 1) by abrasion, pressure melting and the associated "freezing in" of debris at the glacier sole; and 2) by block incorporation of pre-existing till, again by freezing of meltwaters at the base of the ice mass. Although both of the above processes produce similar sediment texture, the sediment to ice concentrations vary (abrasion and regelation less than 1 to 20 percent; till block regelation commonly greater than 15 to over 60 per cent).

The alpine glaciers (including Wright Upper and Victoria Upper, which were previously considered true outlet glaciers) contain diffuse (generally less than 5 per cent sediment to ice), moderate to poorly sorted, angular to subangular sand and pebble debris (Plate III). Such sediment is characteristic of a supraglacial origin, where valley wall rock fall is buried by snow accumulation and subsequently transported englacially.

This project reveals the apparent uniqueness of the Taylor Glacier in comparison to other glaciers terminating on land in the Dry Valleys. However, future observations of glaciers such as the Ferrar, MacKay and Mulock, all plateau-fed glaciers, may reveal an ability to produce basally-derived debris.

Zones of net basal melting and refreezing for the inland ice (Drewry, in press) and Taylor Glacier (Robinson, in prep.) have been determined from geophysical and glaciological data. This is consistent with the already outlined basal debris regelation model. However, for the sediment presently being deposited at the snout of Taylor Glacier incorporation would have to have occurred between 2000 and 6000 years before present. This is based on estimates of present day positions of basal sediment incorporation sites, and assumes present day ice velocities.

Glacial sediments surrounding Taylor Glacier and Lake Bonney exhibit similar features to the englacial material of Taylor Glacier. Therefore, it seems likely that the main process of debris incorporation by Taylor Glacier has been basal, and that Taylor Glacier is, and has been, a wet-based glacier for several thousand years.

The saline discharge at the snout of Taylor Glacier (Black, 1969; Keys, in prep.) was underway during the October visit (Plate I). Temperature measurements of air (-26 to -16°C), ice (-17 to -10°C) and the liquid discharge (-6 to -5.5°C) were made. An estimate of the total discharge was considered to exceed 3000m^3.

While working around Wright Upper Glacier an in situ outcrop of granitic basement was located (Plate IV). Exposure is restricted to 0.5 km^2 in the N.W. corner of the Labyrinth, but appears to extend under the N.E. margin of the Wright Upper Glacier. Here the Labyrinth dolerite sill has thinned out, so that the overlying Beacon sediments are in direct contact with the granitic basement. These observations are in direct contrast with Claridge and Campbell, 1978. They suggest that no granitic material is exposed west of Koenig Valley, Asgard Range. This previously undescribed outcrop may have significant bearing on the inferred direction of ice movement (Robinson, in press).

In conjunction with Event 1 (Dry valley hydrology), Robinson spent two days at Wright Lower Glacier. Attempts at locating glacier ice beneath lake ice were abandoned when drilling equipment was damaged by coarse sediments 2 m down at the probable lake ice glacier ice contact. Further attempts were to be made later on in the season by Event 1.

References

Black, R.F., 1969. Saline discharge from Taylor Glacier, Victoria Land, Antarctica. Antarctic Journal of the U.S. vol 12 (4): 102-104.

Claridge, G.G.C. and Campbell, I.B., 1978. Moraines of probable Miocene age, dry valleys, Antarctica. N.Z. Antarctic Reocord 1 (2): 1-5.

Drewry, D., in press. Geophysical investigations of ice sheet and bedrock inland of McMurdo Sound, Antarctica. Antarctic Geoscience (C. Craddock, ed.). University of Wisconsin Press, Madison.

Keys, J.R., in press. Some saline and glaciological studies in the McMurdo Sound region. PhD Dissertation.

Robinson, P.H., in press. Eastward ice advances in Wright Valley, Antarctica. N.Z. Antarctic Record. 2 (1).

In preparation - An investigation of entrainment, transport and deposition of glacial debris by polar ice, with special reference to Taylor Glacier, Antarctica. PhD Dissertation.

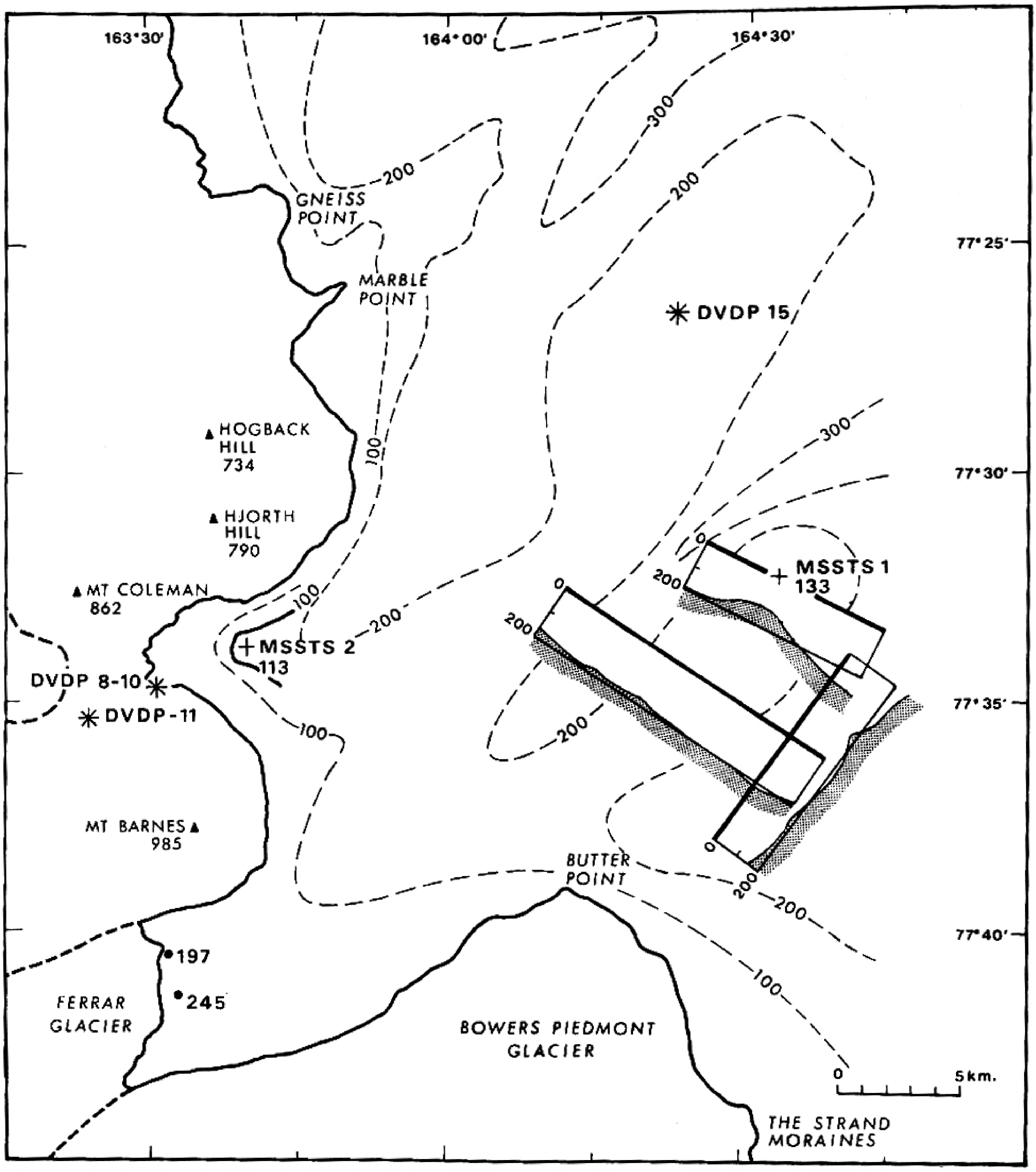


FIG. 2. Map of New Harbour showing the two drill sites investigated. The bathymetry presented by Barrett, Treves et al. (1976, Fig. 2) is shown as dashed contours. The bathymetry obtained from the site survey of November, 1978, is shown by cross-sections (MSSTS 1) and a heavy contour (MSSTS 2).

Physical characteristics of MSSTS Sites 1 & 2 (Peter Barrett and Phil Bentley)

The purpose of this part of VUWAE 23 was to locate and determine the physical conditions at the two sites proposed for drilling in late 1979 in western McMurdo Sound (Fig. 1). For each site local bathymetry was determined and an access hole then opened for current measurements and sea floor sampling. Nothing was found at either site to suggest that drilling should not proceed.

The 1978 winter was unusually cold and the sea ice thickness greater than expected. Around Site 1 the thickness ranged from 2.5 to 2.8 m, though the ice must have formed that year. At Site 2 the thickness was 4.0 m and the two debris layers in snow patches on the ice surface suggest the ice was entering its 3rd season. We had hoped to determine water depth by using a depth sounder and placing the transceiver (the energy source) on the sea ice surface in a puddle to minimise energy loss. Neither of our tow instruments (SIMRAD, frequency kHz, power watts; FURONO, frequency 50 kHz, power 10 watts) displayed a return signal, and we found it necessary to drill a hole through the ice. On some occasions a signal was received when the transceiver was only 1 m down the hole, but on others no signal was received even when the transceiver was lowered to the base of the ice. When a signal was received the depth indicated was within 2% of that obtained from a line. Because of the uncertainty of the depth sounders, and the need to drill a hole through the ice anyway to obtain a depth, we opted for the time-honoured (and time-consuming) method of the weighted line. However, there is no doubt that a depth sounder that could operate through the sea ice would be a major advance for marine scientists using sea ice as an operating platform; Physics and Engineering laboratory, DSIR, are currently investigating ways of improving commercial depth sounders for such an operation.

The bathymetry in the region of MSSTS Site 1 (Fig. 2) shows a shelf at 180 to 200 metres over a large area with a dome close to the proposed drill site. Both major northwest-trending lines were expected to encounter a 300 m deep valley revealed by previous surveys (Northey et al., 1975, Figs. 2 & 3), though it could lie between two stations, which are about 1 km apart for much of the survey. The dome, which rises to less than 120 m below sea level is an odd feature of unknown significance. It could be a volcanic core or reflect a basement high or be one of several other possibilities. In any event it is suggested that the drill site be moved about 2 km to the southwest so that a flat (typical) part of the sea floor is drilled. The bathymetry at MSSTS Site 2 is simple (Fig. 2) and indicates a basin with a maximum depth of a little over 110 m.

We planned to cut the access holes with chain saws and to break out the last few 30 cm or so with crowbars and heavy chisel points attached to SIPRE rods. At Site 1 it took 8 hours of very hard work to make a hole 1.0 x 1.2 m x 2 m deep, by which time we were not at all reluctant to use eight pounds of explosive (2 in each corner) to finish the job. However, one of the holes for the explosive penetrated the bottom filling the excavation with sea water. The nearby tent proved to be too close (Plate V). No damage was sustained, but the sleeping bags were uncomfortably wet, and were almost impossible to dry properly. At Site 2 we cut a hole 1 m deep and sliced the ice below this for a further 0.8 m. Four 4 lb charges were used, and another small charge was necessary to break a hole 1.5 m across through the 4.0 m thickness of ice. A third access hole was attempted at the snout of Ferrar Glacier using a single 30 lb charge three-quarters of the way through the 4.8 m thick ice. This shattered the ice reasonably well but the hole was not large enough to use the grab for sea floor sampling.

Current measurements were carried out every three hours over a 24 hour period at both drill sites and at Ferrar Glacier snout using rotors (Plate V) borrowed from the N.Z. Oceanographic Institute. The meter was read half way down and 1 m above the sea floor. Before the rotor was lowered, it was moved in the water to check that a signal was reading in the meter. No currents were recorded, indicating velocities less than 2.7 cm s^{-1}.

Sea floor sampling with a McIntyre grab (Plate VII), also borrowed from the N.Z. Oceanographic Institute, produced much more positive results. Sampling was successful about two times in three, with the sea floor sediments filling about two-thirds of the grab. The sea floor itself was little disturbed, and at Site 1 showed a varied fauna (Plate VIII), in addition to a dense muddy mat from 1 to 5 cm thick of sponge spicules. Site 2 had very few creatures by comparison. The sea floor was well preserved by subsampling with a metal box and storing in plastic containers (Plates IX and X).

The texture of the sea floor sediments at both MSSTS Sites 1 and 2 is moderately sorted medium to coarse grained sand with admixtures of gravel (>4 mm) typically from 0.3 to 0.8% and of mud from 3 to 13%. The gravel fraction from both sites includes both granitic and basaltic stones, though the latter which include both floor rocks and tuffs, are dominant. Of particular interest are pieces of light olive grey claystone, possibly from early Cenozoic Strata. The sand fraction appears far more distinctive at each site, being basaltic at MSSTS Site 1 and quartzo feldspathic at Site 2 (New Harbour).

An important feature of the sediment is the burrowing, seen in Plates IX and X. As the grab samples were washed for pebbles, mucus-cemented sand tubes collected in the sieve and were disaggregated only with some effort. The tubes are best seen as the sediment surface in Plate X, but occurred in abundance at both sites. The faint mottling in the section of Plate X is also an indication of burrowing. We were not able to determine how far beneath the sea floor present day burrows extend, but they are commonly 8 cm long and this may therefore be taken as a minimum. We noted above that the sponge spicules at Site 1 were abundant only in the upper few centimetres. Perhaps their paucity beneath is due to comminution by burrowing organisms.

Sediment on ice-bergs and sea-ice in western McMurdo Sound (Peter Barrett and Phil Bentley

Sediment on the sea floor in polar regions has three main origins - floating ice, wind and biogenic production. Part of the VUWAE programme this year was to investigate sediment in transport today by wind and ice in western McMurdo Sound.

Ice-bergs are a common feature along the western shore of the Sound. Most are floating and are trapped in the sea-ice, but several large bergs, many to 80 m above sea level, have grounded for some years near the site of DVDP15 (Barrett and Treves, et al. 1976, Fig. 2). Most of the bergs have no visible trace of glacial debris, although patches of wind-blown sand are quite common. This year, however, one small and two large ice-bergs were found in the New Harbour area with a continuous thin (0.3 m) cover of rock debris clearly destined for the sea floor. The largest (Plates XII and XIII) reached a height of about 20 m above sea level and was about 1 km long.

From our examination of the debris we concluded that it accumulated on the surface of a glacier that reached the coast and calved. There are a few abraded and striated pebbles, which must have had a basal glacial origin, but most are angular, which, together with the lack of mud-sized material, indicates a superglacial origin for most of the debris. The ice beneath the debris layer appears to contain no debris itself and therefore can not be the source.

A striking feature of the debris is the wide range of rock types - granite (several types), marble, schist, porphyry, dolerite, quartzarenite, and basalt. This range can at present be found only between the Koettlitz and Mackay Glaciers, and the berg most probably came from the Koettlitz Glacier area.

Our sea floor sampling (see earlier) showed that present day sea floor sediment in western McMurdo Sound contains less than 1% gravel, which is the dominant size fraction in the ice berg debris, indicating that ice bergs of this type are not a major sediment source.

The texture of sea floor sediment samples and of cores obtained from DVDP 15 several kilometres north of the MSSTS 1 site suggests that wind-blown sand, in contrast to ice-rafted debris, is a major source of sediment in western McMurdo Sound. This year we carried out a small sediment sampling programme to estimate annual sediment flux from this source and to document the texture and mineralogy of the sediment.

Sampling of the sediment was concentrated in New Harbour, but several samples were also collected from near MSSTS 1. Bathymetric stations in New Harbour were used as the main sample localities with subsidiary localities further seaward and nearer the coast. Sampling was mainly by digging a snow pit (Plate XV) of uniform size (20 x 20 cm) and sediment layers within the 'block' being retained.

In New Harbour the sediments are well sorted medium quartzo-feldspathic sand and silts, and there is a marked decrease in grain size seawards. Sediments near MSSTS 1 are of basaltic composition, and generally of fine sand and silt size.

Sediments are generally blown within a mobile snow layer up to 15 cm above the sea-ice surface, although wind velocity is an important variable. The main form of movement is by saltation, debris tending to accumulate either within fresh snow dunes, or on higher relief sastrugi and old upthrust ice blocks. Sediment accumulation is more concentrated near the coast (e.g. New Harbour) and around ice bergs, (Plate XIV) which serve as effective wind-breaks. Concentrations of sediment are often found in shallow pits in the ice, sediment melting and consequent concentration on and within older, harder layers of ice.

