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DISTRIBUTION OF SALTS IN THE McMURDO REGION, WITH ANALYSES FROM THE SALINE DISCHARGE AREA AT THE TERMINUS OF TAYLOR GLACIER

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DISTRIBUTION OF SALTS IN THE McMURDO REGION WITH ANALYSES FROM THE SALINE DISCHARGE AREA AT THE TERMINUS OF TAYLOR GLACIER

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INTRODUCTION

Victoria University of Wellington Antarctic Expeditions have had a long association with the salt accumulations and saline lakes of the McMurdo region (Fig. 1). This publication records the crystalline salt phases that have been characterised in the region to date. X-ray diffraction analyses of over 300 salt accumulations are listed with emphasis on locations in Taylor Valley. Also included are analyses of saline spring and glacier discharge brines and melted samples from the area of the saline discharge (Keys 1979) at the terminus of Taylor Glacier, and from other localities on and around the glacier. Major, trace and rare earth element analyses are given for some volcanogenic salts from Erebus Volcano.

These data are from a Ph.D. study of salt distribution and origin in the McMurdo region, and the Taylor Glacier saline discharge phenomena. The information is important because of the extensive interest in salt accumulation in this part of Antarctica and because of the relationship of the salts, Taylor Glacier and the saline lakes to the glacial history of the region.

ANALYTICAL TECHNIQUES

The salt accumulations were analysed using a Philips PW 1010 x-ray generator and PW 4210 x-ray powder diffractometer (XRD) to determine the crystalline phases. Sample preparation consisted of purification by manually removing rock impurities, grinding in a mortar and pestle and placing in on aluminium sample holder or on a glass slide. Diffraction patterns were interpreted using the indices of the American Society for Testing and Materials.

The major cations in the brines (except sample 78/01), meltwaters and melted ice samples were analysed using atomic absorption (AA) spectrophotometry. With this technique the most accurate results are obtained when the standards consist of all the elements being analysed with these elements in the ratios that they are in the sample. Thus reconnaissance analyses were performed first, based on single element standards, with La^{3+} added to suppress interference. Excess Na^+ was added to the K^+ standard to mask Na^+ interference. The results of these analyses enabled preparation of suitable standards for more precise analyses.

The major cations in an acidified, diluted sample of the 1978 discharge brine (sample 78/01) were analysed independently by N.H. Holden (Chemical Service Laboratories Ltd., Wellington). Na^+ and K^+ were analysed using flame photometry with the working samples doped with excess Li^+ to mask inteference. Mg^{2+} and Ca^{2+} were determined by standard EDTA titrations.

Major anions were determined using standard wet techniques (Vogel 1951; Metson 1965; Brown et al., 1970). Cl^- was determined as total halides using silver nitrate, with the titrations viewed through yellow lens goggles to improve the end point determination. SO_4^{2-} was determined gravimetrically with barium chloride. Analysis of HCO_3^- was not performed at the sampling site because of logistic difficulties. After sampling however, a precipitate of calcium carbonate formed in the spring brine samples. A reasonable estimate of HCO_3^- concentration could be obtained therefore, by analysing the HCO_3^- in the solution above the precipitate (using hydrochloric acid) and by determining the Ca^{2+} (by A.A. spectrophotometry) in the precipitate. It was assumed that the HCO_3^- lost, and the Ca^{2+} determined, are stoichiometrically related as in the equation for the reaction

$$Ca^{2+}_{(aq)} + 2HCO^-_{3(aq)} \longrightarrow CaCO_{3(s)} + CO_{2(g)} + H_2O$$

This reaction also involves, and compensates for, the degassing of carbon dioxide.

The specific conductance of the liquid samples was determined using a standard conductivity bridge and water bath thermostated to +25°C. Freezing point depressions were measured by mercury thermometer, using salt-ice freezing mixtures in an apparatus similar to that illustrated by Glasstone (1940).

Major elements in volcanogenic salts from Erebus Volcano were determined by neutron activation at the University of Maryland, U.S.A., by W. Zoller (see Zoller and Gordon 1970). Selected trace and rare earth elements were analysed in pressed powder discs by x-ray fluorescence, using cellulose-based standards, by P. Kennedy, Victoria University of Wellington.