Initial estimates on sediment flux indicate 1 x 10^4 tonnes of sediment was deposited by the wind on the sea ice in New Harbour in 1978, an average rate of 0.5 mm/year The sand on the sea ice is transported and deposited over large areas of the western Ross Sea when the ice breaks out and is blown north. However the accumulation rate of sediment on the sea ice can be used to infer the flux of wind-blown sediment under open water conditions, which are believed to occur for almost 1/5 of the time. On this assumption the sedimentation rate for wind-blown sand in New Harbour averages 0.1 mm/year.

References

BARRETT, P.J., TREVES, S.B. et al. 1976. Initial report of DVDP15, western McMurdo Sound, Antarctica. Dry Valley Drilling Project Bull. No. 7, Northern Illinois Univ., DeKalb, 1-100.

NORTHEY, D.J., BROWN, C., CHRISTOFFEL, D.A., WONG, K., BARRETT, P.J. 1975. A continuous seismic profiling survey of McMurdo Sound, Antarctica - 1975. Dry Valley Drilling Project Bull. No. 5, Northern Illinois Univ., DeKalb, 150-166.

Bottom Sediment Paleontology of the proposed MSSTS sites in Western McMurdo Sound

(David B. Waghorn and Jeffrey N. Ashby)

Bottom sediments from the proposed MSSTS Sites at New Harbour (NH) and off Butter Point (BP) were obtained by members of VUWAE 23, Event 12, using a NZOI McIntyre grab. Two 10 cm^3 subsamples were taken from each grab sample, at depths of 0-1 m (1/A) and 3-5 cm (1/B) below the top of the sample.

Results

The biota includes planktonic and benthonic foraminifera, ostracods, diatoms, radiolaria, sponge spicules and small gastropods (Plate XI). No difference was observed in faunal abundance or diversity between the top and bottom subsamples at each site. Mottling and the presence of ? worm tubes in the sand indicate extensive bioturbation, resulting in homogenity of sediments and samples.

Calcareous Microfossils

A significant difference is apparent, both in species abundance and test composition, in assemblages between the two sites. At New Harbour, sample NH 1/A is dominated by arenaceous benthonic foraminifera, sponge spicules and centric (planktonic) diatoms. Common arenaceous foraminifera include *Rhabdammina* cf. *linearis* Brady, *Rhizammina indivisa* Brady, *Reophax nodulosus* Brady, *Haplophragmoides rotulatum* (Brady) cf. *sphaeriloculus* Cushman, *Textularia earlandi* Parker, *Rzehakinidae* sp, and *Miliammina arenacea* (Chapman). A small number of calcareous benthonic foraminiferal taxa including *Trifarina earlandi* Parr, *Fursenkoina daviesi* (Chapman & Parr), *Robertina sp*. and *Globocassidulina crassa rossensis* Kennett, occur. Also, two juvenile specimens (ostracod) *Echinocytheris* cf. dasyderma (Brady) have been identified. Sample NH 1/B is dominated by arenaceous taxa, but reduced in diversity compared to sample NH 1/A. Both samples lack *Neogloboquadrina pachyderma* (Ehrenberg).

In contrast, both Butter Point samples (BP 1/A & BP 1/B) are dominated by calcareous benthonic taxa. Species present include *Trifarina earlandi* Parr, *Ehrenbergina glabra* Heron-Allen & Earland, *Astrononion antarcticum* Parr, *Pyrgo williamsoni* (Silvestri), *Globocassidulina* sp. and *Fursenkoina daviesi* (Chapman & Parr). Most of the New Harbour arenaceous taxa also occur in abundance in the Butter Point samples. Sinstrally coiled *Neogloboquadrina pachyderma* (Ehrenberg) are common. Ostracod taxa present are *Australicythereis polylyca* (Muller), *Xestoleberis* sp, *Krithe* 2 spp, *Australicythereis* sp and *Trachyleberis* sp. cf. *Cythere polytrema* Brady.

Siliceous Microfossils

Very low radiolarian abundance was encountered at both sites. The New Harbour assemblage is dominated by *Lithelius nautiloides* Popofsky, the remaining taxa being *Antarctic strelkovi* Petrushevskay , *Spongotrochus glacialis* Popofsky and *Spongodiscus* cf. *favus* Ehrenberg. At Butter Point, Radiolaria were of even lower abundance than at New Harbour. The New Harbour assemblage is dominated by *Lithelius nautiloides* Popofsky, with *Spongotrochus glacialis* Popofsky and *Antarctissa* cf. *denticulata* (Ehrenberg) present. The diatom taxa, *Coscinodiscus lentiginosus* McCollum, *Eucampia balustrum* McCollum, *C. sellaris* McCollum, *Charcotia irregularis Peragallow*, *Pseudoenotia* sp and *Denticula* sp occur in the Butter Point sample.

Discussion

The age of young marine sediments in the shallow parts of the Ross Sea is as yet difficult to determine paleontologically. Of the seventeen Brunhes and Gauss age diagnostic taxa described by Fillon (1972) twelve are restricted to depths greater than 450 metres. The remaining five taxa occur at shallower depths. Two of these, Globocassidulina crassa rossensis Kennett and Cassidulina porrechis Heron-Allen & Earland, are found at New Harbour and Butter Point respectively. Both species indicate a Brunhes age (Fillon 1972,1974). The presence at Butter Point of the diatom taxon Eucampia balustrum McCollum found in Gilbert to Brunhes sediments, but more commonly restricted to the Brunhes, also supports a Brunhes age for the Butter Point assemblage. Radiolarian species found have extended age ranges and precise age determinations cannot be made. Present day (Recent) Ross Sea taxa are typically endemic and similar to Gauss assemblages (Fillon 1973).

The difference in foraminiferal test composition between the New Harbour and Butter Point Sites, dominantly arenaceous and dominally calcareous species respectively has been described in other regions of McMurdo Sound and the Ross Sea (McKnight, 1962; Kennett, 1966; Fillon, 1972, 1974). Kennett (1966) suggested that a calcium carbonate solution boundary (CCD) occurred at 500-550 metres, separating arenaceous faunas below from calcareous faunas above. Fillon (1972) described 'relic Gauss' and Brunhes sediments which contain dominantly calcareous and arenaceous taxa respectively. He explained the latter as due to an increased undersaturation of calcium carbonate associated with a late Gauss - early Matuyama expansion of the Ross Ice Shelf.(Fillon,1974 The four samples studied are well above the present day CCD.

Butter Point foraminiferal assemblages lack both the characteristic Brunhes taxon Globocassidulina crassa rossensis Kennett and its Gauss ancestor G. biora (Crespin). A possible intermediate form, Globocassidulina sp., which has a typical G. crassa rossensis shape but lacking the distinctive L-shaped aperture, is common.

High salinities, low temperature and possibly low photosynthetic activity related to the presence of semi-permanent sea ice cover may explain a calcium carbonate depletion of waters.at New Harbour, though none of these parameters have been measured yet at the New Harbour Site. Arenaceous taxa may be better adapted than calcareous taxa to oligotrophic areas such as New Harbour where there is no current activity.

Neogloboquadina pachyderma (Ehrenberg) is absent from New Harbour, although photosynthetic planktonic diatoms are common. This suggests that photosynthetic activity is present at New Harbour, but not high enough to support higher trophic groups.

We thank Dr M.A. Harper for identifying the diatoms and Mr S.H. Eager for the ostracods. Mr P.H. Robinson reviewed the manuscript.

References

Fillon, R.H., 1972. Evidence from the Ross Sea of widespread submarine erosion. Nature Phys. Sci. vol 238, no. 81. pp 40-42. text figs. 1-2, tables 1-2.

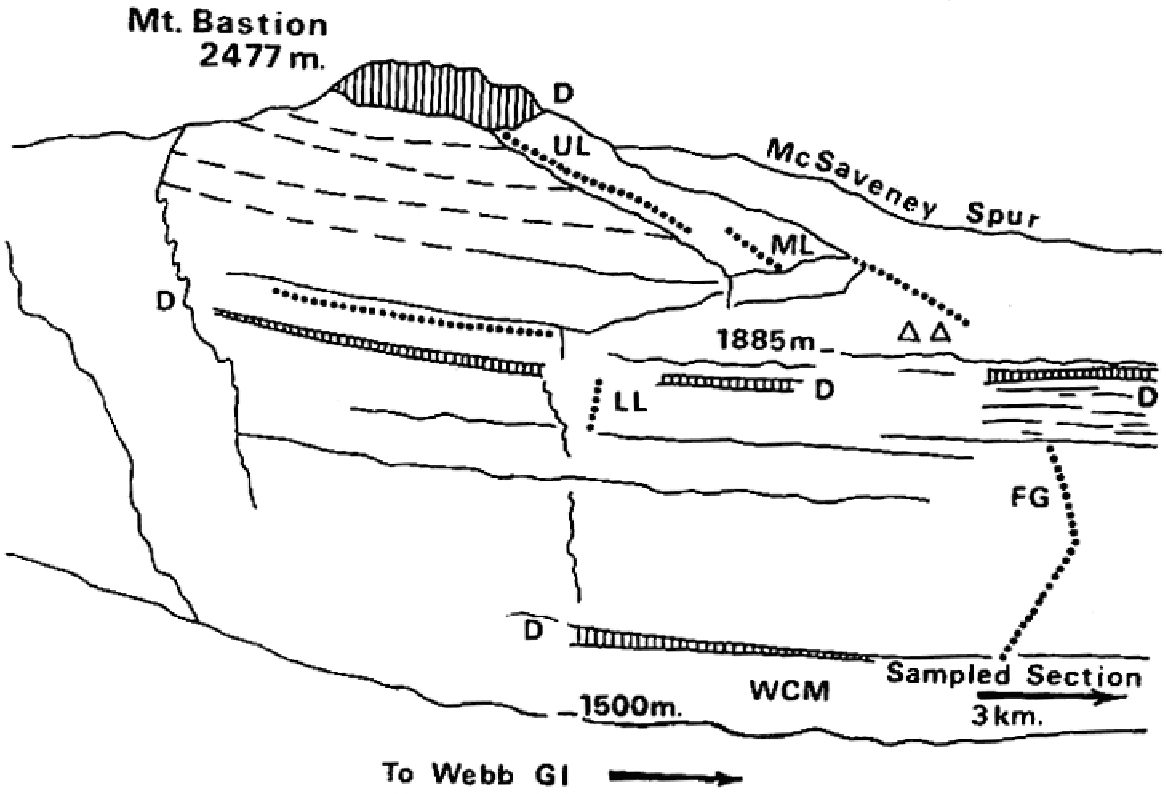
Fillon, R.H., 1973. Radiolarian Evidence of Late Cenozoic Oceanic Paleotemperatures, Ross Sea, Antarctica. Palaeogeography, Paleoclimatology, Palaeoecology vol 14. pp 171-185.

Fillon, R.H., 1974. Late Cenozoic foraminiferal paleoecology of teh Ross Sea, Antarctica. Micropaleontology vol 20, no 2. pp 129-151, pls. 1-6.

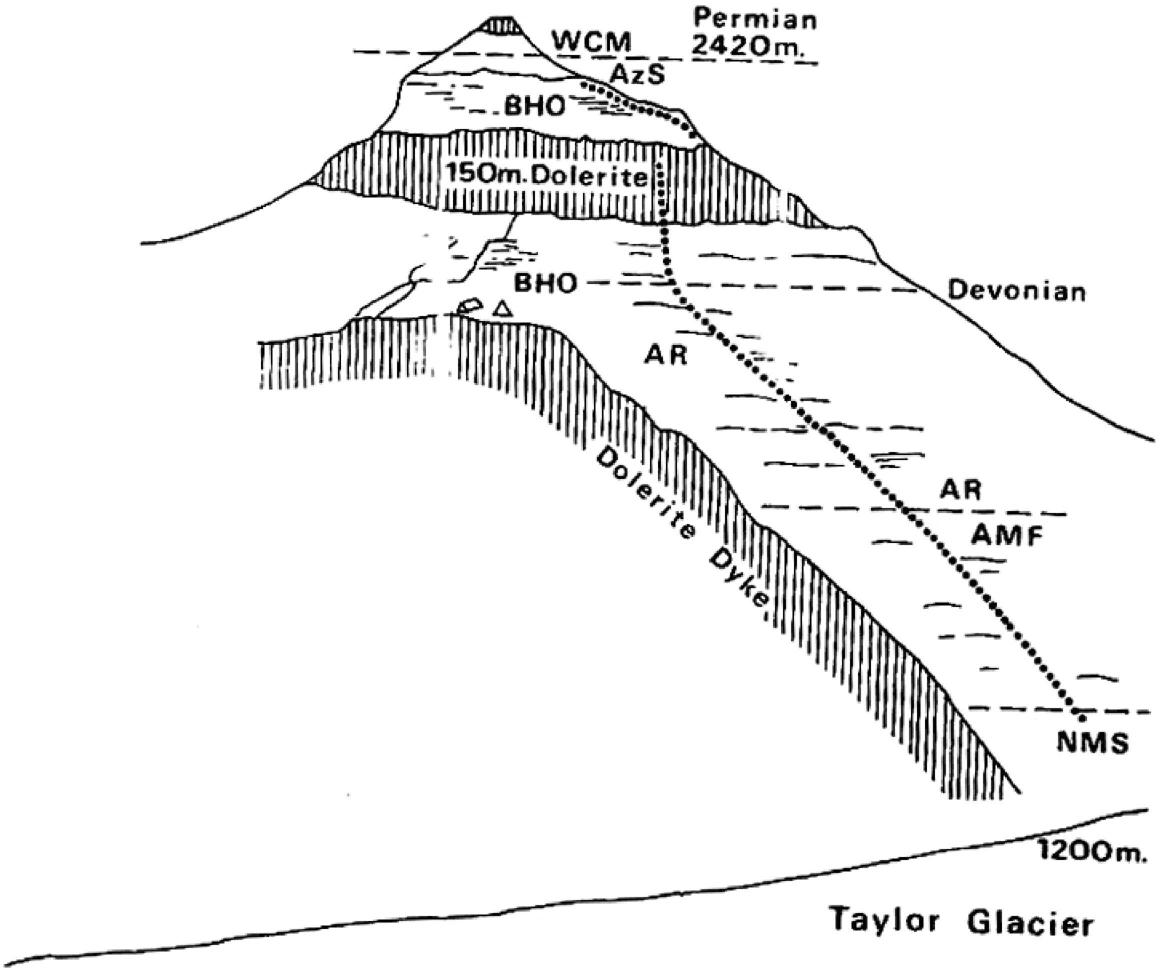
Kennett, J.P., 1966. Foraminiferal evidence of a shallow calcium carbonate solution boundary, Ross Sea, Antarctica. Science vol 153, no. 3732. pp. 193, text figs. 1-2.

McKnight, W.R.M., 1962. The distribution of foraminifera off parts of the Antarctic coast. Bull. Amer. Pal., vol 44, no. 201. pp 65-158, pls. 9-23 text figs. 1-7, tables 1-5.

Thomas, C.W., 1968. Antarctic ocean-floor fossils: Their environments and possible significance as indicators of ice conditions. Pacific Sci., vol 22, no. 1. pp 45-51, text fig 1.



(A) MT BASTION SECTION



(B) WEST BEACON SECTION

FIG. 3. Sections traversed for paleomagnetic sampling at Mount Bastion (A) and West Beacon (B). Traverse line ••••• ; campsites ΔΔ; D - dolerite; UL, ML, LL -upper, middle and lower Lashly Formation; WCM - Weller Coal Measures; AzS - Aztec Siltstone; BHO-- Beacon Heights Orthoquartzite; AR - Arena Sandstone; AMF Altar Mountain Formation. NMS - New Mountain Sandstone; FG - Feather Conglomerate.

Paleomagnetic sampling of Beacon and Ferrar rocks (D.A. Christoffel)

The Beacon Supergroup in the McMurdo Sound region is a flat-lying continental sequence about 2000 m thick and ranging in age from Early Devonian to Late Triassic (400 to 180 m.y. B.P.). It was extensively intruded by sheets of Ferrar Dolerite in the Early Jurassic. The ultimate objective of our programme - to determine a polar wander curve for Antarctica for this 200 m.y. period - has yet to be achieved. However the secondary aim - devising and carrying out a field programme of collecting oriented rock samples - was successfully accomplished.

The field programme was to take oriented samples at time intervals of no longer than 0.5 m.y., roughly one every 3 m. Coring is the only feasible technique, but to date coring attempts in the Antarctic had been unsatisfactory. The main problems had been the large quantities of cooling fluid needed, the inability to use water, and the weight and unreliability of the equipment.

A 22 cc TAS back-pack motor (Plate XVI) used for tree trimming and grass cutting was adapted by attaching a specially designed coring head (Plate XVII) to the flexible drive. The coolant, a glycol and water mixture, was metered by a stock drenching handpiece. The entire unit, including 5 litres of antifreeze, weighs 14 kg.