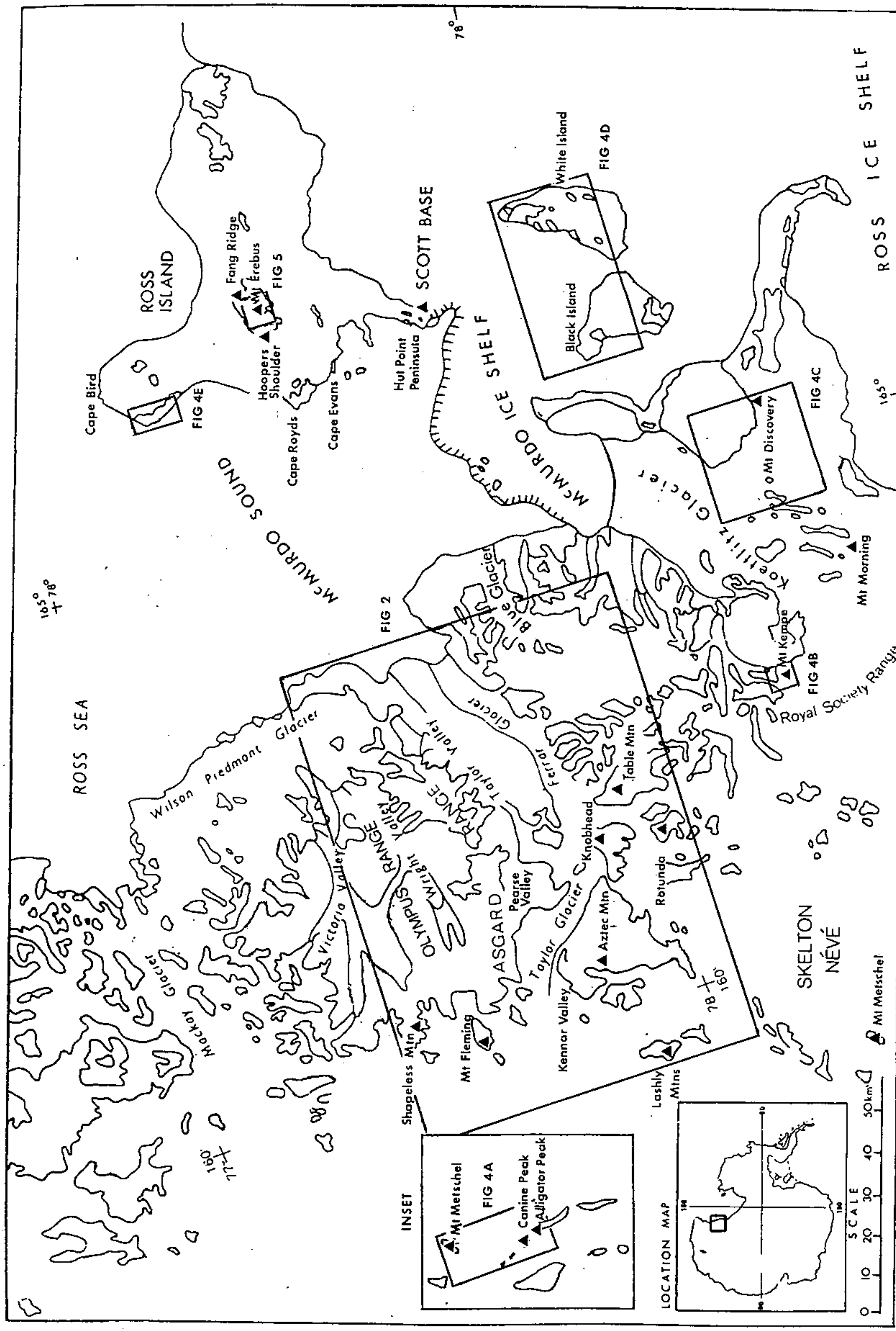

FIGURE 1 The McMurdo region

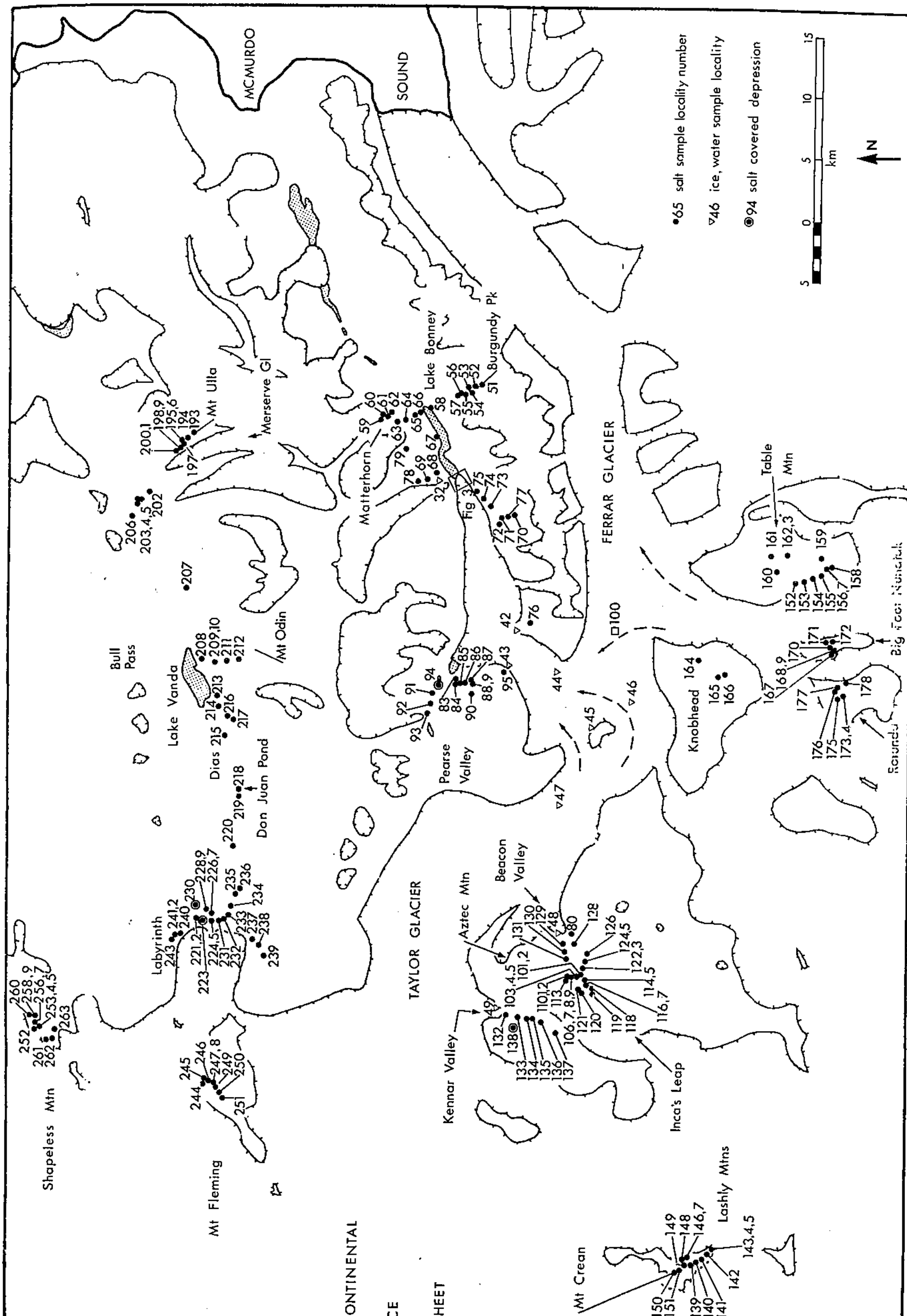

FIGURE 2 Wright, Taylor and Ferrar Valleys

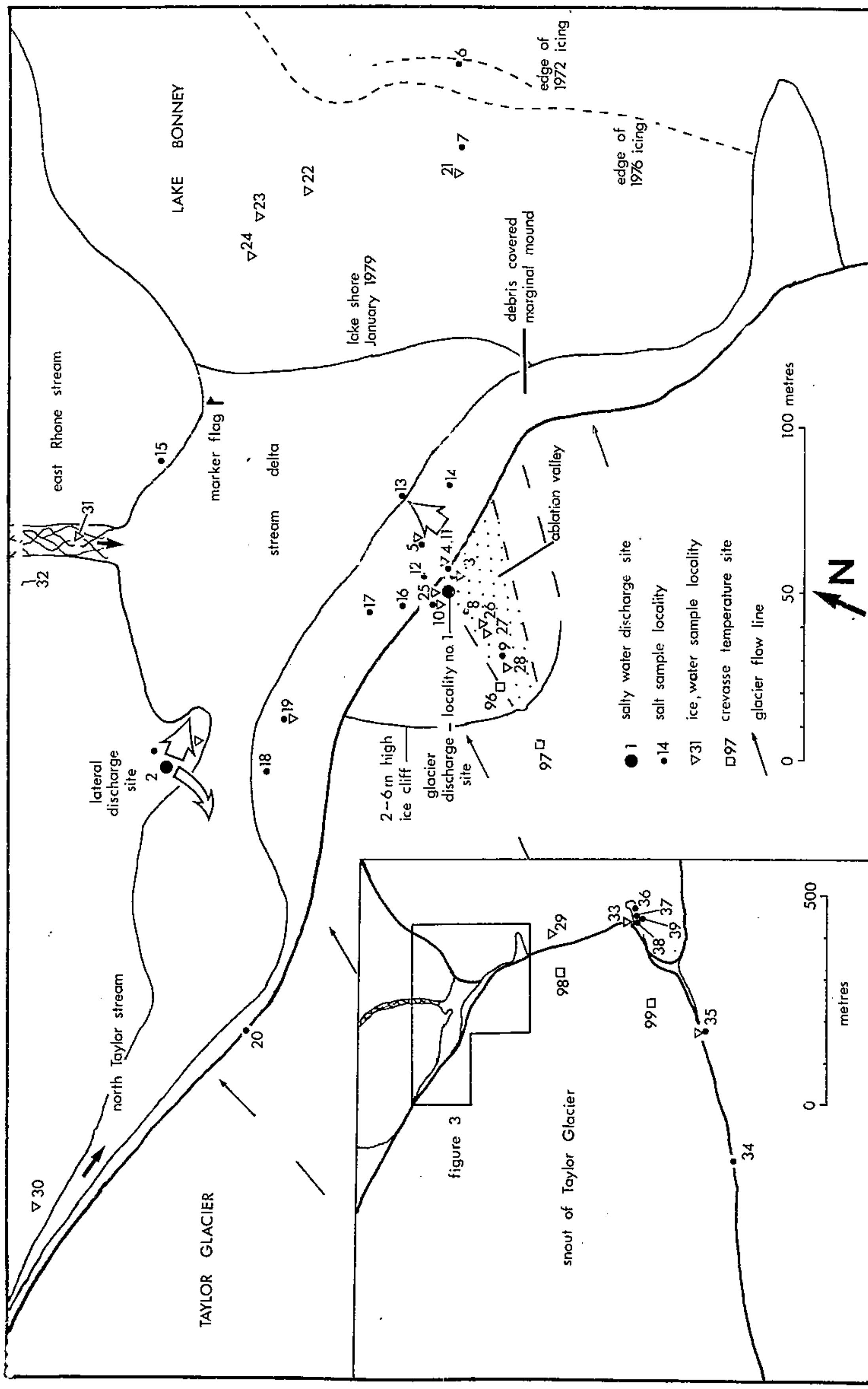

FIGURE 3 Saline discharge area and terminus of Taylor Glacier

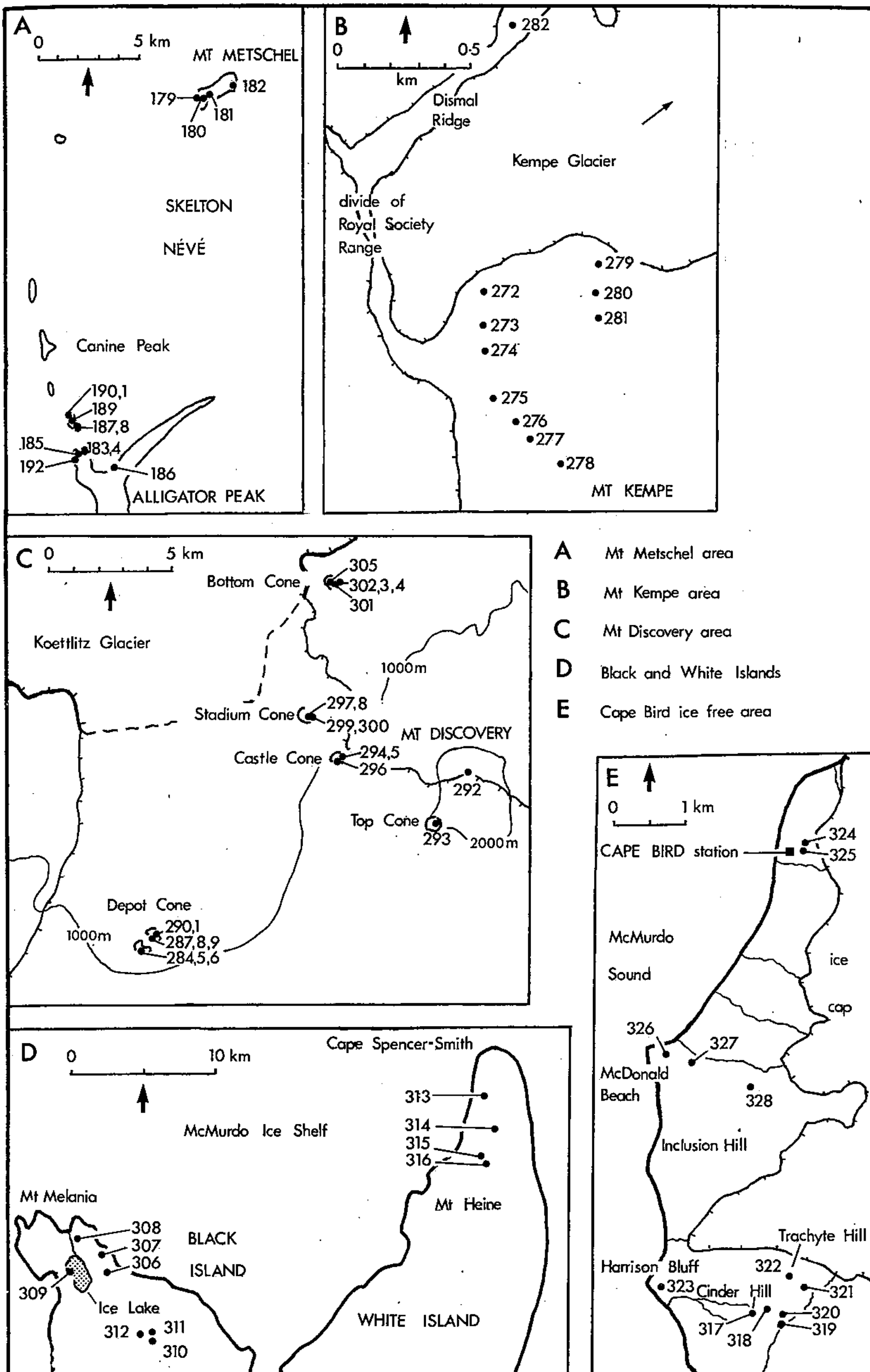

FIGURE 4 Mts Metschel, Alligator, Kempe and Discovery, Black Island, White Island and Cape Bird ice-free area