Under 'normal' operating conditions, at least 2 litres of water was used per core. The aim was to reduce this consumption to less than ½ litre per core. For 600 cores, approximately 150 litres of antifreeze with a 1:1 mix would be required. In the event, 30 gallons (135 litres) was taken. Since the motor was low powered, thin walled coring stems were obtained as they require less driving power. These would be more likely to wear than the normal heavier corers so 10 core stems were taken.

Technique of taking cores

A suitable site, with exposed weathered bedrock is selected. This often requires much clearing with a geological hammer. It is then cored to a depth of approximately 100 mm. The orientation of the sample is measured and recorded (in our case the dip and strike of the top surface). This is done by inserting in the hole a tube (Plate XVIII) with an adjustable plane table. The table is levelled and the strike measured, preferably with a sun compass, but at least with a magnetic compass. The sample is then removed, marked and bagged. Even under good conditions in temperate climes, two operators take about 10 minutes per core.

Operation in Antarctic Conditions

We quickly found that the magnetic readings of both our geological compasses were unreliable. It was thus necessary to work with the sun on the rock face. At Mt Bastion, 75% of the section was on the southern face. This required working in the very early morning when temperatures were low (-25° to -30°C). Even so, the motor performed very well, usually starting first pull. However, the 1:1 antifreeze mixture froze. It was increased to two parts antifreeze to one of water and finally 100% antifreeze, when no further trouble was experienced. The handpiece metering system worked well and on average, four cores per litre were obtained.

Mount Bastion

A major difficulty here was the weather and the snow that accumulated during our stay. The weather was normally fine in the early morning, but by mid-day, had clouded over and snow was falling. This normally continued for the rest of the day. By the end of our time, most of the slopes were covered by about 300 mm of snow. We were fortunate in having the initial two fine days with clear rock. By carrying out the reconnaissance with P.J. Barrett who had described the section previously (Barrett and Webb, 1973), we were able to select the locations we wished to sample in the first few days and were subsequently able to carry on almost blind, which was a distinct advantage considering we worked much of the time in near white-out conditions and our tracks from one day to the next were almost obliterated. We are very grateful to Dr Barrett for making this time available.

West Beacon

Sampling at West Beacon was much more rapid. Our camp on the northeast ridge was almost half way up the section, and a minimum of time was spent in travelling to the sites. We benefited considerably by a third person in the party. Two people orienting and collecting the samples can slmost keep up with one driller.

The weather was better and although there was some snow on the rocks near the summit, it was easily cleared.

The slopes containing the chosen section faced north and northeast, enabling sampling to be carried out during the normal day. Sun compass orientations were obtained on a large proportion of samples.

The effect of these factors is reflected in the fact that it took 7 days to sample an equivalent length of section that took 14days at Mt Bastion.

We started sampling near the bottom of the section, at the New Mountain Sandstone - Altar Mountain Formation boundary in the Devonian - the exposures below this were very scattered beneath scree and it was difficult to tell whether they were in place.

Sampling was straightforward up and through the Arena Sandstone to the very prominent Beacon Heights Orthoquartzite (BHO) boundary. The rock was rather friable near the contact with dolerite sill, presumably due to baking. Some cores were taken through the 150 m thick dolerite sill. The section was then continued further around to the North and more directly up to the main peak. The BHO - Aztec Siltstone contact was a prominent erosion surface. The Aztec siltstone was characterised by hard layers of dark green siltstone which gave good cores.

The Weller Coal Measures (Permian) comprised the topmost part of the section to the summit dolerite cap rock. It was fairly coarse and extensively cross-bedded, but had no coal beds here - very similar to the lower Weller at Mt Bastion. The sampling overlap between here and Mt Bastion should provide a useful check on the reliability of the paleomagnetic measurements.

During the coring of the last few samples, the motor was behaving erractically and had considerably reduced power. With the day remaining after finishing the Beacon Heights section, the motor was decarbonised and the spark plug checked. In addition the samples were packed for transport.

Table Mountain

In the three remaining days of our programme, we had been scheduled to join Event K12 at New Harbour. Since they had already completed their programme we instead moved to Table Mountain in order to complete our sampling of the Beacon sandstones, which, in this region rest at the Kukri Erosion Surface, which is cut in plutonic basement rocks.

On Friday 15 December, we arrived at Table Mountain. Karen Williams replaced Peter Garden, who had twisted his knee on the final sampling day at Beacon Heights and returned to Scott Base as a precautionary measure.

The remainder of the 15th and part of the 16th were spent surveying the section. Then the motor malfunctioned and the rest of the day was used in repairing it.

Consequently, Sunday 17th, the last day began at 0100. We started at the bottom of the section, about 1½ hours' walk from the camp. Although clear, it was very cold. The petrol hose froze stiff and fractured, but after being retained and restarted, the motor ran for about 15 minutes and stopped, due to no spark. We returned to camp, stripped the motor, to find a short at the contact breaker and returned to the top of the section by 1200. It had started to snow, but this time we worked down. We completed our sampling near the base of the section at 1900 hours. By this time approximately 300 mm of snow had fallen and visibility was very restricted.

Conclusions

The sampling of cores in the Beacon section was very successful. The lightweight coring equipment worked well, enabling us to collect samples more efficiently than our coring equipment used in New Zealand. The system was ideally suited to a team of three. The hand piece, used for dispensing the coolant, finished up being held together by string and wire, but modifications should overcome this problem. Significant saving in cooling fluid was achieved so that bulk and weight of equipment and samples were reduced to a minimum.

Contact Metamorphism at Mount Bastion (Chris Mroczek)

The aim of this project was to sample the contact zone and surrounding sediment, associated with a Jurassic dolerite intrusion. Detailed laboratory analysis will be carried out during the year. Mt Bastion was chosen as a suitable site for sampling, as a 170 + m sill overlies approximately 500 + m of Lashly sandstone (Triassic) The sill was thought to be thick enough to have more than just a local baking effect; also the sandstone is generally feldspathic and should therefore be more prone to mineralogical changes as a result of $ill intrusion than say, a quartzose sandstone.

The dolerite sill, the chilled margin (0.6 m) the contact between the chilled margin and the underlying sediment and sediment for a distance of 200 m from the sill were sampled extensively. In the field the effect of the sill, the green colour of the sediment caused by the oxidation of chlorites in the matrix (Korsch, 1973; Haskell, 1964), was obvious for approximately 1 m only.

Subsequent laboratory analysis will try to determine:

i) The mineralogy of the contact zone to see if any new minerals have been formed as a result of the intrusion, and the reactions leading to the formation of these minerals.

ii) For what distance the underlying sediment has been affected, to try and distinguish between sill effects and diagenetic effects.

iii) The original temperature of the contact zone. Stability limits of minerals such as chlorite have already been used to determine temperature ranges. Haskell (1964) used the chlorites brunsvigite and ripidolite obtained a minimum temperature of 350°C and a maximum of 700°C. Barrett (1966) used colour loss in pink zircons to determine an upper limit of the temperature reached in the sediments (around 450°C)

High pressure, high temperature work will hopefully be carried out to try and simulate original conditions. No detailed work of this kind has been carried out before; only general observations by various workers have been produced previously.

References

Barrett, P.J., 1966. Petrology of some Beacon Rocks between the Axel Heiberg and Shackleton Glaciers, Queen Maud Range, Antarctica. Jour. of Sed. Pet.

Haskell, T.R., 1964. Thermal metamorphism of Beacon Group Sandstone of the Taylor Valley, Antarctica. Nature vol 201.

Korsch, P.J., 1973. Petrographic comparison of the Taylor and Victoria Groups in South Victoria Land, Antarctica. N.Z. Jour. of Geol. & Geophys. 17.

Permian coal measures at Mount Bastion and Mount Fleming (Alex Pyne)

At Mt Bastion sedimentary strata of the Victoria group (Beacon Supergroup) and the intruding dolerite were mapped to aid the paleomagnetic and metamorphism studies. In the area mapped the strata is generally flat-lying and intruded by terminating and climbing sills, although in the area at the head of Gibson Spur immediately to the south the dip of the Beacon strata approaches the vertical.

Two detailed sections were measured from the Weller Coal Measures, here 200 m thick into the Feather Conglomerate. A point of considerable interest is the discovery of fossil soils (Plate XX) preserved in a sequence of silty beds forming the gradational contact between the Weller Coal Measures and overlying Feather Conglomerate. Soil horizons are extremely rare in any of the Permian coal measures of the Southern Hemisphere. Similar horizons were found in the same stratigraphic position at Mt Fleming.

The Beacon Supergroup and the intruding Ferrar Dolerite were also mapped at Mt Fleming (Plate XXIII) and Horseshoe Mt., and three laterally related sections of the Weller Coal Measures were measured in detail. The Beacon strata at Mt Fleming extend from the upper Beacon Heights Orthoquartzite (Late Devonian) to the Lashly Formation (Late Triassic). They are in part monoclinally folded and probably faulted also, in contrast to most other areas in south Victoria Land where there is scarcely a hint of tectonism. Careful mapping showed that the vertical displacement (throw) across the faulted monocline was about 230 m. The detailed study of the Weller Coal Measures begun this season will be used to determine a depositional model for the coal measures. Initial work this year has shown that in the lower and upper parts alternating coarse feldspathic sandstone and shale-coal horizons have resulted from channel and overbank deposition (Plate XXII) The middle part, predominantly medium to fine sandstone, is of channel deposits containing silicified-calcified logs and stumps in growth position (Plate XXI). This indicates exposure of channel bars for periods of time up to two hundred years.

Seismic, Audio, and Magnetic readings at Erebus Volcano, December 1978 (Ray Dibble)

Volcanic earthquakes and eruptions from Erebus volcano (Plate XXVI) were detected by a geophone at Camp Cave, a low frequency microphone at the main crater rim, and a magnetic induction loop around the crater rim, and recorded on tape between 14 and 25 December 1978. Small earthquakes were as numerous as in December 1974, but larger ones (>1 kJ, including explosion earthquakes) were less frequent (Fig. 4). There was a weak and doubtful peak at 12-14 hours NZST in the occurrence of large earthquakes during the day, but not in the occurrence of small earthquakes (Fig. 5). Of well recorded earthquakes exceeding 10 J, 24% also appeared on the microphone channel, 5% on the magnetic channel, and 10% were accompanied by observed eruptions. The microphone events (which had dominant frequency 1-4 Hz) were of four distinct types: One corresponded with explosions of the Active Vent (Plate XXVIIA) but not with magnetic signals, and two other types (Plate XXVIIB & C , with rarefactional audio onsets) often corresponded with magnetic signals, but the fourth and most common type (Plate XXVIID), for which the air-wave velocity is confirmed, corresponded only with a particular type of earthquake with simple onset. Earthquakes accompanying the other audio types had fore-running vibrations beginning up to 45 s earlier. Lava bulged from the Active Vent during the forerunner before the explosion which occurred while W.F. Giggenbach was in the inner crater, but no signals corresponded with the 2-5 m drop and rise of Lava Lake level in the 15 minutes after the explosion. Occasional brief periods of volcanic tremor were recorded for the first time in December 1978.

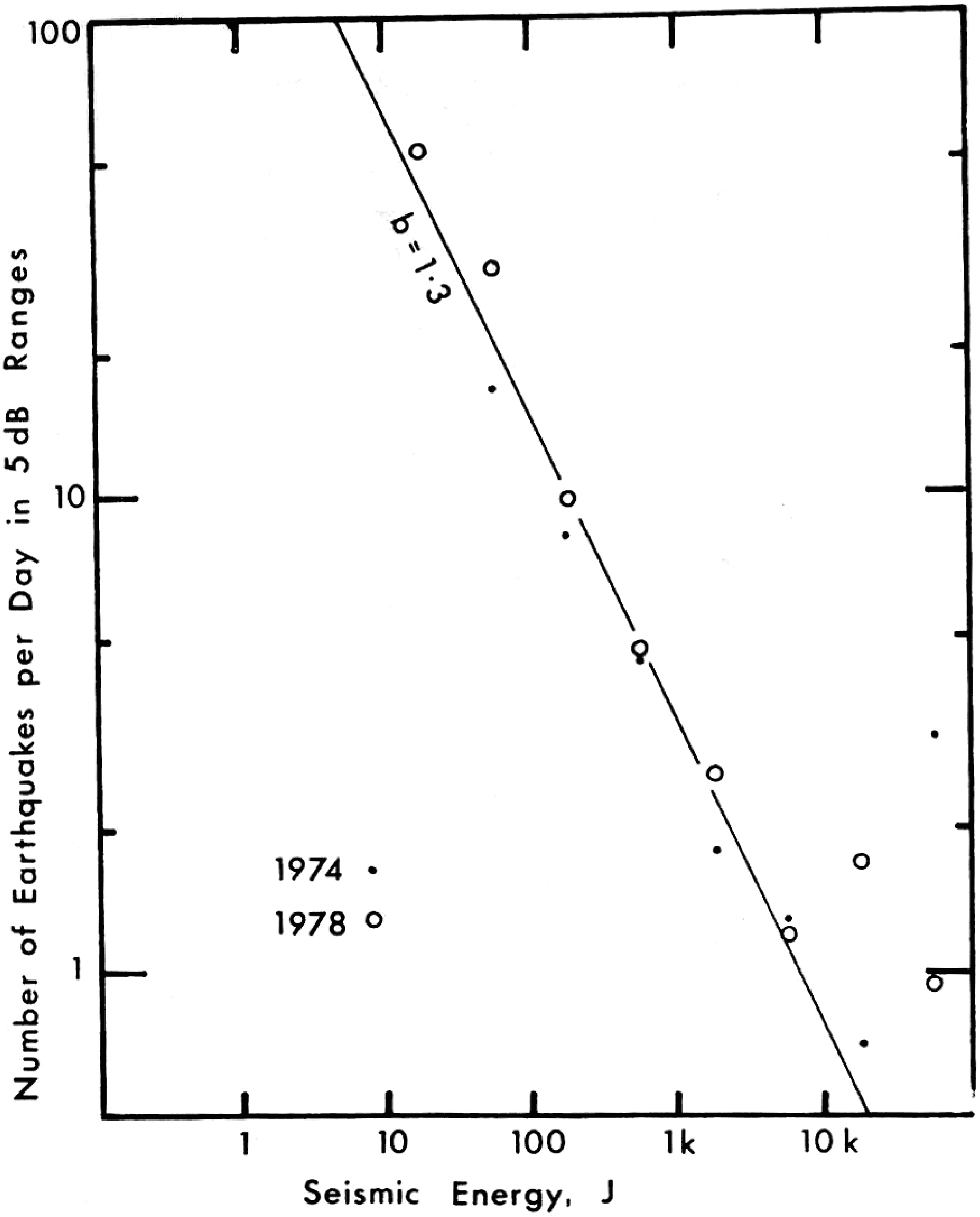
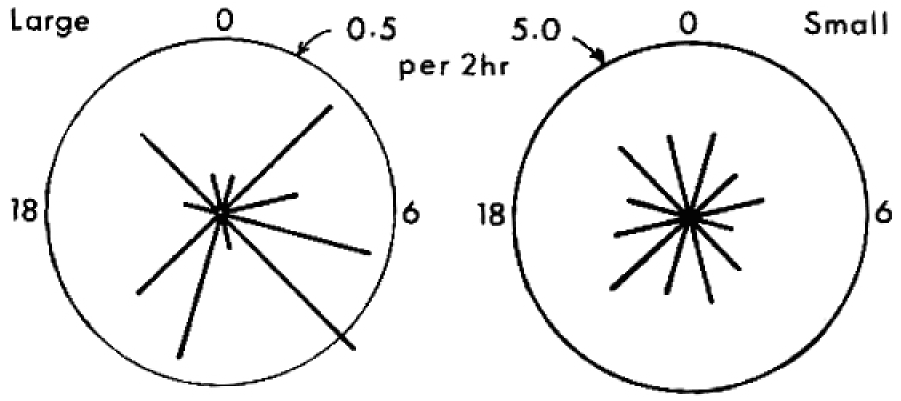
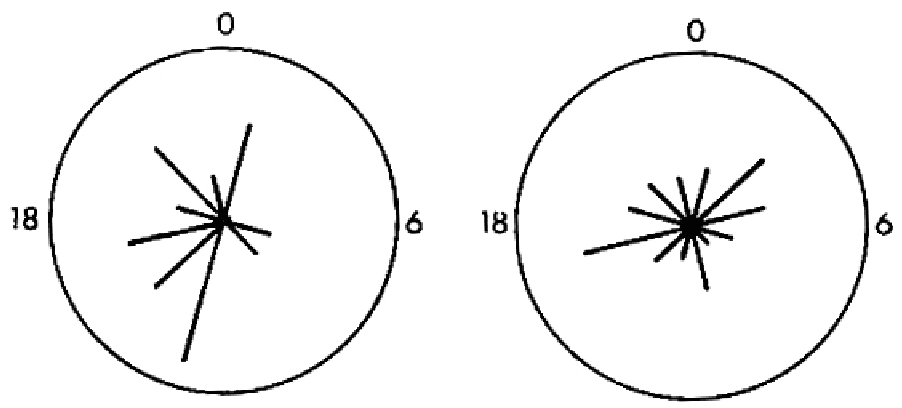


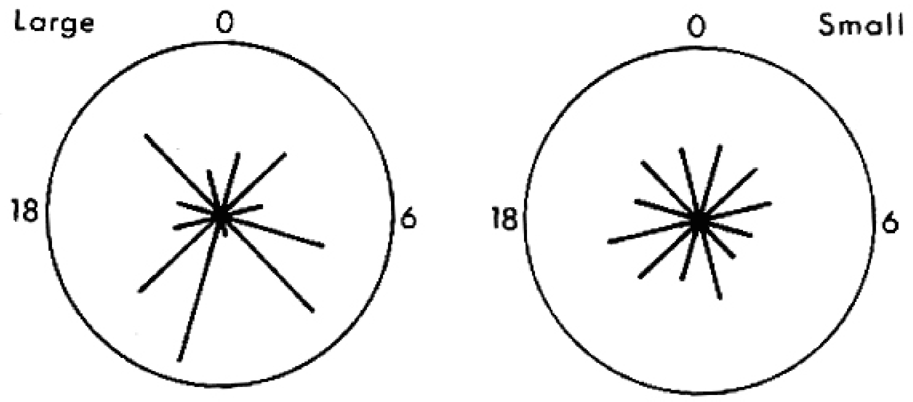
FIG. 4. Number of earthquakes of all types at Erebus volcano per day (in 5 dB ranges) versus seismic energy, for 1974 and 1978. The number of small earthquakes and slope (b) of the curve were similar in 1974 and 1978. The excess number of larger earthquakes (mostly observed explosions) was less in 1978 than 1974.