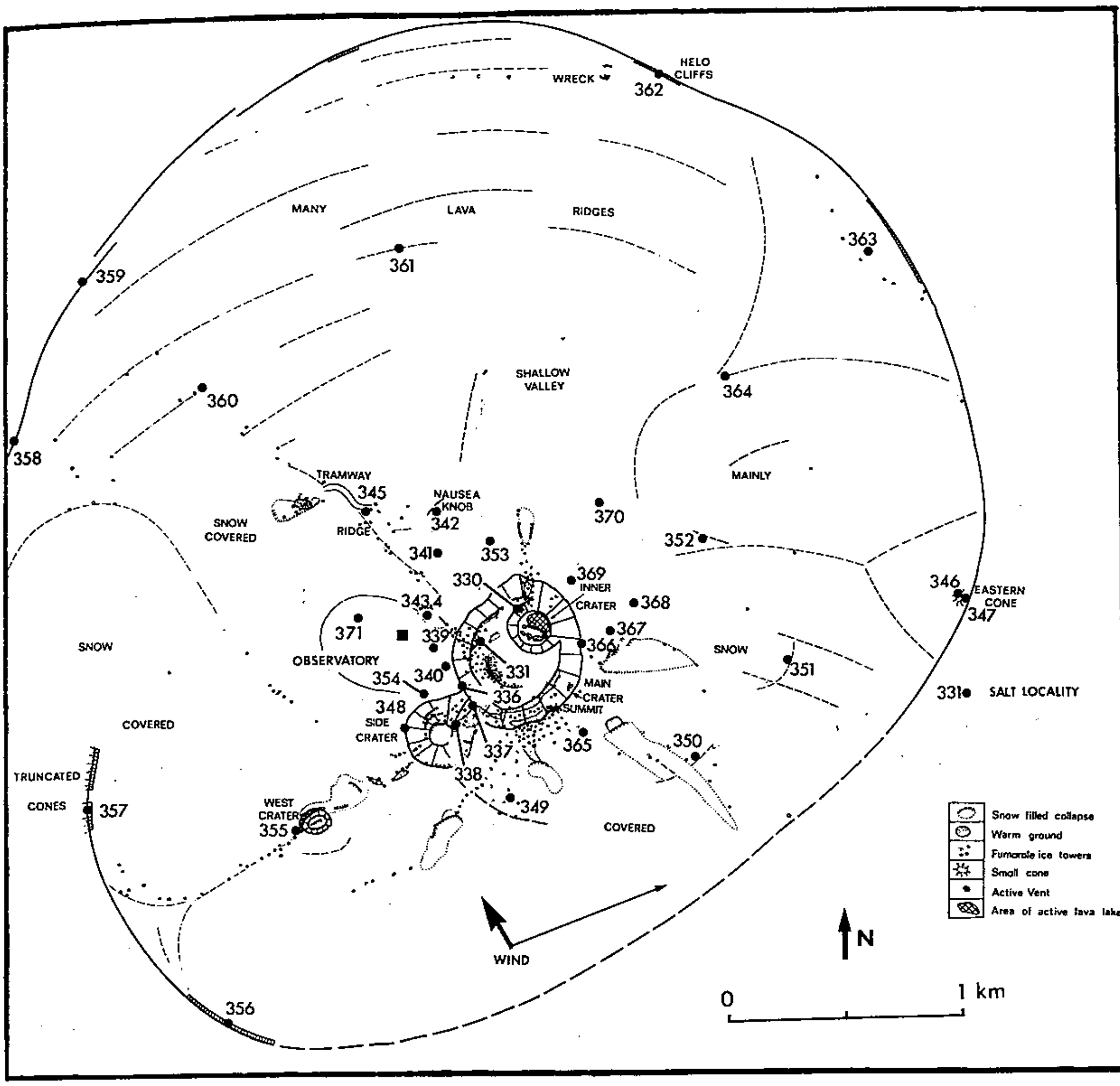

FIGURE 5 Sketch map of Mt Erebus Summit region.

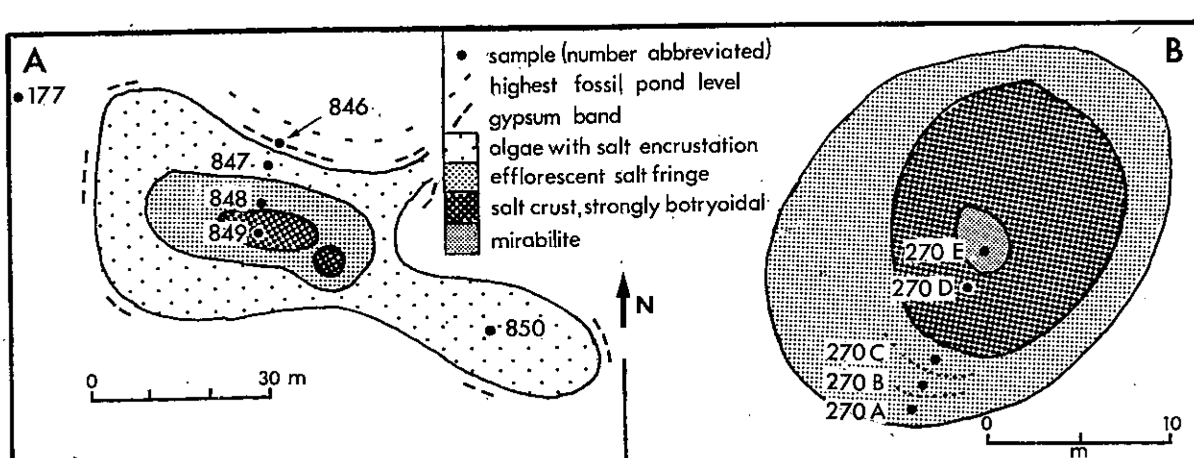

FIGURE 6 Sketch map of two salt-covered depressions:
A. Mae West Pond, Pearse Valley, locality No. 94;
B. Labyrinth area, locality No. 230

NOTES ON SELECTED TABLES

TABLE 1 Crystalline salt phases

More than 30 phases have been reported to date by workers in the region. Here these phases are grouped into three sub-tables on the basis of distribution and frequency of reports in antarctic literature.

The iodate-containing phase present in trace amounts is probably lautarite, rather than sodium iodate as reported by Johannesson and Gibson (1962) and Gibson (1962).

TABLES 3, 5, 6, 7 Distribution of Salt phases in Taylor Valley, upper Ferrar Valley, Wright Valley and McMurdo Sound Area

The tables list: locality number (shown on Figures 2, 4, 5); sample number (either a Victoria University of Wellington, Geology Department five figure catalogue number or a two-part field number); the salt phases (in order of importance in the sample); the deposit type (from Table 2); site aspect (northwest NW etc, flat F, small hollow where aspect is of lesser importance, H); rock types associated with the deposit (determined in the field and using Haskell et al., 1965; Barrett 1971; Barrett and Webb 1973; McKelvey and Webb 1962; and Cole and Ewart 1968); and site elevation (based on barometer readings; and U.S. Geological Survey maps, 1:50,000 topographic series and 1:250,000 reconnaissance series).

TABLE 4 Distribution of crystalline salt phases around the terminus of Taylor Glacier

These salts are related to the saline discharge phenomena. Localities are given in Fig. 3.

TABLES 8-11 Crystalline salt phases in salt-covered depressions

These show the succession of salts after capillary transfer, evaporation and freezing out from solution in saline depressions. Fig. 6 shows the sample locations at the two largest depressions studied.

TABLE 12 Identification of melanterite

The salt deposit consisted of about 0.3 grams of small green crystals, 1 to 2 mm long of melanterite ($FeSO_4.7H_2O$), encrusting part of the magnetite (Fe_3O_4) bed. A small amount of yellow-orange and white encrustation and associated rock detritus was taken with the 0.1g sample. The non-assigned peaks in the diffraction pattern represent the associated material; the yellow-orange and white encrustation consists mostly of iron III and iron II sulphates. **More definate identification by XRD is not possible owing to peak interference and to the small sample size.**

TABLE 13 Identification of burkeite

The interpretation of this pattern is difficult due to peak overlap. The three annotated, unassigned peaks in the table include the main halite peak at 2.82 Å. The second, third and fourth halite peaks (at 1.994Å, 1.628Å and 3.26Å respectively) are obscured because halite is present in low concentration.

Both of the other annotated, unassigned peaks did not disappear after oven drying at 105°C and can therefore be attributed to an anhydrous species. They probably represent additional or modified planes of ions in the burkeite $Na_6(CO_3)(SO_4)_2$ crystal lattice, caused by mutual substitution of sulphate and carbonate. These anions can mutually substitute over a wide range in the artificially-produced salt (Palache et al., 1951).

The other unassigned peaks all disappeared on oven drying: therefore most of these peaks can be attributed to trona. Thermonatrite which is present in relatively low concentration has little effect on the pattern in this region.