14 to 22 December 1978



23 to 29 December 1978



14 to 29 December 1978

FIG. 5. Average number of earthquakes each 2 hours of the day (NZST) at Erebus between the dates shown.

Left: Earthquakes (mostly explosions) with seismic energy 10 kJ show a possible peak at 12-14 hours.

Right: Earthquakes (mostly B-type) = 0.1 = 10 kJ show no consistent peak.

FIELD NOTES

Event 12

including Event 12a	Basal debris studies
12b	MSSTS Site investigation

A. TRANSPORT

Event 12a

Early season work by Robinson and Ross was restricted to "glacier jumping" by helicopter and supplemented by walking.

Event 12b

Movement on the sea ice was by two Sno-tracs (Nos. 35 & 12) and one OMC motor toboggan (#23). Snotrac 12 was replaced by another OMC (#25) on 6 December in New Harbour. Considering the purpose of the expedition the vehicles (especially sno-tracs) proved immensely successful and practical, although mechanical problems were encountered. Fortunately the expertise of Stew Ross, allied with good co-operation from Scott Base, sorted the problems out, and underlined the need for parties using Sno-tracs to have at least one member with considerable mechanical experience. Each Sno-trac could pull two fully loaded Tamworth sledges; the motor-toboggan coped easily with one Nanses. The toboggan proved most reliable till late in the programme (12 December) when soft powder snow on a reconnaissance of the Blue Glacier proved too heavy on a weld associated with the track runners.

Summary of vehicular breakdowns/failures -

Sno-trac 12	- one puncture - a sheared weld on the rear stub axle - a nylon spacer within the inner clutch housing came out of position due to loss of a pin.
Sno-trac 35	- had continual fuel starvation problems due to sedimentation and clogging of the carburetor. Only frequent cleaning helped alleviate this problem.
Motor Toboggan (#23)	- Normal starting problems most of the time (i.e. susceptible to flooding) - a sheared rear tracker weld.

B. MAIN AREAS COVERED

Event 12a

Taylor, Wright Upper and Victoria Upper Glaciers were the main areas visited. Field work was restricted to areas within walking distance of the main camp. Camps at Taylor and Victoria Upper Glaciers were established on the true right deltas entering Lakes Bonney and Victoria respectively. Good campsites around Wright Upper Glacier were limited; helicopter landing sites being the main difficulty. A site, central glacier, on the snow apron was found to be the most suitable. Two additional areas (Lake Vanda to Bulls Pass and Sykes Glacier) were worked as a result of overestimate of time required in the main areas.

Event 12b

The party conducted scientific work principally at three localities on the McMurdo Sound Sea Ice - about 15 km NE of Butter Point, in Explorers Cove, New

Harbour, and at the snout of the Ferrar Glacier. Gravity survey lines were completed on Mt Coleman and Mt Barnes. The trip back to Scott Base from the Ferrar involved reconnaissance of the Strand Mo raines, Lower Blue Glacier, and Hobbs Glacier (including Cape Chocolate).

C. WEATHER

Event 12a

Detailed weather reports were taken by Stewart Ross for most of the field days (except while at Vanda and Scott Base). Only one day in 21 was unfit for work; this too contributed to the early return to Scott Base.

Event 12b

Weather reports were also maintained daily by the party. No days were lost, due to the nature of the scientific work. Although visibility on the sea ice was occasionally very low, no high winds were encountered.

D. COMMUNICATIONS

Event 12a

Early season communications were good both to Scott Base and Vanda. Through preference Event 12 were allocated Compak 8 radios, which again gave good service, except for a faulty aerial plug. Even though this was tested before leaving Scott Base, the fault developed to the stage of almost nil communication. The testing of radios too close to Scott Base is the probably reason for this fault not being detected earlier. For this reason, it is essential that all radios should be tested every time a party is put into, or shifted in the field by helicopter. This also is a safe measure against leaving radios on helicopters.

Event 12b

The party utilised the same radios (with fresh batteries) as 12a, and encountered the same difficulties with one of them. Having the two radios however, proved useful as one was able to be left at camp, while the other utilised for daytime communications with Scott Base and helicopters while field work was being undertaken.

E. LOSS/DAMAGE TO EQUIPMENT

Event 12a

No serious equipment damage or loss was indurred by Event 12a. Although it was necessary to make repairs on the guy rope reinforcing patches on one of the polar tents prior to going into the field.

Event 12b

See A. TRANSPORT. The only damage incurred to scientific equipment was some bending of the MacIntyre grab when retrieving from the ice hole. Minor breakages (straps & one split cross member) were suffered by the sledges, these being repaired in the field, and on return to Scott Base.

F. RECOMMENDATIONS

See Event 13.

Event 13

including Event 13a (Paleomagnetic Studies)
13b (Coal and metamorphic studies)

A. TRANSPORT

All major movements were by helicopter and in general the service was satisfactory. However, it was difficult at times to find out when flights were scheduled even on the day for which they had been arranged. A particular difficulty we encountered resulted in our resupply being four days overdue. For three days low cloud developed regularly in the late morning and persisted through to evening; the other day was Thanksgiving when there were no scheduled flights. The situation was made especially difficult by a requirement not to fly over the barwick Valley Site of Special Scientific Interest, which covered the obvious approach to the North and East. The resupply was effected only through good communications, co-operation, and a determined helo crew, on the evening of the fourth day. A letter requesting permission for overflying Barwick Valley has since been sent to the Chairman, N.Z. National Committee on Antarctic Research.

B. MAIN AREAS COVERED

Both parties camped together on the east face of Mount Bastion on an extensive platform at 1850 m (77°15'S; 160°30'E) about halfway between the base and top of the strata under study. Most of the platform is rock but a snow bank on which to erect the tents was located without much difficulty.

In early December Event 13b moved to Mount Fleming and remained in that area for the rest of the season, camping at 77°33'S;161°16'E. Vanda Station was visited by foot, the journey taking between 11 and 13 hours one way. The only difficult area is Vortex Col. The western side is less disturbed, and even so delaying is necessary. Horseshoe Mountain was also visited and no difficulties were encountered.

Event 13a in early December moved to West Beacon, camping on a small platfrom at the top of a dolerite dyke on the East Ridge at 1800 m (77°49'S; 160°47'E). After two weeks here, sampling the entire 2 1000 m face, the party moved to Table Mountain (77°59'S; 162° 00'E). The camp here was at 2100 m on the boulder-strewn plateau to the south of the East Peak.

C. WEATHER

The party was landed at Mt Bastion in winds gusting over 40 knots. The following three days were clear and calm, but after that a pattern developed. The sky would be clear in the early morning, but the clouds would gather about 1000 and snowing would begin for the day. It would then clear up in the late evening. Temperatures were low (-15° to -28°C).

Mt Fleming was generally subjected to continuous Katabatic winds averaging 15 to 20 knots from the Polar Plateau which together with air temperatures generally much lower than -10°C made work uncomfortable and restricted the duration of a field day. Of the 37 days between early December and mid January when the weather was recorded only 9 had winds of less than 5 knots. Cloud and snow were generally observed to come from the east, especially as rising cloud from the Wright Valley.

The paleomagnetic party at West Beacon had generally fine weather, which deteriorated upon moving to Table Mountain. However, there was a break of sufficient length to complete the work.

D. COMMUNICATIONS

Technically, communications were good. All camps were at reasonable altitude and practically line-of-sight with Scott Base. We had no difficulty with any schedule and could almost always hear all K-network stations. At Mt Bastion, we devised an inverted-V antenna which gave very good reception.

E. LOSS/DAMAGE TO EQUIPMENT

Nothing beyond some breakages with scientific equipment.

F. RECOMMENDATIONS

1. That Barwick Valley Site of Special Scientific Interest be cleared for overflying. Mt Bastion has the thickest and most complete upper Beacon sequence in Victoria Land and is likely to be of continuing geological interest. The easy approach by air is currently not permitted, and could put a party at risk.

2. That responsibility for dispatch of mail to field parties be clarified. The Post Office staff indicated that their only responsibility was for sorting. Possibly the deputy O.I.C. could see that sorted mail was in fact dispatched.

3. That Antarctic Division recommend or supply a standard weather kit. These were available on request from the N.Z. Meteorological Service, but no longer. Some parties used equipment borrowed from McMurdo, but an NZARP Standard kit would be more desirable.

4. That parties intending to walk long distances be supplied with Compak radios containing the light lithium cells.

Event 5 (Erebus crater studies)

A. TRANSPORT

Christchurch to Scott Base: RNZAF Hercules
Scott Base to Fang to Erebus to Scott Base: U.S. Navy helicopters
Scott Base to Christchurch: U.S. Hercules

The only problems encountered were delays in leaving Erebus due to capricious cloud conditions, and in leaving Antarctica due to defects and mishaps to our aircraft.

B. AREA COVERED

The Crater, and the Fang of Erebus volcano.

C. WEATHER

The weather was mostly good before 25 December, and mostly bad after that. There were:

14 fine calm days	(Dec 8-15, 17,18,20,22,23,31);
7 days with wind	(Dec 16,19,21,24,25,28,30);
3 days with gales and snow	(Dec 26,27,29)

Temperatures on Erebus averaged about -22°C, the lowest being -32° on Fang Glacier at night, and the highest at the summit being about -15°C.

D. COMMUNICATIONS

The 6 p.m. sked with Scott Base was normally used, and reception was so good that we sometimes relayed messages to and from field parties far north. Kyle's USARP party were also in daily contact with MAC-centre, giving us two possible channels of communication for transport and supply, which had to be used carefully to avoid confusion. Although it was desirable to minimise transmitter usage because it obliterated the geophysical recordings, there were 42 communication periods between 14 and 29 December 1978.

E. LOSS/DAMAGE TO EQUIPMENT

The magnetic induction loop wire was damaged, and the cableway across the crater was destroyed during the gale of 25-27 December. Guy ropes tore off my DSIR tent, and my DSIR mattress was lost in the same storm. On 29 December my DSIR tent, which had been repaired and re-erected by the Field Leader and assistants, and also the DSIR ground sheet, USARP mattress, VUW double sleeping bag, and a few personal items, blew away completely. A shirt, down trousers, and the tent were recovered (with the frame badly bent), but there was no trace of the rest.

F. RECOMMENDATIONS

It is now evident that tents, and nylon ropes and ribbons, are weakened by exposure to gases from Erebus Volcano. Resistant materials such as polypropylene and an extra guy rope to the top of each tent are recommended, especially close to the rim or within the crater.

The joint project between DSIR, USARP, FRANCE, and ourselves, using the NSF Observatory Hut and DSIR sleeping tents should be actively promoted (with special gratitude for USARP food and French liquid fortification)

ACKNOWLEDGMENTS

The 1978-79 Victoria University of Wellington Antarctic Expedition members would like to extend their gratitude and thanks to:

The University Grants Committee for financial assistance in the purchase of equipment and supplies.

The University Council for grants to expedition students.

Antarctic Division, DSIR, personnel for their continous logistic and clerical assistance.

The U.S. National Science Foundation for providing generous air support from the imperturbable US Navy VXE-6 Squadron.

A special thanks to:

- John Presland, Alan Berry and the Scott Base Winter and Summer Support Staff.

- Stewart Ross, for his skilled mechanical assistance and good humour throughout the season.

- Annette Richards and Karen Williams for help with paleomagnetic sampling.

- Graham Lees and Alan Burt for their work on the sea ice.

- Colin Wicks for surveying the drill sites for us.

- Hans Höfle and Dieter Grund for their willing and substantial contribution to the sea-ice programme.

APPENDIX 1 - FLIGHT REQUIREMENTS VUWAE 23

Date	Event	Purpose	Origin	Destination	Aircraft
Oct	5,12,13	Aircargo	Chch	Scott Base	C-130
Oct 17	12	Transport 2	Chch	Scott Base	C-141
21	"	Put in 2	SB	Taylor Glacier	Helo
28	"	Transfer 2	TG	Wright Upper Glacier	"
Nov 7	"	Transfer 4	Vanda	Victoria Upper Glacier	"
11	"	Take out 2	VUG	Vanda	"
		Take out 2	VUG	SB	"
11	12,13	Transport 6	Chch	SB	C-141
17	13	Put in 5	SB	Mt Bastion	Helo
24	13	Resupply	SB	MB	"
		Take out 1	MB	SB	"
25	12	Put in 1	SB	Butter Point	"
26	12	Take out 1	BP	SB	"
28	12	Put in 1	SB	BP	"
Dec 5	13A	Put in 1	SB	MB	"
		Transfer 3	MB	Beacon Heights	"
	13B	Transfer 2	MB	Vanda	"
6	13B	Transfer 2	Vanda	Mt Fleming	"
	12	Put in 1	SB	New Harbour	"
		Take out 2	NH	SB	"
7	5	Transport 4	Chch	SB	C-141
8	12	Transport 1	SB	Chch	"
10	5	Put in 6	SB	Fang	Helo
11	12	Take out 1	NH	SB	"
13	5	Transfer 6	Fang	Erebus Summit	"
15	13A	Put in 1	SB	BH	"
		Transfer 4	BH	Table Mountain	"
		Take out 1	TM	SB	"
16	13B	Put in 3	SB	MF	"
18	13A	Take out 3	TM	SB	"
21	13A	Transport 2	SB	Chch	C-130
31	5	Take out 2	ES	SB	Helo
Jan 3	5	Transport 1	SB	Chch	C-130
14	13B	Take out 4	MF	SB	Helo
18	13B	Transport 3	SB	Chch	C-141

APPENDIX 2 - ITINERARIES

Event 12 - Glacial Sediment Studies

Oct 17	Robinson and Ross (DSIR field assistant) to Scott Base.
17-20	Preparing field gear.
21	Robinson and Ross to snout of Taylor Glacier.
22-27	Work around glacier, on englacial debris, temperature measurements and saline discharge.
28	Robinson and Ross shift to Wright Upper Glacier.
29-30	Work around glacier; sampling englacial debris.
31	Walked Wright Upper Glacier to Vanda, via North Fork.
Nov 1	Day at Vanda.
2	Work on lake benches and glacial deposits, north side of Lake Vanda.
3-4	Robinson and Ross to Asgard Hut and Sykes and Albreich Glaciers. Returned Vanda Nov 4.
5	Day at Vanda.
6	Walked to Sandy Glacier, Bull Pass.
7	Robinson, Ross, (and Millington and Fraser, Vanda staff) to Victoria Upper Glacier.
7-10	Work around glacier and lake.
11	Robinson and Ross to Scott Base (Millington and Fraser return to Vanda). Barrett, Bentley to Scott Base.
12-17	Preparation of field gear, scientific equipment, vehicles and shake-down trip to Cape Royds (13/14th).
17	Barrett to Mt Bastion (helo) with K13
18	Robinson, Ross, Bentley, Höfle, Grund travel to area of MSSTS Site 1 - 12 km NE of Butter Point with 2 Snotracs, 1 toboggan and 4 sleds.
19-24	Site located approximately. Lines surveyed transverse and parallel to the sea floor topography (NE and NW), each approximately 10 km long.
25	Barrett, and McGinnis and Power (K-10), arrive from Scott Base. Decision made to establish another transverse line 5 km NW.
26-28	Survey of new transverse line. MSSTS Drill Site 1 selected in 131 m of water. Robinson out on 26.
28	Cutting access hole begins in evening. G. Lees arrives from Scott Base by helo.
29-Dec 1	Access hole completed by blasting. Current measurements and sampling completed. Visited and sampled icebergs near Marble Point.
Dec 2	Ross, Bentley, Lees toboggan to New Harbour to locate MSSTS Site 2. Barrett, Höfle arrive later with rest of equipment.
3	Surveying, bathymetry and location of site.
4-5	Access hole cut and blasted. Current measurements and contour sampling completed. Ross and Bentley survey Ferrar Glacier front.
5-6	Late night and early morning efforts to blast hole through 4.8 m of ice at Ferrar Glacier.
6	Barrett, Grund, and McGinnis and Power (K-10) to Scott Base by helo. Alan Burt and toboggan arrive. Geddes and Lees return to Scott Base in 6 hours.
7	Bentley, Ross carry out gravity survey of Mt Coleman.
8	Bentley, Höffle sample wind-blown sediments, and two icebergs in New Harbour. Ross, Burt carry out gravity survey up Mt Barnes. (Burt probably gets snow blindness during day).
9	Ross, Bentley erect cairns for 1979/80 Drilling Camp. Camp shifted to Ferrar Glacier.
10	Work on Ferrar Glacier access hole. Several attempts made to lower grab but no success. Improvised sampler with some success.