Reference to relative peak intensities assisted the interpretation. The strong peak at 4.89Å disappeared on oven drying and can be assigned to trona although there is a significant discrepancy between the experimental and literature peak positions. Relative peak intensities bear reasonable resemblance to the literature values. As is normally the case, distortions are due to particle size effects.

TABLE 14 Reconnaissance analyses of major cations

Listed here are analyses by AA using single element standards. These results allow semiquantitative comparisons between samples of specific cations. Locality numbers are shown on Figures 2 and 3.

TABLE 15 Composition of saline spring and glacier discharge brines

The concentrations of major cations and anions in these brines and in seawater are given, together with oxygen and deuterium isotope data. In saline spring sample 76/72, the sum of each cation concentration (in moles per kilogram) times its cationic charge, and the corresponding anionic sum, agree within two percent. This close agreement indicates a satisfactory analysis.

TABLES 17-21 Specific conductance, chloride concentration and freezing point depressions

These five tables present selected analyses to show generic relationships between samples, involving saline icing, englacial and subglacial iron-stained ice. Dirt layer and meltwater samples are included. Sample locations are shown on Figures 2 and 3.

TABLES 23-25 Major trace, and rare earth element analyses of volcanogenic salts from Mt Erebus

X-ray diffraction of these volcanogenic salts, and simple wet tests, indicate that a complex mixture of alums and other volcanogenic phases are present. Unstable hydration states and the possible existence of rare or unknown salt minerals further means that identification of most phases by XRD is difficult. Major element analysis by neutron activation gives the elemental composition of three volcanogenic salts. Analytical totals are within ten percent after equating with oxygen, although normal stoichiometric relationships cannot all be relied upon in these salts. Electroneutrality is difficult to show because of unknown amounts of OH^-, Al^{3+} and other ions. Trace and rare earth elements can be used to determine enrichments of specific species.

TABLE 26 Accumulation of salts

Measurement of the total amount of salt at a site of known absolute or relative age, enables assumptions of the rate of salt accumulation to be tested. Locality numbers are given in Fig. 2.

TABLES 27-36 Frequency data

The data from Tables 1, 3, 4, 5, 6, 7 have been reduced to summary form for construction of histograms and other diagrams. Salt phases are counted in each deposit they occur, subject to constraints depending on the subject of the specific summary table. In several instances insufficient data have been accumulated for statistical purposes.

In each deposit the most common hydrate (or polymorph) is considered in most cases (as indicated). For Tables 27, 28, 29, 31, samples are excluded that are listed as having both surface and subsurface deposit type Deposits in hollows and flats are not considered in Tables 28, 31. To generate sufficient data for Tables 29-31, the eight compass points listed in the parent tables are condensed to quarters by combining NW, NE with N, NE, SE with S etc. The significance of these two-dimensional orientation distributions is tested against randomness using a rearranged equation of Curray (1956), relating the vector magnitude, L (percent), at the significance level, p, to the total number, N, of data, where

$$L = 100\sqrt{\frac{-\ln P}{N}}$$

If the magnitude of the aspect class is greater than L for significance levels 0.01 and 0.05, then the distribution is not uniform. For Table 32 only those sites were considered where a particular rock type could be qualitatively assessed as being dominant. Only localities on the continent were considered for Table 34 (elevation). In this table salt occurrences in the 4 largest salty depressions were not included. Table 35 (distance from coast) includes data derived from the maps of Nishiyama (1977) for parts of Taylor and Wright Valleys (aragonite occurrences are excluded). Data from Table 7 are not considered here because of difficulties or ambiguities in determining distance. Neglect of those occurrences with unambiguous distances (Table 7.5), has an insignificant effect on Table 35. Gypsum and calcite occurrences are not included in Table 36. No calcite accumulations were recorded at Cape Bird although they are possible having been found nearby in similar situations at Capes Royds, Barne and Evans, and Hut Point Peninsula (Keys 1972). Because of this uncertainty and their generally low frequency of reported occurrences here, these salts are not included.

It is possible that systematic sampling errors have affected the recorded relative frequency of gypsum and calcite deposits. In areas where salt deposits are sparse and small, it is easiest to obtain workable or identifiable samples of gypsum and calcite than the more soluble salts. Therefore some results may portray a stronger trend than really exists. For this reason the more soluble salts have often been considered by themselves here. This makes the trends for such salts clearer but stronger than in reality. Rounding off insignificant figures results in all totals not being exactly 100 per cent.

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TABLE 1 CRYSTALLINE SALT PHASES OCCURRING IN THE McMURDO REGION.
GROUP A (FREQUENTLY NOTED IN ANTARCTIC LITERATURE)

Chemical Name	Mineral Name	Formula
sodium chloride	halite	NaCl
sodium sulphate decahydrate	mirabilite	$Na_2SO_4.10H_2O$
sodium sulphate	thenardite	Na_2SO_4
calcium sulphate dihydrate	gypsum	$CaSO_4.2H_2O$
Calcium carbonate	calcite	$CaCO_3$

GROUP B (LESS WIDESPREAD THAN GROUP A)

Chemical Name	Mineral Name	Formula	Early reference
magnesium sulphate heptahydrate	epsomite	$MgSO_4.7H_2O$	Gibson (1962) and others
magnesium sulphate hexahydrate	hexahydrite	$MgSO_4.6H_2O$	Claridge & Campbell (1968 a,b,c), Tasch & Angino (1968)
sodium nitrate	soda nitre	$NaNO_3$	Gibson (1962) & others
sodium-magnesium sulphate quadrahydrate	bloedite (astrakhanite)	$Na_2Mg(SO_4)_2.4H_2O$	Claridge & Campbell (1968 a,b,c)
sodium sulphate-nitrate hydrate	darapskite	$Na_3(NO_3)(SO_4)H_2O$	Claridge & Campbell (1968 a,b,c)
potassium chloride	sylvite	KCl	Nishiyama & Kurasawa (1975), Kumi et al. (1976)
calcium chloride hexahydrate	antarcticite	$CaCl_2.6H_2O$	Torii & Ossaka (1965)
calcium carbonate	aragonite	$CaCO_3$	Angino et al. (1964 & others)
sodium carbonate hydrate	thermonatrite	$Na_2CO_3.H_2O$	Browne (1973); Nishiyama & Kurasawa (1975)
sodium bicarbonate-carbonate hydrate	trona	$NaH CO_3.Na_2CO_3.H_2O$	Nishiyama & Kurasawa (1975)
mineral containing iodate ion	lautarite? (see text)	$Ca(IO_3)_2$	Johannesson & Gibson (1962), Gibson (1962)

TABLE 1 Cont. GROUP C (OCCURRING IN LOCALISED AREAS, AND SELDOM OR NOT PREVIOUSLY REPORTED)

Chemical Name	Mineral Name	Formula	Early reference
sodium bicarbonate	nahcolite	$NaHCO_3$	Keys (1972)
sodium sulphate - carbonate	burkeite	$Na_6(CO_3)(SO_4)_2$	this work (Tables 7.2,13)
calcium-sodium carbonate pentahydrate	gaylussite	$CaCO_3.Na_2CO_3.5H_2O$	Browne (1973)
magnesium carbonate-sodium carbonate-chloride	northupite	$MgCO_3.Na_2CO_3.NaCl$	Browne (1973)
magnesium carbonate	magnesite	$MgCO_3$	Dow & Neall (1974), Watanuki & Morikawa (1974)
magnesium carbonate trihydrate	nesquehonite	$MgCO_3.3H_2O$	Morikawa et al. (1977)
calcium-magnesium carbonate	dolomite	$CaMg(CO_3)_2$	Morikawa et al., (1975)
calcium carbonate	vaterite	$CaCO_3$	Browne (1973)
calcium carbonate hydrate	monohydrocalcite	$CaCO_3.H_2O$	Nishiyama & Kurasawa (1975)
iron (II) carbonate	siderite	$FeCO_3$	Browne (1974)
iron (II) sulphate heptahydrate	melanterite	$FeSO_4.7H_2O$	this work (Tables 5.6,12)
calcium sulphate+	anhydrite	$CaSO_4$	Grindley et al., (1964), Tasch & Angino (1968)
potassium-calcium sulphate hydrate	syngenite	$K_2SO_4.CaSO_4.H_2O$	Lindholm et al., (1969)
sodium chloride dihydrate	dihydrohalite	$NaCl.2H_2O$	Craig et al., (1974), Hoehn et al., (1974)
magnesium chloride phase	bischofite? tachyhydrite? carnallite?	$MgCl_2.6H_2O$ $CaMg_2Cl_6.12H_2O$ $KCl.MgCl_2.6H_2O$	Kumai et al., (1976)
calcium phosphate	whitlockite?	$Ca_3(PO_4)_2$	Campbell & Claridge (1966)
magnesium hydrogen* phosphate trihydrate	newberyite	$MgHPO_4.3H_2O$	Campbell-Smith in Stewart (1964)
volcanogenic salt minerals e.g.		various	this work (Table 7.6)
potassium aluminium basic hydrated sulphate	alunite	$KAl_3(SO_4)_2(OH)_6$	this work (Table 7.6)

\+ reported from the Queen Maud Mountains, Transantarctic Mountains
* reported from Cape Adare, northern Victoria Land

\+ Addendum These reports were based on misidentification of prehnite which has similar optical properties to anhydrite (Barrett 1969). Anhydrite has subsequently been reported in sediments from DVDP 4 (Lake Vanda) by Cartwright et al., 1974b); the phase may have formed during drilling, since it does not appear to be thermodynamically stable under ambient conditions and has not been reported elsewhere from similar samples in this or other lakes.