Dec 11	Burt to Scott Base by helo. (Snow blindness). Camp shifted to Cape Chocolate via Strand Moraines.
12	Cape Chocolate, Hobbs, Blue Glacier, Strand Moraines revisited.
13	Back to Scott Base in early hours of morning.
13-15	Ross, Bentley, Höfle at Scott Base, packing and checking gear, samples, etc.
16	Ross, Bentley, Höfle helo to Mt Fleming to join K13.

Event 13 - Beacon Studies

Nov 11	Barrett, Bentley, Christoffel, Garden, Mroczek, Pyne to Scott. (Flight postponed 24 hrs).
12	Preparing field gear (Events 12, 13).
13	At 1800 hrs NZST: K12, K13 to Royds by vehicle. Field gear test, survival course, gravity meter tests and paleomag sampling.
14	Return to Scott Base.
15-16	Field resupply checked and arranged for transport.
17	Barrett, Christoffel, Garden, Mroczek and Pyne put in Mt Bastion. (Marginal conditions - high winds).
18-24	Work at Mt Bastion.
21	Resupply cancelled - weather.
22	" " "
23	Thanksgiving Day, no helo flights.
24	Second resupply attempt of the day successful; Barrett to Scott Base.
25-Dec 2	Continued mapping, paleomag and metamorphism sampling.
Dec 3	White out - Tent day.
4	Final sampling at Mt Bastion summit.
5	1845 hrs - deteriorating weather, Richards to Bastion. a) Christoffel, Garden and Richards to West Beacon (see EVENT 13A). b) Mroczek and Pyne to Vanda. (Move to Mt Fleming postponed).
6	Mroczek and Pyne to Mt Fleming.
7-15	Initial reconnaissance; mapping and Weller studies begun.
16	Bentley, Höfle and Ross to Fleming.
17-19	Continued work, Höfle began work on Metschel Tillite.
20-24	Bentley, Mroczek and Pyne continued work at Fleming.
20	Höfle and Ross to Labyrinth on foot, Ross continued to Vanda Station. Höfle worked in Labyrinth.
22	Ross to Labyrinth by helo.
23	Höfle and Ross to Mt Fleming. Tent Day.
25	Christmas Day dinner.
26	Storm, tent day.
27	Helo resupply (opportunity basis) didn't arrive.
28-30	Continued work.
29	Recce to Shapeless Mt.
30	2045 hr. Bentley, Höfle, Mroczek, Ross, Pyne to Vanda via Vortex col and North Fork Labyrinth.
31-Jan 2	New Year at Vanda.
Jan 2	Ross to Don Juan Pond by foot.
3	Bentley, Höfle, Mroczek, Pyne to Mt Fleming (helo). Ross assisted Event 15 at Don Juan.
4-8	Continued work.
5	2045 hr Ross to Mt Fleming from Don Juan (foot).
7	Ross to Vanda. (foot).
9	Bentley, Höfle, Mroczek, Pyne to Horseshoe Mt (foot). Recce and mapping.
10-11	Completion of mapping and Weller description.

Jan 12	Helo delay (weather), tent day.
13	Helo delay (insufficient pilots), tent day.
14	Bentley, Höfle, Mroczek, Pyne to Scott (helo).
15-17	Packing cargons, Mouse at Scott.
18	Bentley, Mroczek, Pyne to New Zealand.

Days in Antarctica	69
Days at Scott	6
Days in field	63
Travel	8
Tent days, helo waits	10
Work	45

Event 13 -Paleomagnetic Studies

Nov 11-Dec 4	(see Beacon Studies above)
Dec 5	Helo arrives with re-supply. Christoffel and Garden to W. Beacon. Joined by Richards. Now designated Event K13 - Bravo Hotel.
6	Reconnaissance W. Beacon section and to summit for altimeter check.
7-13	Sampling on W. and N. faces fo W. Beacon, from New Mountain sandstone outer base to Weller coal measures near summit.
13	Final sampling. Garden twists knee.
13-14	Sorting samples, packing gear, circumnavigate Beacon for reconnaissance.
15	Joined by Williams. Christoffel, Richards and Williams to Table Mt. Garden to McMurdo for observation on leg.
15	Reconnaissance of New Mountain sandstone and Terra Cotta siltstone on Table Mt.
16	Overhaul coring drill. Continue reconnaissance.
17	Sampled entire section to within 10 m of Kukri peneplain.
18	Return to Scott Base.
18-20	Packing field gear.
20-21	Christoffel and Garden to Christchurch (via Dunedin).

Days in Antarctica	40 (Nov 11-Dec 20)
Days at Scott Base	7
Days in field	33
Travel	4
Tent days	1
Work	28

Event 5 - Erebus Crater Studies

Dec 7	Dibble to Scott Base, with Monteath, Giggenbach (DSIR), and Tazieff (France
8-9	Preparing field gear.
10	Dibble to Fang acclimitization camp, with Monteath, Thompson, Giggenbach (DSIR), Fink (L & S) and Tazieff (France).
11-12	Climbing practice, and magnetic survey of Fang.
13	Party to Erebus Observatory Hut. Install seismograph and microphone at Hut.
14	Shift geophone to site above Ice Cave.
15	Shift microphone to Crater rim.
16	Install magnetic induction loop around Crater rim. Connect to tape recorder in Hut.

Dec 18	Attempted descent into inner crater.
19	USARP party (Kyle, Keys, McIntosh, Cashman) arrive from Fang.
22	Tazieff leaves for France.
23	Install steel cableway across Crater (for dropping penetration viscometer spears into Lava Lake) while Monteath and Giggenbach descend into inner crater (stopped by explosion at 1811 NZST).
24	Add nylon draw cords to cableway. (One broke almost immediately due to chemical attack and increasing wind).
25	Replace faulty geophone with spare one.
26	Magnetic induction loop broken by gales.
27	My tent blows down when 2 guy ropes fail. Repaired.
28	Cableway found to have blown down.
29	Retreived geophone and mirophone. Giggenbach and Fink's tent ripped and my tent completely disappeared in a full gale.
30	Prepare to leave. Kyle and Cashman to Scott Base. Only 1 Helo flight possible.
31	Dibble and Fink to Scott Base.
Jan 3	Dibble to Christchurch. Monteath, Thomson, Giggenbach, and McIntosh to Scott Base.

Days in Antarctica	27
Days at Scott Base	5
Days in field	22
Travel	2
Work	20

APPENDIX 3 - WEATHER

Event 12 - Glacier Sediment Studies

Date	Location	Altitude (m)	Temp (°C)	Pressure (mb)	Wind speed and direction	Visibility	Sky	Remarks
Oct 22	77°43.5'S	57	-26		Calm	50 km	Clear	Easterly later
23	162°17'E	"	-24		2 knts @ 055°T	"	Clear	
24	"	"	-26		Calm	"	Clear	
25	"	"	-19		Calm	"	SCT	
26	"	"	-17		Calm	"	SKC	
27	"	"	-17		Calm	"	SCT	Halo around sun.
28	"	"	-10		10 knts @ 090°T	"	OVC	Gusting 15-20 knts.
29	77°33'S							
	160°43'E	920	-14		Calm	"	OVC	
30	"	"	-14		10 knts @ 235°T	"	BKN	
31	"	"	-14		9 knts @ 220°T	"	SKC	
Nov 1-7	Vanda							
8	77°17.5'S							
	161°30.5'E	400	-12		Calm	500 m	OVC	Slight snow.
9	"	"	-15		Calm	50 km	OVC	
10	"	"	- 9		"	50 km	BKN	
11	"	"	- 9		"	20 km	OVC	
12-18	Scott Base							

Date	Location	Altitude (m)	Temp (°C)	Pressure (mb)	Wind speed and direction	Visibility	Sky	Remarks
Nov 19	77°32'S 164°34'E	0	- 7	987.5	Calm	50 km	SCT	
20	"	"	- 7	986.8	1 knot @ 020°T	50 km	BKN	
21	"	"	-	982.1		"	BKN	Thermometer broke.
22	"	"	-	979.7		"	SCT	SW 15-20 knts. Blowing snow.
23	"	"	-	978.0		"	SCT	
24	"	"		979.7		"	SCT	
25	"	"	-	982.8	7 knts @ 150°T	"	BKN	
26	"	"	-	988.8	7 knts @ 150°T	"	SCT	
27	2 km North	"	-	986.1	5 knts @ 190°T	"	SCT	
28	"	"	-	982.1	8 knts @ 150°T	"	OVC	
29	"	"	-	981.4	4 knts @ 160°T	20 km	OVC	Intermittent light snow.
30	"	"	-	983.4	8 knts @ 190°T	50 km	BKN	
Dec 1		"	-	982.1	6 knts @ 190°T	50 km	OVC	
2		"	-	984.1	Calm	50 km	BKN	
3	77°34'S 103°38'E	"	-	986.1	9 knts @ 060°T	4 km	OVC	Blowing snow
4	"			989.5	Calm	50 km	SCT	20 cm snow fell yesterday
5	"			986.1	Calm	50 km	SCT	
6	"	"	-	989.5	Calm	50 km	BKN	
7	"	"	-	993.9	"	50 km	SCT	
8	"	"	-	993.9	"	50 km	BKN	
9	"	"	-	993.9	8 knts @ 170°T	50 km	SCT	
10	77°41'S 163°32'E	"	-	994.9		"	BKN	15 knts @ 230°T in afternoon
11	"	"	-	998.3	Calm	"	CLR	
12	Cape Chocolate	"	-	994.9	"	"	CLR	
13	Strand Moraines	"	-	994.2	"	"	CLR	

Event 13 - Beacon Studies (Mt Fleming)

Date	Location	Altitude (m)	Temp (^{o}C)	Pressure (mb)	Wind speed and direction	Visibility	Sky	Remarks
Dec 6	161°16'E 77°33'S	1687	-	-	5 knts @ 090°T	50 km	BKN	
7	"	"	-	-	15 knts @ WSW	"	SKC	Snow later from East
8	"	"	-	-	2 knts @ "	"	BKN	
9	"	"	-	-	10 knts @ "	"	SCT	Blowing snow later
10	"	"	-	-	13 knts @ "	"	OVC	Cleared later
11	"	"	-	-	24 knts @ "	"	SKC	
12	"	"	-	-	13 knts @ "	"	SKC	
13	"	"	-	-	19 knts @ "	"	SKC	
14	"	"	-	-	19 knts @ "	"	SKC	Cloud in Wright Valley
15	"	"	-	-	15 knts @ "	"	SCT	Cleared later
16	"	"	-	-	13 knts @ "	"	SCT	
17	"	"	-	-	4 knts @ 300°T	"	SCT	Snow from SW, cleared
18	"	"	-	-	10 knts @ 260°T	"	SCT	Snow from E, later SW wind
19	"	"	-	-	5 knts @ 280°T	"	BKN	
20	"	"	-	-	10 knts @ 280°T	"	SCT	
21	"	"	-	-	8 knts @ 270°T	20 km	OVC	
22	"	"	-	-	12 knts @ 260°T	50 km	SCT	Light blowing snow
23	"	"	-	-	15 knts @ 260°T	50 km	SKC	
24	"	"	-15	-	20 knts @ 270°T	"	SKC	

Date	Location	Altitude (m)	Temp (°C)	Pressure (mb)	Wind speed and direction	Visibility	Sky	Remarks
Dec 25	161°16'E 77°33'S	1687	-17		28 knts @ 280°T	50 km	SKC	Blowing snow
26	"	"	-15		10 knts @ 280°T	"	BKN	
27	"	"	-12.5		25 knts @ 260°T	"	OVC	Later 55 knts gusts
28	"	"	-10.5		25 knts @ 270°T	"	BKN	Blowing snow, 50 knts gusts
29	"	"	- 6.5		26 knts @ 280°T	"	SCT	
30	"	"	- 6		10 knts @ 270°T	"	BKN	Cleared, cloud in Wright Valley
31	Vanda							
Jan 1	"							
2	"							
3	"							
4	161°16'E 77°33'S	1687	- 7		0	50 km	SKC	Mild day
5	"	"	-10		15 knts @ 270°T	10 km	BKN	
6	"	"	-13.5		25 knts @ 270°T	50 km	SCT	
7	"	"	-11		8 knts @ 240°T	30 km	OVC	Snow later
8	"	"	-10		14 knts @ 270°T	50 km	BKN	
9	"	"	- 7		2 knts @ 095°T	50 km	SKC	Wind change to SW
10	"	"	- 7.5		2 knts @ 240°T	50 km	SKC	
11	"	"	- 5		4 knts @ 045°T	50 km	SKC	Temperature decrease to -12°C
12	"	"	-		2 knts @ 060°T	1 km	OVC	

BIBLIOGRAPHY - 1978

ROBINSON, P.H. and HULL, A.G., 1978. Glacial Deposits and the Taylor Glacier. N.Z. Antarctic Record 1(1): 34-38.

BARRETT, P.J. and FROGGATT, P., 1978. Densities, Porosities and Seismic Velocities of some rocks from Victoria Land, Antarctica. N.Z.J. Geol. Geophys. 21(2): 175-87.

PLUME, R.W., 1978. A Revision of the Existing Stratigraphy of the New Mountain Sandstone (Beacon Supergroup), South Victoria Land, Antarctica. N.Z.J. Geol. Geophys. 21(2): 167-73.

VUCETICH, C.G. and ROBINSON, P.H., 1978. Quaternary Stratigraphy and Glacial History of the Lower Taylor Valley, Antarctica. N.Z.J. Geol. Geophys. 21(4): 467-82.

EGGERS, A.J., 1978. The Scallop Hill Formation, Brown Peninsula, McMurdo Sound, Antarctica. N.Z.J. Geol. Geophys.

STERN, Timothy A., 1978. Gravity Survey of the Taylor Glacier, Victoria Land, Antarctica. Antarctic Data Ser. No. 5 (Geol. Dept. Publ. No. 8), Victoria Univ. of Wellington, 6 p.

ROBINSON, P.H., 1978. Taylor Glacier research programme in glaciology. N.Z. Antarctic Record, 1(3): 51-57.

McPHERSON, J.G., 1978. Stratigraphy and sedimentology of the Upper Devonian Aztec Siltstone, Southern Victoria Land, Antarctica. N.Z.J. Geol. Geophys. 21(6): 667-83.

THESIS

PYNE, A.R., 1978. Facies interpretation, diagenetic and coal studies of the Weller Coal Measures in Kennar Valley, South Victoria Land, Antarctica. B.Sc (Hons) thesis, Victoria Univ. of Wellington library.

PLATES

I - IV	Glacial debris studies
V - X	MSSTS Site investigations
XI	Microorganisms in bottom sediments
XII - XV	Ice-berg and sea-ice debris
XVI - XIX	Paleomagnetic studies
XX - XXIII	Weller Coal Measures
XXIV - XXV	Metamorphic studies
XXVI - XXVII	Erebus crater studies

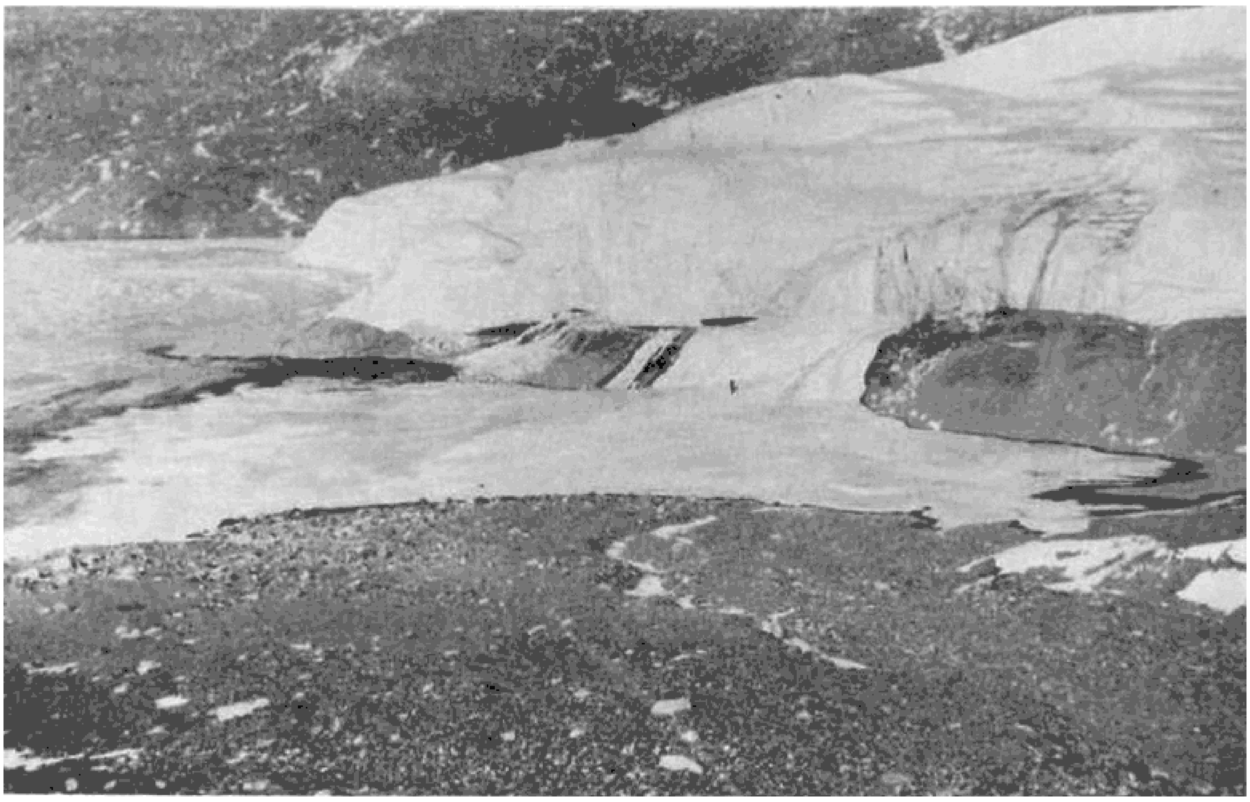


PLATE 1. A large saline water discharge (over 3000 m^3) from the snout of Taylor Glacier in late October (figure just right of centre for scale).

PLATE II. Victoria Upper Glacier shows remarkably clean, debris-free marginal cliffs, ice surface and ice aprons. One medial moraine emerges from an englacial position 1000m up glacier of the margin.

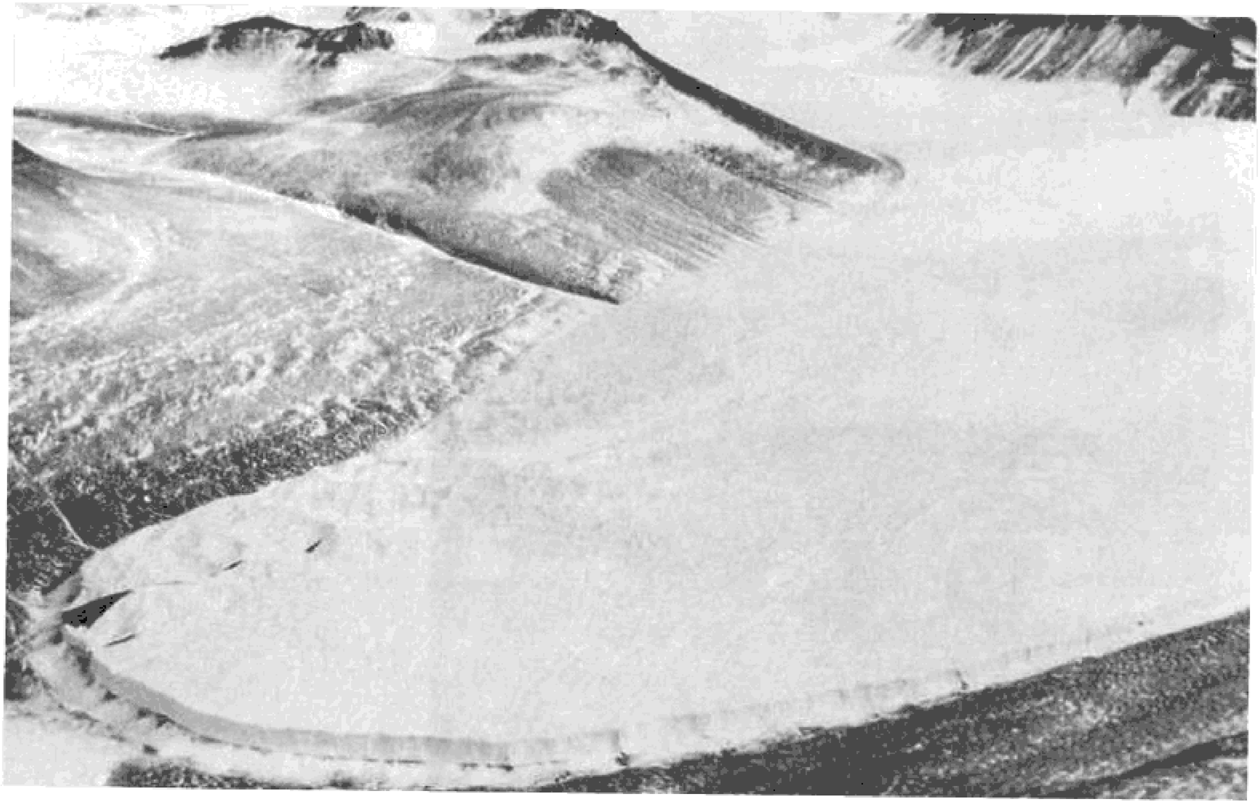


PLATE III. Englacial debris in Wright Upper Glacier is characterised by clasts of coarse, angular sandstone and dolerite with a moderately well sorted sand matrix.

PLATE IV. In the northwest corner of the Labyrinth, retreat of Upper Wright Glacier has exposed previously undescribed *in situ* granite (dashed lines).

PLATE V. The access hole at MSSTS Site 1 is blasted.

PLATE VI. The current meter ready for lowering as soon as the seal is clear of the hole.

PLATE VII. Lowering the McIntyre grab.

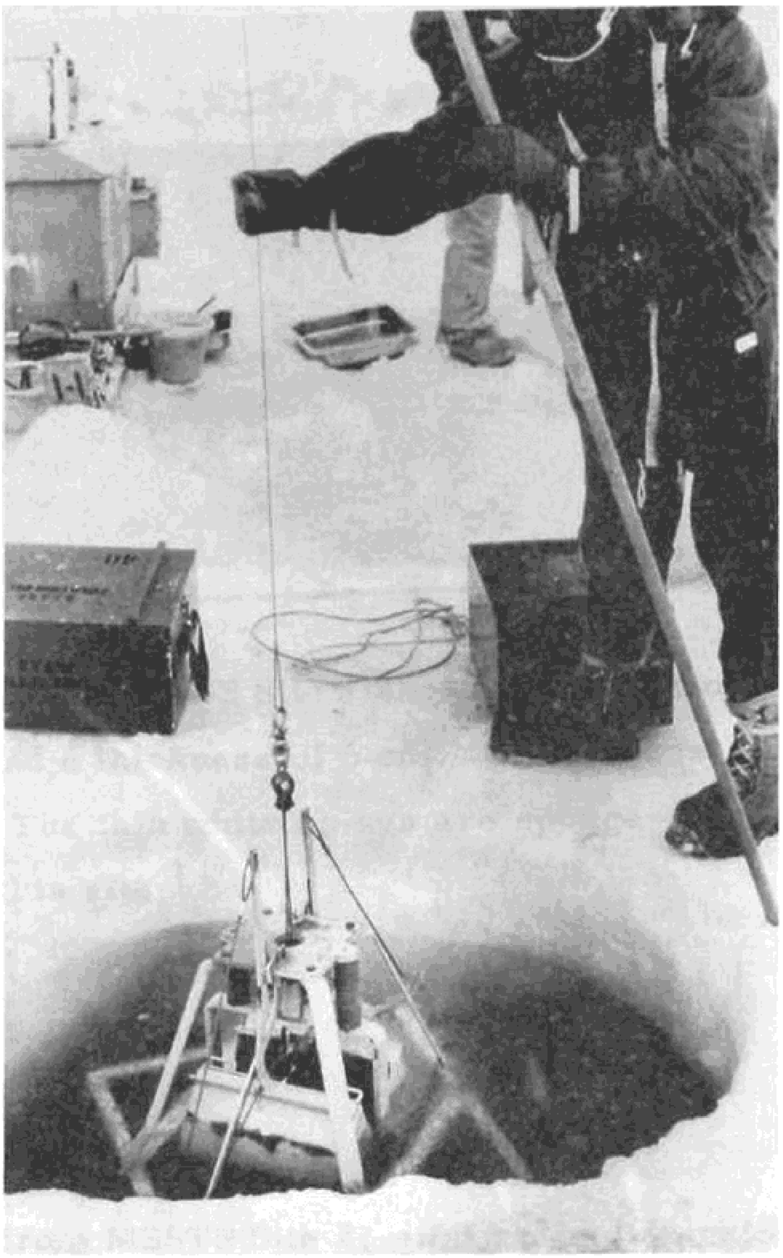
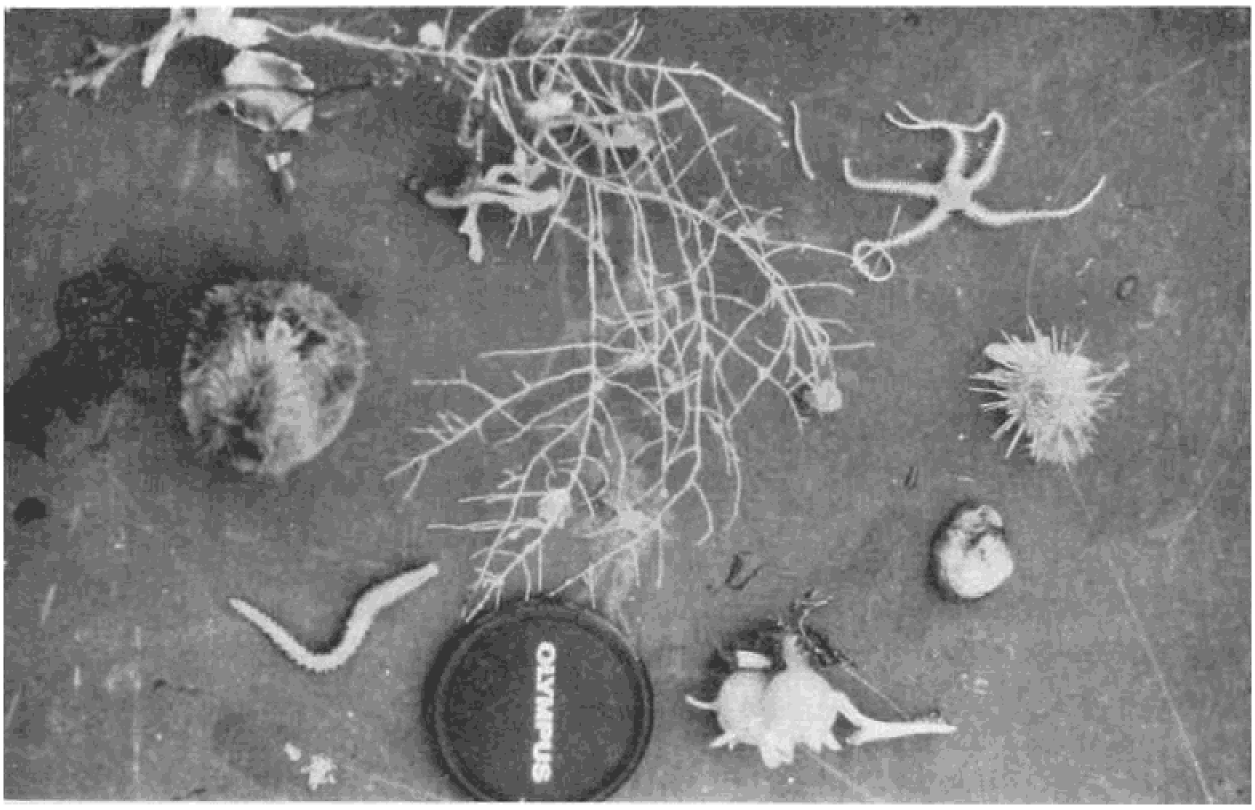


PLATE VIII. Biota from the sea floor include sea urchins, picnogonids and a bivalve.



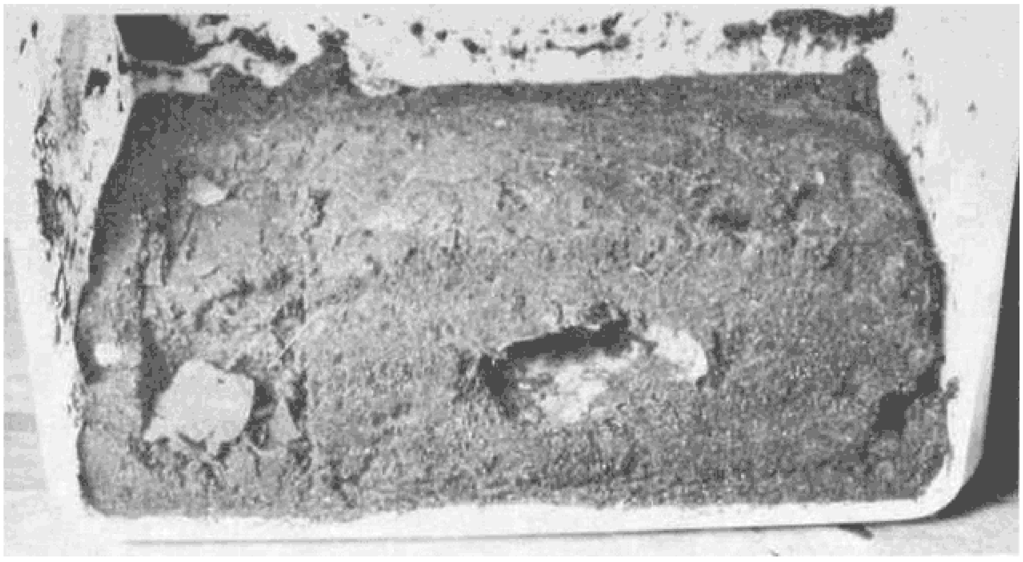


PLATE IX. Box core from MSSTS Site 1 showing an area of sea floor 20 x 10 cm and a thickness of 6 cm. Sediment is muddy basaltic sand. The thin white spines are sponge spicules, abundant at this site.

PLATE X. Box core from MSSTS Site 2, similar in dimensions to that above. Sediment is muddy feldspathic sand. The surface and the mottled section show signs of extensive burrowing.