TABLE 2 MAIN TYPES OF SALT DEPOSIT (EXTENDED FROM NISHIYAMA AND KURASAWA 1975; NISHIYAMA 1977)

Type of deposit	Type Number	Typical salt phase
encrustation on surface of bedrock, boulder or cobble	1A	calcite
accumulation or encrustation in joint crack or behind flake of bedrock, boulder or cobble	1B	calcite, soluble salts
accumulation in cavity in bedrock or boulder	1C	soluble salts
efflorescence or encrustation on surface of regolith	2A	soluble salts
deaquation deposit in enclosed basin	2B	soluble salts
veneer and encrustation on underside of boulder, cobble or pebble	3	calcite, gypsum
accumulation beneath boulder, cobble or pebble	4	soluble salts
strong salt horizon or nodule in regolith	5	soluble salts

TABLE 3 DISTRIBUTION OF SALT PHASES IN TAYLOR VALLEY

Locality No.	Sample No.	Phases present	Deposit type	Aspect	Rock types associated with deposit	Elevation (m)
1.	LAKE BONNEY AND LOWER TAYLOR GLACIER AREA - Traverse from Burgundy Peak*, Kukri Hills, to L. Bonney					
51	24789	calcite	1A,3	NW	granodiorite dolerite	1800
52	24788	calcite	1A	N	"	1600
53	24790	calcite	1A	NW	"	1400
53	24801	thenardite, gypsum	2A	NW	"	"
54	24791	gypsum	2A	NW	basalt	1300
55	24792	halite, sylvite	2A,4	NW	"	1100
56	24793	gypsum	2A	NE	"	900
57	24794	thenardite, halite sylvite, gypsum	2A	NW	"	700
58	72/209	halite, thenardite	2A	NW	mixed[1]	57
	traverse from base of The Matterhorn, Asgard Range, to L. Bonney					
59	24796	gypsum	1B	SE	granite	1400
59	24802	thenardite	1B	SE	"	"
60	24795	thenardite, mirabilite halite	4	SE	granite, dolerite	1200

TABLE 3 Cont.

61	24797	thenardite, mirabilite	4	SE	granite, dolerite	1100
62	24798	halite, thenardite	4	SE	"	1000
63	24799	halite, minor darapskite	2A,4	SE	granodiorite, dolerite	900
64	24800	thenardite, halite, minor gypsum	2A,1A	SE	mixed[1]	700
65	72/109A	halite, gypsum	2A	S	"	200
65	72/109B	aragonite, minor calcite	broken biscuit	SE	"	"
66	72/106A	halite, thenardite, gypsum	2A	SE	"	70
66	72/106B	aragonite, calcite	broken biscuit	S	"	"
67	72/210	halite	2A	S	"	57
	above Taylor Glacier					
68	72/114	halite, minor thenardite	4	SE	mixed[1]	500
69	72/115	gypsum	2A	SE	basalt	1000
70	76/48A	gypsum	1A,2A	N	"	1100
70	76/48B	calcite	3,1A	N	"	"
71	76/46	thenardite, halite, minor gypsum	2A,1A	NE	"	700
72	24831	darapskite, halite, thenardite, gypsum	1C	NW	"	600
73	76/49	gypsum	1A,2A	NE	granite gneiss	500
74	76/45	calcite	1B	N	metasediments	400
75	76/44	gypsum	4	N	mixed[1]	300
76	72/208	calcite	3	N	granite	600
	terminus of Taylor Glacier					
1-39	(various) see Table 4)	halite, gypsum, calcite, aragonite, thenardite, mirabilite	see Table		mixed[1]	57-120

Footnote

* name approved by N.Z. Geographic Board

1 mixed i.e. several rock types present including dolerite, granite, metasediments, basalt and sandstone

2. PEARSE VALLEY

Traverse from Lake Joyce up side of Friis Hills

83	24832	thenardite, halite, darapskite, bloedite, minor gypsum	5	N	mixed[2]	450
83	72/154B	thenardite, halite, epsomite, darapskite, minor bloedite	5	N	"	"
84	72/157	thenardite, minor gypsum, halite	4,5	N	"	550
85	72/158	gypsum, calcite	3,4	N	"	"
86	72/165A	halite	1B,1C	N	granite	700
87	72/166	halite, minor gypsum	4	NE	"	800
88	72/170	halite, minor soda nitre	4,5	SE	dolerite	900
89	24833	mirabilite, thenardite, gypsum	2A,(2B?)	H, NW	sandstone[3] dolerite	950
89	72/171B	thenardite, gypsum	2A	NW	"	"
90	72/174	thenardite, halite, minor gypsum darapskite	2A,5	NE	dolerite	1000

Floor of Valley

91	72/189	halite	2A,5 (old 2B?)	F	mixed[2]	400
92	72/194	gypsum	4	NW	"	450
93	72/196	thenardite, gypsum, minor halite, epsomite	2A,5	E	"	400
94	various (see Table 8)	halite, gypsum, thenardite, calcite, darapskite, (epsomite[I])	mainly 2B	H	"	450

Bluff at east end of Friis Hills

95	24834	halite, minor gypsum	1B,4	E	granite	700
"	76/24B	gypsum	1A,1B,4	E	"	"

Footnotes

2 mixed i.e. several rock types present including dolerite, granite and sandstone

3 from lower Taylor Group of Beacon Supergroup

I crystallised from wet sand at VUW

3. AZTEC MOUNTAIN AREA

Traverse from floor of alpine valley south of Aztec Mountain to summit of Aztec Mountain

101	24835	mirabilite, thenardite, minor gypsum, epsomite	4	F	dolerite,[4] sandstone[4]	1640
102	73/62	gypsum	1A	S	sandstone[4] dolerite	1650
103	23836	darapskite	4	S	"	1680
103	73/66	gypsum	1B	S	"	"
104	73/68	gypsum	1B	SW	"	1700
105	73/69	darapskite, minor thenardite	4	S	"	1720
106	73/70	soda nitre, gypsum	4	SW	"	1750
107	23837	soda nitre	⊛	SW	"	1770
108	73/74	soda nitre, minor gypsum	4	S	"	1780
109	73/79	darapskite, bloedite, thenardite	4	S	dolerite, sandstone[4,5]	1800
110	73/80	thenardite, gypsum	2A	NE	sandstone[5]	1850
111	73/83	gypsum	1A,1B	NE	"	1900
112	73/84	thenardite, minor gypsum	2A	NE	"	"
113	23838	epsomite, bloedite, thenardite, minor gypsum	4	NE	dolerite	2000

traverse from floor of alpine valley to summit of Inca's Leap*

114	not sampled	calcite	3,1A	NE	dolerite, sandstone[4,5]	1700
115	73/97A	thenardite, minor gypsum	2A	NE	"	1800
116	73/99A	gypsum	3,4	N	dolerite	1850
116	73/99B	calcite	3	N	"	"
117	73/101	gypsum	3,4	NE	dolerite, sandstone[5]	1950
118	73/104	calcite	1A,1B	E	dolerite	2100
119	73/103	epsomite, bloedite, thenardite, minor gypsum	4,5	F	"	2200

divide ridge east of Turnabout Valley

120	73/106	gypsum	3,4	F	dolerite	1800
121	73/PN	calcite	1A,1B	N	"	1850
121	73/PS	minor calcite	1B	S	"	"

Traverse from floor of alpine valley eastwards, down into Beacon Valley

122	73/113A	soda nitre, gypsum	4	F	dolerite, sandstone	1600
123	73/116	soda nitre, gypsum	2A,4	SE	"	1550
124	73/118	thenardite, epsomite, gypsum, mirabilite	4	SE	"	1500
125	73/121	gypsum	4	E	mixed[7]	1460
126	24839	soda nitre, gypsum	2A,4	SE	"	1400

Traverse from Beacon Valley up into alpine valley east of Aztec Mountains

128	73/126	gypsum	5	NW	mixed[7]	1300
128	73/127	gypsum	1A,2A	NE	"	"
129	24840	gypsum, thenardite	2A	SE	"	1400
130	73/MC	calcite	1A	E	dolerite	1600
131	73/133	gypsum	3,4	NE	mixed[7]	1650

Footnotes

4 Beacon Heights Orthoquartzite, and Aztec Siltstone, formations of the upper Taylor Group

5 mainly Weller Coal Measures, of the Victoria Group, Beacon Supergoup

6 various: upper Taylor Group and Victoria Group

7 mixed: i.e. dolerite, sandstone and some granite

(*) 10-20mm inside bedrock of Beacon Heights Orthoquartzite

4. KENNAR VALLEY

Traverse from lobe of Taylor Glacier up east fork and down west fork

132	76/32	thenardite, gypsum minor darapskite	2A	F	dolerite, sandstone[6]	1500
133	76/KV1	gypsum	4	N	"	1600
134	24841	thenardite, minor darapskite, bloedite gypsum	2A,4	NW	"	1650
135	not sampled	calcite	3	NW	dolerite	1800-2000
136	76/KV2	calcite+	1B	NW	"	2000
137	76/34	thenardite, minor gypsum	2A	W	"	2000
138	various (Table 9)	darapskite, mirabilite, gypsum, bloedite, soda nitre, epsomite, halite	2B,4	H	dolerite, sandstone[6]	1600