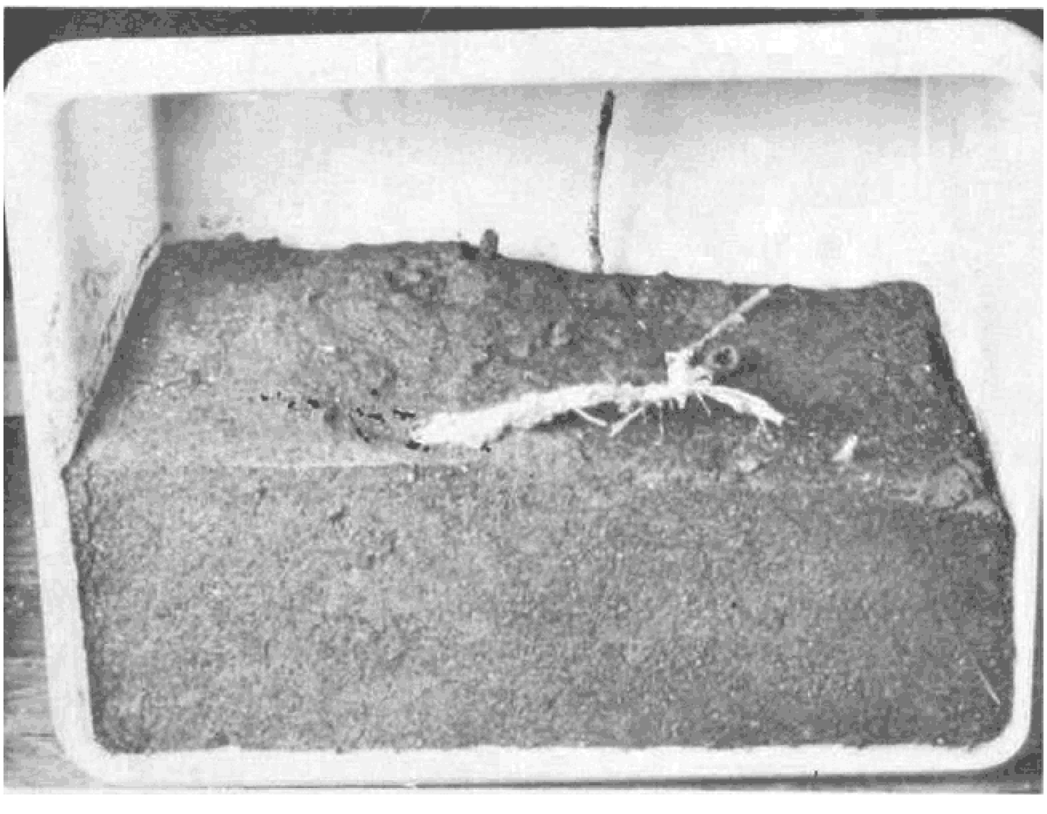


PLATE XI

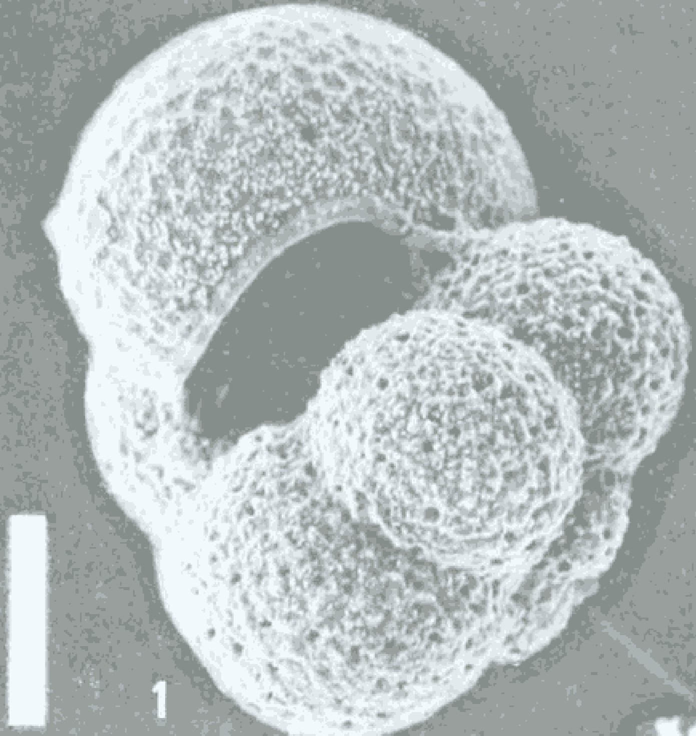
1. Planktonic foraminifera *Neogloboquadrina pachyderma* (Ehrenberg). Scale bar 100 microns.

2. Benthonic foraminifera *Trifarina earlandi* (Parr). Scale bar 200 microns.

3. Radiolaria *Spongodiscus* cf. *favus* (Ehrenberg). Scale bar 40 microns.

4. ?Sponge spicule Scale bar 40 microns.

5. Ostracod *Trachyleberis* sp. Scale bar 200 microns.



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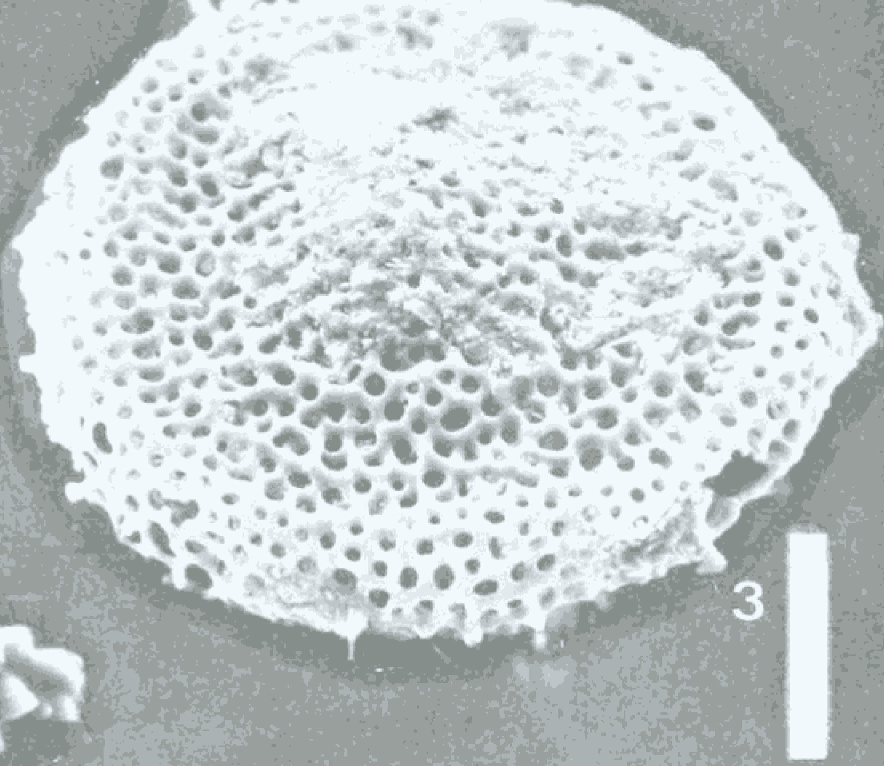

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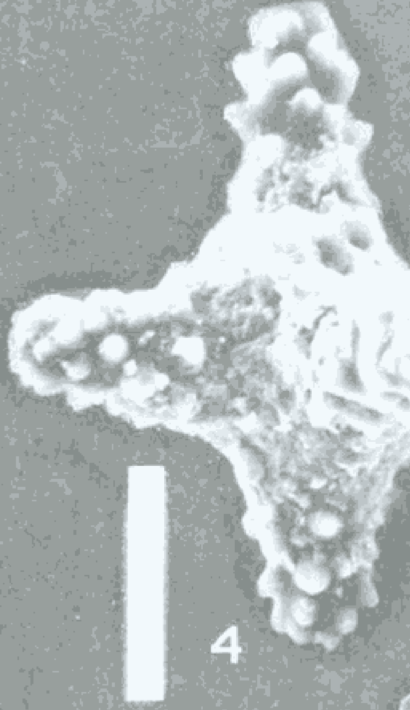

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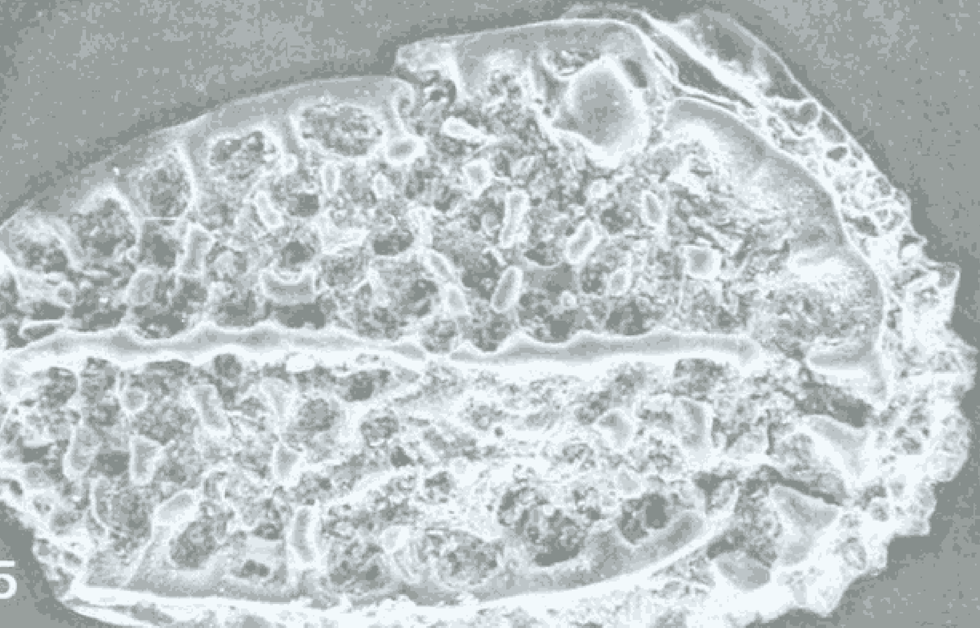

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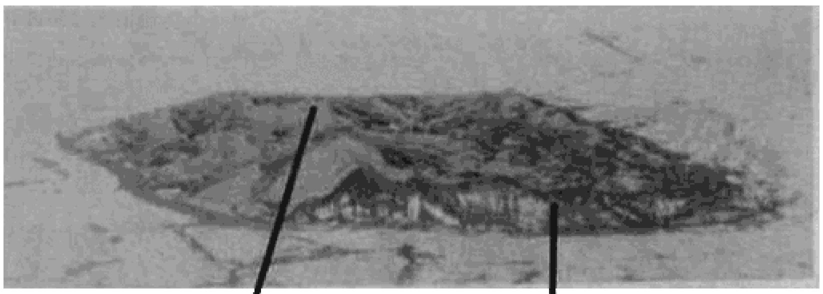


PLATE XII. Boulder-strewn superglacial debris on hummocky surface of dirty iceberg near Marble Point.

PLATE XIII. The debris layer on the iceberg (Plate XII) is only 30 cm thick and is mainly a sandy gravel.

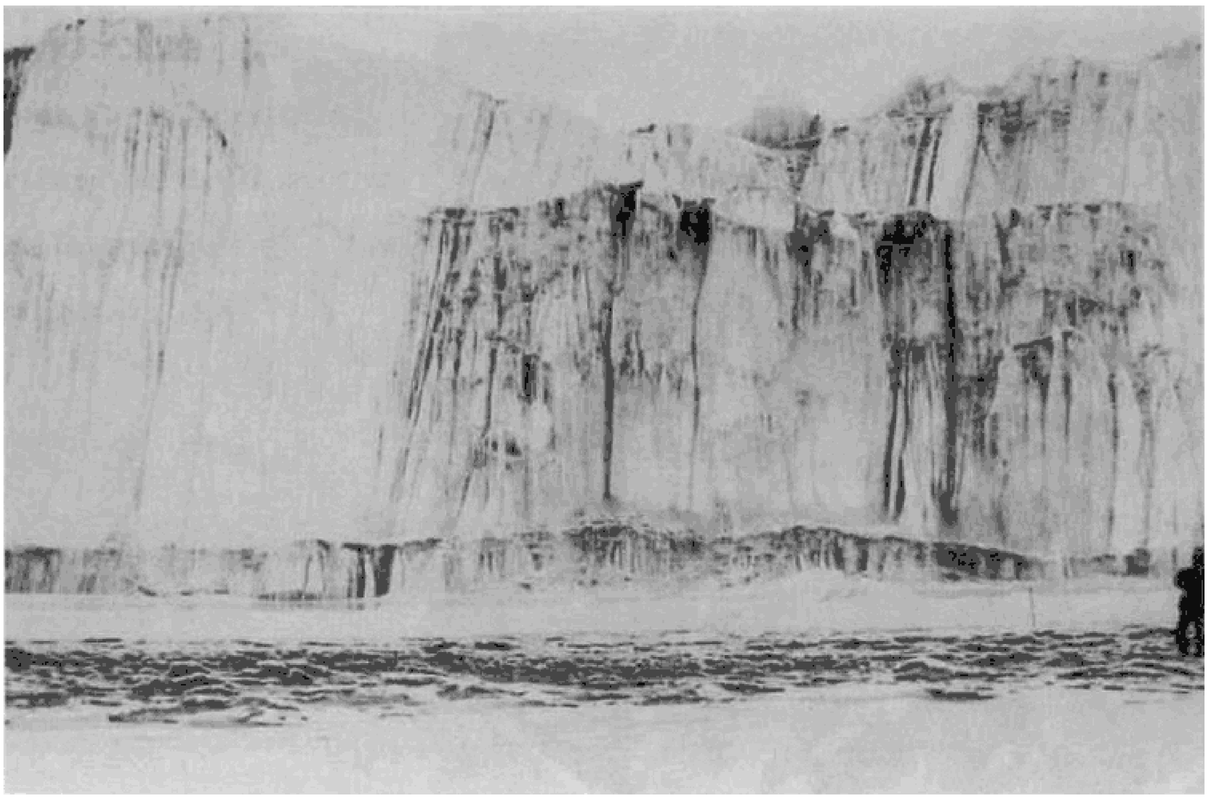


PLATE XIV. Wind-blown debris caught on an iceberg trapped in the sea ice. Debris has also been deposited on the sea ice in the wind shadow (foreground).

PLATE XV. Two dirt layers (arrowed), thought to be annual, on the sea ice in Explorers Cove, New Harbour.

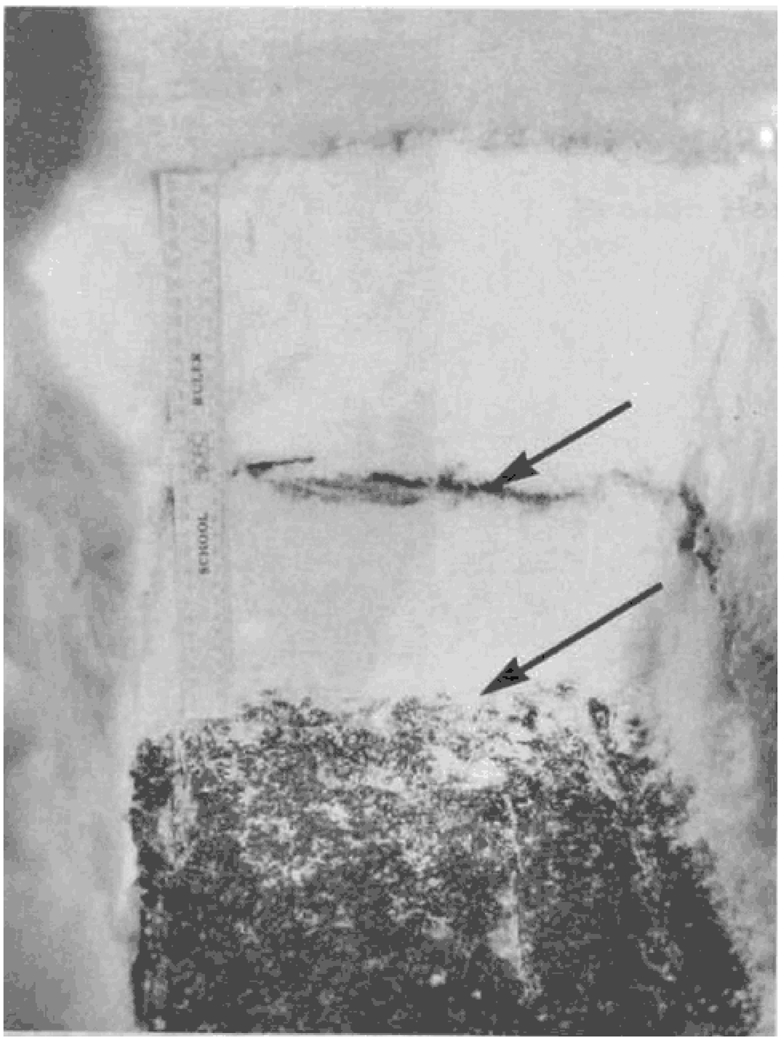


PLATE XVI. Professor Christoffel starting the drill motor for paleomagnetic sampling.