6 various: upper Taylor Group and Victoria Group

+ hydrothermal calcite

5. LASHLY MOUNTAINS

	Traverse south along main ridge					
139	73/29	gypsum, minor calcite	4	F	sandstone[5]	2400
140	73/36	gypsum, calcite	1B,4	E	"	"
141	73/30	gypsum, calcite	1B	E	"	"
	Section L1					
142	73/40A	thenardite, gypsum	1B	SW	sandstone[5]	2250
143	73/33	gypsum	1B,4	SE	siltstone[7]	2130
144	24842	gypsum[8]	1B	SE	siltstone[8]	2118
145	73/41	gypsum	4	SE	siltstone[9]	2116
	Section L2					
146	73/49A	thenardite, minor gypsum	4	NE	sandstone[5] dolerite	2300
147	73/49B	gypsum	3	N	"	"
148	73/52	epsomite	4	SE	dolerite sandstone[5]	2350
149	24843	epsomite, hexahydrite, bloedite, minor gypsum	4	SE	"	2400
	Summit plateau of Mt Crean					
150	24844	thenardite, minor gypsum	2A	F	dolerite sandstone[10]	2540
150	73/56B	mirabilite, thenardite, minor gypsum	4	F	"	"
151	24845	epsomite, gypsum	4	F	"	"

Footnotes

5 mainly Weller Coal Measures

7 Aztec Siltstone, Unit 10; gypsiferous claystone (Barrett 1971)

8 Aztec Siltstone, Unit 8; in situ Devonian lacustrine gypsum veins, 1 to 3 mm thick, parallel and subparallel to bedding (Barrett 1971)

9 Aztec Siltstone, Unit 7 (Barrett 1971). Elevations of 7,8 and 9 are those measured by Askin and Barrett in Barrett (1971)

10 Victoria Group, probably Feather Conglomerate

TABLE 4. DISTRIBUTION OF CRYSTALLINE SALT PHASES AROUND THE TERMINUS OF TAYLOR GLACIER

Location or description of salt deposit	Locality No.	Sample No.	Phases present
flood "tide mark" of salt on wall of crevasse from which issued the 1972 discharge event	1	24820	gypsum, mirabilite, thenardite, minor halite, calcite
wall of crevasse below tide mark	1	24821	mirabilite, thenardite
surface of 1972 icing, 6m from crevasse	3	24822	aragonite, calcite^{o}
surface of 1972 icing, 1m above lateral mound	4	72/223	calcite, aragonite^{o}
surface of 1972 icing, 10m from glacier	5	72/212	halite, calcite
surface of 1972 icing, 110m from glacier, at furthest edge of icing: light orange coloured material	6	24823	calcite^{o}
darker orange coloured material	6	72/211B	calcite^{o}
salt in botryoidal surface layer 1-3 cm thick, 4m from edge of 1976 icing: underlain by 5cm icing, over lake moat ice	7	24824	halite, gypsum, minor calcite
surface of englacial orange layer in ablation valley	8	72/219	mirabilite, thenardite, gypsum, halite
salt on cobble in ablation valley	9	72/220	thenardite
salt on surface of englacial orange layer, exposed after calving of ice block	10	76/09A	mirabilite, thenardite, halite
euhedral crystals of salt in ice blocks just calved from glacier	10	76/09B	gypsum^{o}
1973 surface of orange coloured ice in basal layer of glacier, immediately below 1972 discharge site, 3m above top of ice-marginal mound	11	73/250	calcite, aragonite halite^{o}
top of marginal mound, 8m NW from locality 11	12	73/252	halite, calcite, gypsum, minor aragonite
foot of marginal mound, beneath glacier discharge site	13	24825	calcite, aragonite, gypsum, minor halite^{o}
flank of marginal mound, 10m SE of locality 13	14	73/254	halite, gypsum, calcite, aragonite^{o}
salt occurring in white bands 0.2 to 0.4m above stream delta opposite glacier discharge site	15	73/255	halite, gypsum
surface salt around lateral discharge site	2	78/02	halite, gypsum
top of marginal mound, 5m NW (up glacier) from edge of 1972 icing	16	72/224	halite, thenardite, calcite
flank of marginal mound, 15m NW from edge of 1972 icing	17	72/229	halite, gypsum, minor thenardite
flank of marginal mound, opposite lateral discharge site	18	24826	thenardite, halite

TABLE 4 Cont.

salt on surface of orange coloured ice, within marginal mound, 60m from glacier discharge site	19	76/17S	gypsum
salt on melt-out till at base of glacier on north side 150m up glacier from glacier discharge site	20	76/14	halite, gypsum, minor thenardite
salt encrusting dirt in basal dirt layers on south (true right) side of glacier, 500m from L. Bonney	34	76/02B	halite, gypsum, minor thenardite
salt on surface of orange coloured ice in basal dirt layers on south side of glacier, 180m from lake	35	24827	halite, gypsum
crystalline salt 'nodules' in southern ice cored moraine ridge at terminus of glacier	36	24828	mirabilite, thenardite
salt on surface of this moraine ridge, 10m from glacier	37	76/67A	thenardite, halite
salt on surface of this moraine ridge, 5m from glacier	38	76/67D	gypsum
salt encrusting pebble at base of ridge, 10m from glacier	39	76/67E	mirabilite, thenardite

o stained by hydrated iron oxides

TABLE 5 DISTRIBUTION OF SALT PHASES IN UPPER FERRAR VALLEY AND SKELTON NÉVÉ

Locality No.	Sample No.	Phases present	Deposit Type	Aspect	Rock types associated with deposit	Eleva- (m)
1.	Table Mountain ice free area					
	Traverse along dolerite ridge on westside, towards the south					
152	not sampled	calcite	3	NE	dolerite	1700
153	74/17	gypsum, bloedite, minor halite, epsomite, thenardite	2A	N	"	1800
154	not sampled	calcite	3	N	"	"
155	"	gypsum	4	N	"	1900
156	74/18B	mirabilite	4	S	"	2000
156	74/18A	thenardite	4	S	"	"
157	not sampled	calcite	3	W	"	2050
158	24868	thenardite	2A	NW	sandstone[1], dolerite	2000
158	24869	mirabilite, minor gypsum	4	NW	"	"

TABLE 5 Cont.

158	24870	thenardite, minor gypsum	4	NW	sandstone[1], dolerite	2000
159	not sampled	calcite	3	N	"	1950
	Traverse across northern and eastern parts of the ice free area					
160	74/22	thenardite, minor gypsum, bloedite, darapskite, mirabilite	4	NW	dolerite, sandstone[2]	1500
161	not sampled	calcite	3	E	"	1600
162	24871	gypsum	1B	S	siltstone[3]	1700
163	74/23B	gypsum	3,4	S	dolerite, sandstone[2]	"

Footnotes

1 mainly New Mountain Sandstone, Taylor Group

2 Taylor Group

3 Terra Cotta Siltstone, lower Taylor Group. Apparently in situ lacustrine gypsum veins, 1-2mm thick, parallel bedding in slatey unit.

2. Knobhead

cirque east of summit

164	74/24A	thenardite, minor darapskite, mirabilite	4	SE	dolerite, sandstone[2]	1700
164	74/24B	mirabilite, thenardite, minor gypsum, darapskite	4	SE	sandstone[2], dolerite	"
	on slope to southeast below summit					
165	24872	darapskite, thenardite	5	S	dolerite	1700
165	not sampled	calcite	3	S	"	"
166	74/26	darapskite, thenardite	5	S	dolerite, sandstone[2]	1600
166	not sampled	calcite	3	S	"	"

Footnotes

2 Taylor Group

3. Big Foot Nunatak*

Traverse up west side to summit ridge

167	73/230	mirabilite, thenardite	4	SW	sandstone[2], dolerite	1400
167	73/233	gypsum	1A	SW	"	"
167	73/232	gypsum	3	SW	"	"
167	73/231	gypsum	4	SW	"	"
167	not sampled	gypsum	5	SW	"	"
167	73/235	mirabilite, thenardite, minor gypsum	4	SW	"	"
167	73/236	thenardite, gypsum	3,4	SW	"	"

TABLE 5 Cont.

Locality No.	Sample No.	Phases present	Deposit Type	Aspect	Rock types associated with deposit	Elevation (m)
168	73/240	thenardite	2A	W	sandstone[2], dolerite	1400
169	73/241	gypsum	3,4	S	dolerite, sandstone[2]	"
170	73/243	thenardite, minor mirabilite, gypsum	4	W	sandstone[2]	1600
171	73/244	gypsum	3,4	W	sandstone[2], dolerite	1600 to 1900
172	73/245	mirabilite, thenardite, bloedite	4	W	dolerite, sandstone[2]	1800

Footnotes

* Name approved by N.Z. Geographic Board

2 Taylor Group

4. Rotunda*

Traverse from summit of butte capping northend, to Rotunda Glacier* to the east

Locality No.	Sample No.	Phases present	Deposit Type	Aspect	Rock types associated with deposit	Elevation (m)
173	73/206	mirabilite, thenardite, minor gypsum	4	F	sandstone[4]	2250
174	73/207	gypsum	4	F	"	"
174	73/211	gypsum	1B	NW	"	"
175	73/223	calcite	1A	NW	"	2100
176	24873	thenardite, halite, bloedite, darapskite, minor gypsum	4	E	dolerite, sandstone[2]	1700
177	DB/01	calcite	3	E	"	1600
178	73/228	calcite, gypsum	1B	NE	dolerite	1400

Footnotes

2 Taylor Group

4 Arena Sandstone, Taylor Group

5. Mt Metschel

Traverse from west end up southwest ridge to summit

Locality No.	Sample No.	Phases present	Deposit Type	Aspect	Rock types associated with deposit	Elevation (m)
179	73/144	calcite	1B	NW	dolerite	1700
180	73/149A	gypsum	4	W	"	1750
181	24874	soda nitre, minor gypsum epsomite	4	W	"	1830
		On east ridge				
182	73/159	gypsum	3,4	NE	dolerite, siltstone[5]	1750

Footnotes

5 mainly Aztec Siltstone, but some Victoria Group present

TABLE 5 Cont.