PLATE XVII. Peter Garden drilling a core at Beacon Heights

PLATE XVIII. Measuring dip and dip direction before removing the plug.

PLATE XIX. Annette Richards recording location and directional data. Stratigraphic level was measured with the aid of a Jacobs staff (lower right).

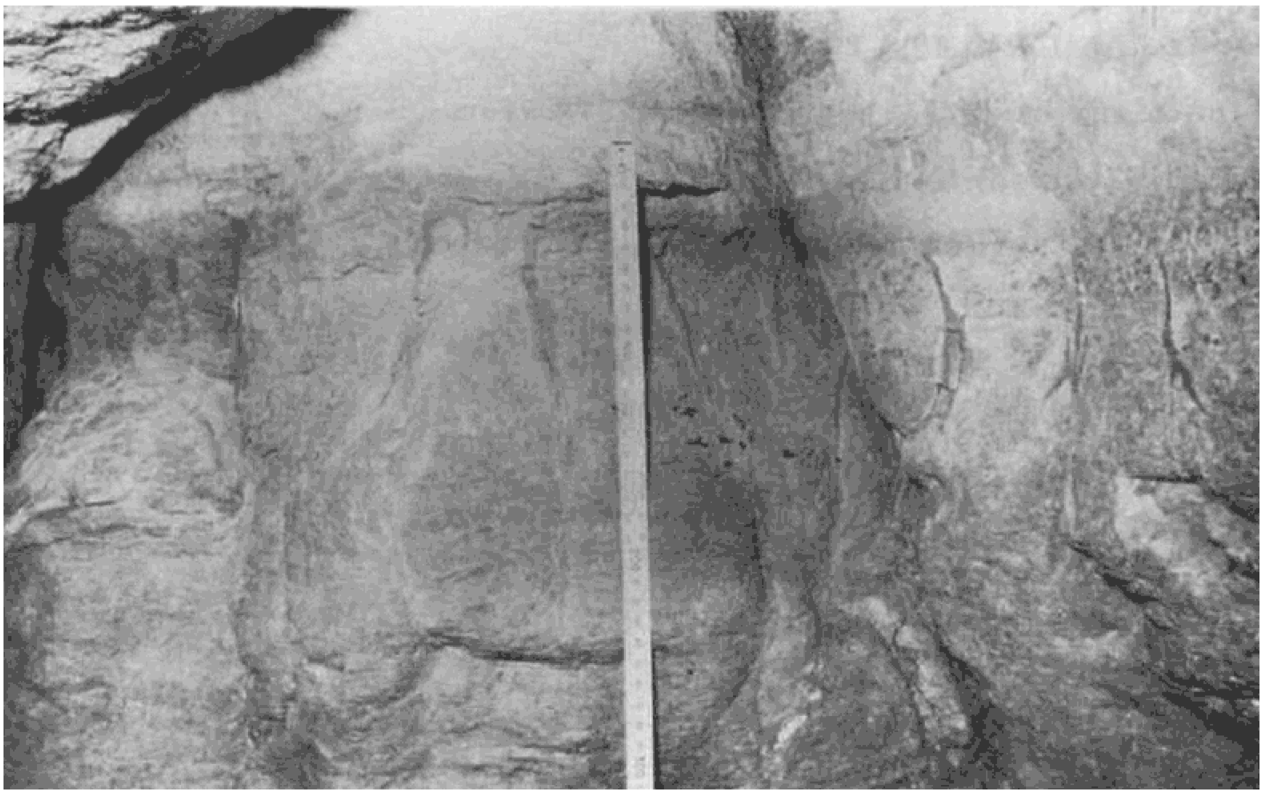
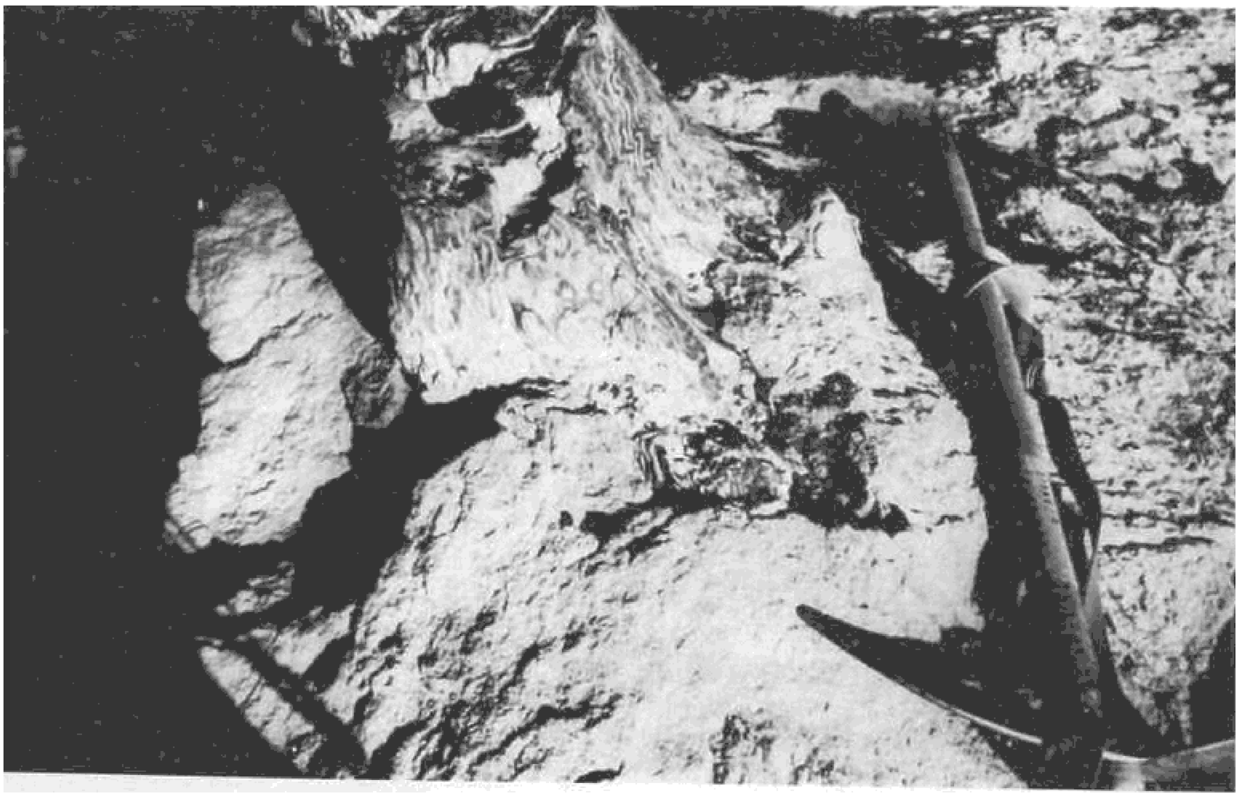


PLATE XX. Permian fossil soil showing prismatic jointing. Top of Weller Coal Measures, Mount Bastion.

PLATE XXI. Silicified tree stump in growth position. Light and dark bands are annual rings. Weller Coal Measures, Mount Fleming.



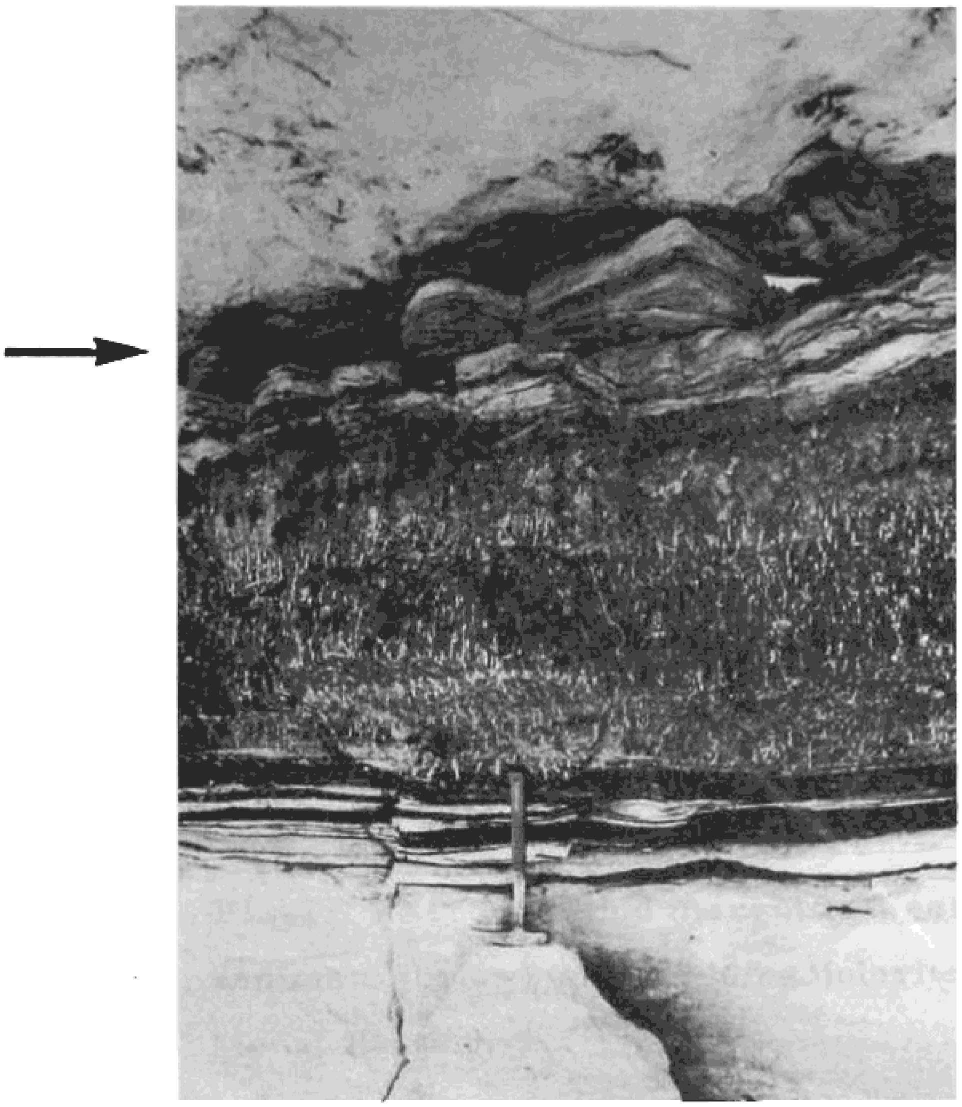


PLATE XXII. Coal seam grades up to shale cut by channel (arrow) filled with sand (top).

PLATE XXIII. Cirque basin, Mount Fleming, with dolerite dike cutting Aztec Siltstone (foreground) and Weller Coal Measures (background)

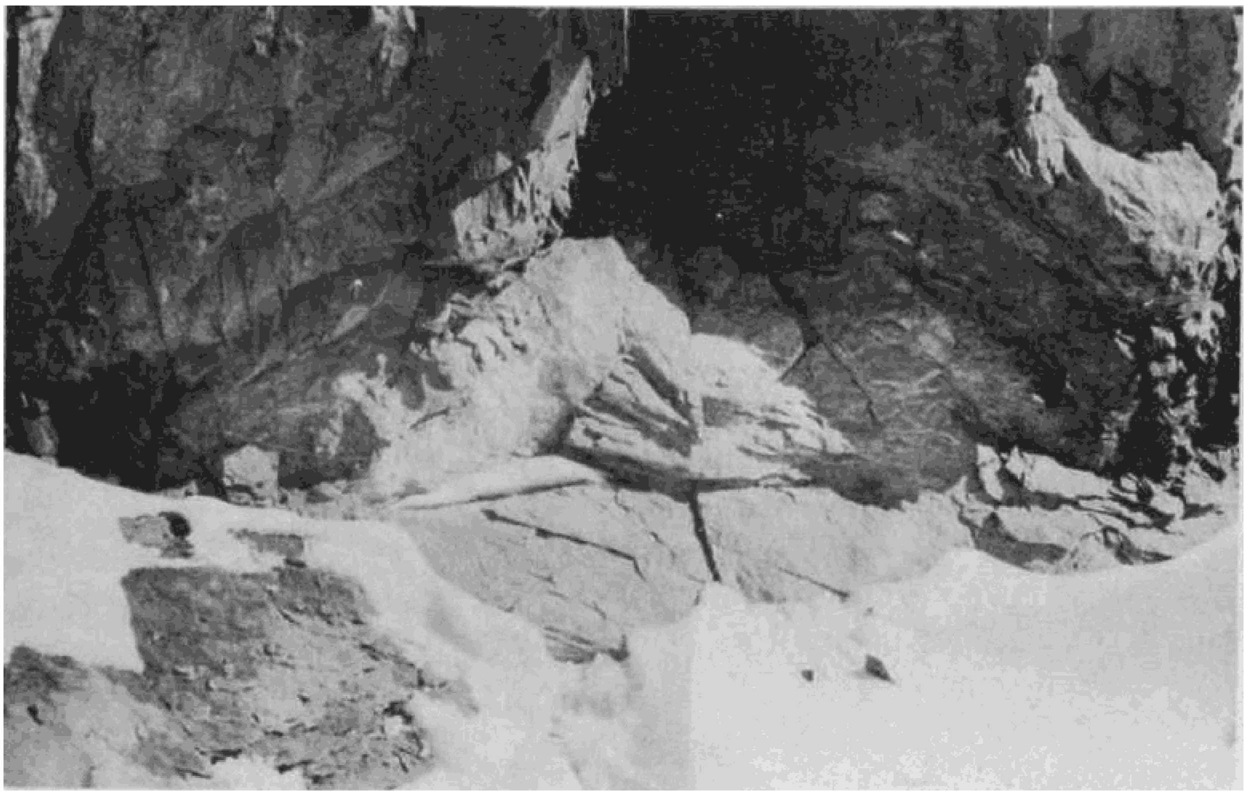


PLATE XXIV. Chilled margin between Lashly Formation sediment (below) and intruding dolerite (above). Summit sill, Mount Bastion.

PLATE XXV. Raft of Lashly Formation sandstone and mudstone in sill of Ferrar Dolerite. South face of Mount Bastion

PLATE XXVI. View across the inner crater of Mount Erebus. Four of the party at the edge indicate scale.

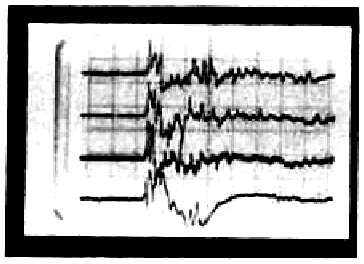
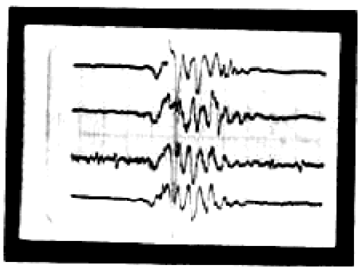
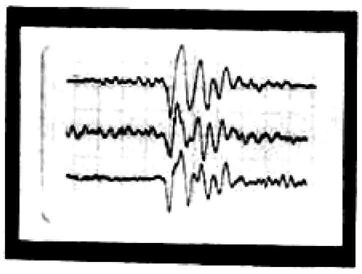


PLATE XXVII. Audiograms from Mount Erebus.

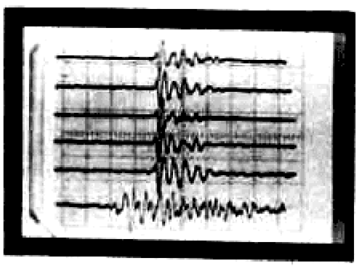
A. Observed explosions of the active vent. Second from top occurred at 1810 NZST on 23 Dec 1978, while Dr. Giggenbach was descending the crater.



B. Audiograms with emergent low frequency onsets, probably accompanying non-explosive discharges from the active vent.



C. Audiograms with rarefactional low frequency onsets, usually accompanied by both magnetic and seismic signals, but not by observed eruptions.



D. Audiograms with compressional onsets accompanied by B-type earthquakes (bottom trace), but not by observed eruptions or (with one exception) magnetic signals. Top 2 recorded at camp; next 3 at crater rim; propagation velocity about 300 $m.s^{-1}$.