Locality No.	Sample No.	Phases present	Deposit Type	Aspect	Rock types associated with deposit	Elevation
6.	Alligator Peak area					
	Section A1 area, northwest of Alligator Peak					
183	73/165	calcite	1A,1B	NW-S	siltstone[5]	1850
184	73/167	gypsum	4	NE	"	1860
185	73/170	calcite	1A	N	sandstone[6]	1900
	foot of Alligator Ridge					
186	73/178	gypsum, calcite	1A	N	dolerite	1800
186	73/180	gypsum, thenardite epsomite	1A	N	"	"
	Canine Peak*: traverse up southeast ridge to summit, down north ridge and northwest face					
187	73/186	gypsum	1B,4	F	sandstone[6], dolerite	1900
188	24875	epsomite, soda nitre, minor gypsum, darapskite	4	S	dolerite	1950
189	73/192	calcite	1B	SW	"	2000
190	73/195	gypsum	4	N	"	1900
191	73/203	bloedite, epsomite	4	W	"	"
	magnetite bed near section A_3: illustrated by Barrett (1972)					
192	24876	melanterite	1A	W	magnetite	1850

Footnotes

5 mainly Aztec Siltstone, but some Victoria Group present

6 mainly Weller Coal Measures

TABLE 6 DISTRIBUTION OF SALT PHASES IN WRIGHT VALLEY

1.	Wright Lower Valley					
	traverse from summit of Mt Ulla towards valley floor					
193	24803	gypsum	4	NE	dolerite	1550
194	24804	thenardite, gypsum	2A	N	metasediments and other[1]	1350
195	24805	gypsum, thenardite	4	N	"	1200
196	24806	calcite	1A	N	"	1180
197	24807	gypsum	2A	W	"	1100
198	24808	thenardite	4	NW	"	1050
199	24809	thenardite	4	NW	dolerite and other[2]	1000
200	24810	thenardite, gypsum	4	NW	mixed[3]	900
201	24811	halite, thenardite, darapskite, bloedite	4	NW	mixed[3]	850
	traverse up slopes of Olympus Range opposite Merserve Glacier					
202	72/311	halite, minor thenardite	2A	SE	mixed[3]	300
203	72/314	gypsum	4	SE	metasediments and other[1]	800
204	72/315	halite, soda nitre, gypsum	4	SE	"	850

TABLE 6 Cont.

Locality No.	Sample No.	Phases present	Deposit Type	Aspect	Rock types associated with deposit	Elevation
205	72/316	halite, minor gypsum	4	SE	metasediments and other[1]	900
206	72/317	soda nitre, halite, minor gypsum	4	S	mixed[3]	1100
	valley floor beneath Bull Pass					
207	72/318	halite, minor gypsum	2A	S	mixed[4]	150

Footnotes

1 "other" includes dolerite and some lamprophyre and porphyry

2 "other" includes metasediments, and some lamprophyre and porphyry

3 mixed - metasediments, dolerite, granite

4 mixed - dolerite, granite, sandstone and dyke rocks

2. Mt Odin

Locality No.	Sample No.	Phases present	Deposit Type	Aspect	Rock types associated with deposit	Elevation
	traverse from Lake Vanda up slopes of Mt Odin					
208	72/297A	halite, thenardite	2A,4	NE	mixed[4]	130
208	72/297B	gypsum	4	NE	"	130
209	72/319	thenardite, minor mirabilite	4	N	dolerite and others[5]	500
210	72/320	gypsum	2A	N	"	"
211	72/321A	halite, soda nitre, minor darapskite	2A	N	mainly dolerite	700
211	72/321B	gypsum	2A	N	"	"
212	72/322	thenardite, gypsum	2A	N	"	1000

Footnotes

4 dolerite, granite, sandstone and dyke rocks

5 "other" includes granite, sandstone and dyke rocks

3. Dias and South Fork

Locality No.	Sample No.	Phases present	Deposit Type	Aspect	Rock types associated with deposit	Elevation
	east of Dias and east end of Dias					
213	72/296	halite, minor gypsum	2A	N	mixed[4]	150
214	not sampled	calcite	3	NW	"	"
215	72/298	halite, thenardite	4	F	dolerite	700
	traverse through Don Juan Pond basin from east to west					
216	72/295	gypsum	4	SW	mixed[4]	200
217	not sampled	calcite	3	SW	"	180
218	72/294A	halite	1C	E	granite	119
218	72/294B	halite, gypsum	2B	H	mixed[4]	118
218	72/292	antarcticite	2B	H	"	"
218	72/291	antarcticite	2B	H	"	"
219	72/293B	halite	2A	E	"	130
220	72/288	gypsum	4	E	mixed[6]	400

TABLE 6 Cont.

Locality No.	Sample No.	Phases present	Deposit Type	Aspect	Rock types associated with deposit	Elevation

Footnotes

5 dolerite, granite, sandstone and dyke rocks

6 granite, dolerite, sandstone

Locality No.	Sample No.	Phases present	Deposit Type	Aspect	Rock types associated with deposit	Elevation
4.	Labyrinth and Wright Upper Glacier area					
	traverse through western and northwest parts of Labyrinth					
221	72/252	gypsum	1B	N	dolerite	900
222	72/249	thenardite, gypsum	4	F	"	"
223	see Table 10	epsomite, halite, gypsum, minor soda nitre, darapskite, thenardite	mainly 2B	H	"	860
224	72/255	thenardite, halite, darapskite	4	H	mixed[6]	850
225	72/256	gypsum, trace halite	2B	H	"	"
226	72/257	gypsum	2A	N	dolerite	870
227	72/258	calcite	1A	E	sandstone[7]	"
228	72/262	gypsum	4	H	dolerite, sandstone[7]	850
229	not sampled	calcite	3	NE	dolerite	"
230	see Table 11	halite, soda nitre, mirabilite, darapskite, bloedite, thenardite, gypsum	mainly 2B	H	dolerite, sandstone[7]	"
	traverse through southern portion of Labyrinth					
231	72/279	gypsum	4	W	dolerite	850
232	72/278	halite, soda nitre, minor gypsum	2A	H	dolerite, sandstone[7]	800
233	not sampled	calcite	3	E	dolerite	850
234	72/286	halite, bloedite, soda nitre, gypsum	2B	H	"	800
235	not sampled	calcite	3	E	"	850
236	72/287A	thenardite, halite	2A	NW	dolerite, sandstone[7]	"
236	72/287B	mirabilite, thenardite	4	NW	"	"
	traverse up and into Tyrol Valley					
237	72/275	gypsum	4	N	dolerite, sandstone[7]	1100
238	72/273A	soda nitre, darapskite, bloedite, minor gypsum	4	N	"	1200
238	72/273B	mirabilite, thenardite	4	N	"	"
239	72/274	soda nitre, darapskite	4	N	sandstone[7], dolerite	1300

TABLE 6 Cont.

slope of Olympus Range, north of terminus of Wright Upper Glacier

Locality No.	Sample No.	Phases present	Deposit Type	Aspect	Rock types associated with deposit	Elevation
240	72/284	thenardite	4	S	dolerite, sandstone[7]	1000
241	72/283	soda nitre, epsomite, bloedite, darapskite, minor gypsum	4	S	sandstone[7], dolerite	1100
242	72/280	soda nitre, halite, gypsum	4	S	dolerite, sandstone[7]	1200
243	not sampled	calcite, gypsum	3,4	S	"	1250

Footnotes:

6 granite, dolerite, sandstone

7 Taylor and Victoria Groups

5. Mt Fleming

traverse from cirque basin northeast of summit, to main ridge and southwest towards summit

Locality No.	Sample No.	Phases present	Deposit Type	Aspect	Rock types associated with deposit	Elevation
244	73/15	epsomite, minor gypsum, bloedite	4	NE	dolerite, sandstone[8]	1850
245	73/16	mirabilite, thenardite, bloedite, minor gypsum	4	SE	"	"
246	73/17	gypsum	4	N	sandstone[8]	1950
246	not sampled	calcite	3	N	"[8], dolerite	"
247	73/18A	soda nitre, minor gypsum	4	N	dolerite, sandstone[8]	2000
247	73/18B	mirabilite, thenardite, darapskite	4	N	sandstone[8], dolerite	"
248	73/19A	gypsum	4	N	sandstone[8]	2050
249	73/20	darapskite, mirabilite, thenardite, bloedite, minor gypsum	4	SE	dolerite	2100
250	73/21	mirabilite, thenardite, minor gypsum	4	N	sandstone[9]	"
251	73/22	gypsum	1B	S	coal beds[9]	"

Footnotes

8 mainly Aztec Siltstone, but some Victoria Group

9 Weller Coal Measures

6. Shapeless Mountain

traverse over ridge of dolerite north of summit and down section S9

Locality No.	Sample No.	Phases present	Deposit Type	Aspect	Rock types associated with deposit	Elevation
252	KB/11	epsomite, minor gypsum thenardite	4	NW	dolerite	2400
253	73/04	mirabilite, thenardite, minor gypsum	4	W	"	2500
254	73/05	mirabilite, thenardite	4	W	"	2550
255	73/07	gypsum	4	E	sandstone[10]	2500
256	73/09	thenardite, gypsum	4	NE	sandstone[11]	2300
257	not sampled	calcite	3	NE	sandstone[11], dolerite	"

TABLE 6 Cont.

Locality No.	Sample No.	Phases present	Deposit Type	Aspect	Rock types associated with deposit	Elevation
258	73/10A	epsomite, bloedite	4	NE	sandstone[11], dolerite	2200
258	73/10B	gypsum.	4	NE	"	"
259	73/11	gypsum, epsomite	4,2A	S	"	"
260	73/12	bloedite, hexahydrite, minor epsomite	4	SE	dolerite, sandstone[11]	2150
ridge system west of summit						
261	73/24	minor epsomite, hexahydrite	4,1B	N	sandstone[12], dolerite	2500
262	73/25	gypsum	4	SW	sandstone[12]	2600
263	KB/17A	epsomite, gypsum	4	NW	Mawson[13], dolerite	2700
263	KB/17B	gypsum, calcite	4,3	NW	"	"

Footnotes

10 Feather Conglomerate

11 Victoria Group, mainly Weller Coal Measures

12 Lashly Formation, upper Victoria Group

13 Mawson Formation, Ferrar Group

TABLE 7 DISTRIBUTION OF SALT PHASES IN McMURDO SOUND AREA, AND INCLUDING MT KEMPE, ROYAL SOCIETY RANGE

1. Mt Kempe

traverse up northface, and northwest ridge to summit of Mt Kempe

272	74/01	gypsum	4	N	mixed[1]	2500
273	74/02	thenardite	4	N	"	2550
274	74/03	gypsum	1B,1A	N	metasediments	2600
275	74/15A	epsomite, bloedite, minor gypsum	4	N	mixed[1]	2700
276	not sampled	gypsum	1B	NW	siltstone[2]	2800
277	not sampled	gypsum	1B	NW	dolerite	2850
278	74/MK	calcite[+]	1B	SW	"	2900
southside of Kempe Glacier adjacent to marble bluff						
279	74/12	calcite	1A,3	N	mixed[3]	2500
280	not sampled	gypsum	1A,1B	N	marble	2550
281	not sampled	calcite	1A,3	N	metasediments	2600
Dismal Ridge						
282	74/06	gypsum, minor calcite	1B,1A	N	metasediments	2500

Footnotes

1 metasediments (Skelton Group), dolerite, sandstone (lower Taylor Group)

2 Terra Cotta Siltstone

TABLE 7 Cont.

Footnotes

3 metasediments, dolerite, sandstone, alkali basalt cinders

+ hydrothermal calcite

Locality No.	Sample No.	Phases present	Deposit Type	Aspect	Rock types associated with deposit	Elevation
2.	Mts Discovery and Morning area					
	summit of Mt Morning					
283	24812	thenardite, minor gypsum	4	W	basalt	2720
	Depot Cone**					
284	76/74	gypsum	2A	S	basalt	1000
285	24813	epsomite, minor gypsum, hexahydrite, bloedite	2A	S	"	"
286	not sampled	gypsum	2A	W	"	"
287	76/76	gypsum	2A	F	"	"
288	not sampled	gypsum	2A	NE	"	"
289	76/77	gypsum	1A	NE	"	"
290	76/78	thenardite	2A	E	"	980
291	not sampled	gypsum	2A	SE	"	1000
	summit of Mt Discovery					
292	76/MD	calcite	1A	N	basalt	2670
	summit of Top Cone**					
293	76/80A	gypsum, thenardite,minor halite	4	F	basalt	2000
	Castle Cone**					
294	not sampled	gypsum	2A	S	basalt	1000
295	not sampled	calcite	3	N	"	"
296	76/81	thenardite	4	E	"	"
	Stadium Cone**, southeast portion of crater rim					
297	not sampled	gypsum	2A	NE	basalt	750
298	not sampled	gypsum	4	NE	"	"
299	24814	trona, burkeite,thenardite thermonatrite, trace halite	4	W	"	"
299	24815	thenardite, trona, possibly trace nahcolite	4	W	"	"
300	76/SC	gypsum	4	W	"	"
	Bottom Cone**					
301	not sampled	gypsum	4	S	basalt	180
302	76/83	thenardite, bloedite, minor hexahydrite, epsomite	4	F	"	180
303	not sampled	calcite	3	F	"	180

TABLE 7 Cont.

Locality No.	Sample No.	Phases present	Deposit Type	Aspect	Rock types associated with deposit	Elevation
304	not sampled	gypsum	4	E	basalt	170
305	76/84	mirabilite, thenardite	4,5	NW	"	180

Footnotes

** unofficial name

3. Black Island

traverse from Ice Lake over Mt Melania

Locality No.	Sample No.	Phases present	Deposit Type	Aspect	Rock types associated with deposit	Elevation
306	74/30	mirabilite, thenardite	2A,4	SW	olivine-augite basalt[4]	250
307	74/VUW	mirabilite, thenardite, halite	4[6]	F	mixed alkali basalt[5]	150
308	74/31	halite	2A[7]	W	"	"
309	74/32	mirabilite, thenardite	2A[8]	360°	"	100
Centre of Island						
310	74/33A	mirabilite, minor thenardite	4	SE	trachyte	600
311	74/33B	thenardite, minor mirabilite	2A	N	"	"
312	not sampled	calcite	3	NW	"	550

Footnotes

4 after Cole and Ewart (1968)

5 glacial drift

6 under boulders used for anchoring tent of VUWAE9 Oct-Nov 1964

7 surface of recent mudflow

8 ice cored mound of glacial drift, on western shore of Ice Lake

4. White Island

traverse from Cape Spencer-Smith to summit of Mt Heine

Locality No.	Sample No.	Phases present	Deposit Type	Aspect	Rock types associated with deposit	Elevation
313	78/05	thenardite	2A	NW	basalt	400
314	78/06	mirabilite, thenardite	4	SE	"	550
315	not sampled	calcite	3	NW	"	650
316	not sampled	gypsum	2A	NW	"	760

5. Cape Bird, Ross Island

Cinder Hill area

Locality No.	Sample No.	Phases present	Deposit Type	Aspect	Rock types associated with deposit	Elevation
317	72/324A	mirabilite, thenardite	2A	F	olivine, basalt[9]	305
318	72/324B	thenardite, halite	2A	NE	"	"
319	72/328A	halite, minor gypsum	2A	SW	"	280
320	72/328B	halite, thenardite, bloedite	2A	SW	"	"

TABLE 7 Cont.

Locality No.	Sample No.	Phases present	Deposit Type	Aspect	Rock types associated with deposit	Elevation
		traverse over Trachyte Hill to top of Harrison Bluff				
321	72/329	thenardite, halite	2A	SE	hornblende trachyte[9]	430
322	72/330	halite, thenardite	2A	W	"	460
323	24816	halite, thenardite, bloedite, gypsum	2A	F	"	30
		moraines above Cape Bird Station				
324	72/336	mirabilite, thenardite	2A	E	mixed alkali basalt[10]	60
325	72/346	halite, thenardite	2A	NE	"	100
		traverse from McDonald Beach towards Inclusion Hill				
326	72/344	halite	2A	F	mixed alkali basalt[10]	2
327	72/343	halite, minor mirabilite, thenardite	4	W	"	30
328	72/342	halite	2A	N	hornblende-pyroxene trachyte[9]	300

Footnotes

9 after Cole and Ewart (1968)

10 glacial drift or beach deposits

6. Mt Erebus, Ross Island

		Main Crater rim, Side Crater and slopes of active cone				
336	72E/15	halite	4	NW	anothoclase phonolite	3740
337	72E/07	calcite[+]	1B	SE	"	"
338	24877	calcite	5	W	"	3660
339	72E/02	halite	2A	W	"	3670
340	24878	halite, gypsum, sylvite	4	W	"	3680
341	24879	complex mixture including halite, minor gypsum	2A	NW	"	3700
342	24880[I]	halite plus unidentified phases	1B,4	SE	"	"
		inside camp cave				
343	74E/04	mirabilite	1A[x]	-	anorthoclase phonolite	3620
344	74E/10	gypsum	1A[x]	-	"	"
		summit plateau				
345	24881	gypsum, minor other	4	NW	anorthoclase phonolite	3450
345	24882	halite, minor other	4	NW	"	"
345	24883	complex mixture	4	NW	"	"
346	24884[I]	complex mixtures including some alunite, also halite gypsum, thenardite	4,2A	NW and other	"	3200 to 3500
347-371	not all sampled					

TABLE 7 Cont.

Locality No.	Sample No.	Phases present	Deposit Type	Aspect	Rock types associated with deposit	Elevation
		outer slopes of volcano opposite Fang Peak and on Fang Ridge				
375	74E/01	mirabilite, thenardite	4,2A	NE	anorthoclase phonolite	2800
376	74E/02	complex mixture	4	NE	"	"
377	74E/03	" "	4	N	trachyte	"
		Hoopers Shoulder				
378	24888	mirabilite, thenardite	4	W	anorthoclase phonolite	1800

Footnotes

+ hydrothermal calcite

I see tables 23-25 for further analyses of these samples

x rock face in cave

Tentatively identified phases in the mixtures include chloraluminate, alunogen, jarosite, malladrite, alphohalite, and aluminium trifluoride.

TABLE 8 CRYSTALLINE SALT PHASES IN MAE WEST POND** AREA, PEARSE VALLEY (LOCALITY NO. 94)

Location or description of salt deposit	Sample No.	Phases present
salt beneath cobble above highest discernable fossil water level	72/177	halite
highest salt level: laterally persistent horizontal band ca 0.1m wide and 5mm thick	24846	gypsum
salt encrusting dried algae	24847	gypsum, minor halite
intense white band of salt bordering central salt area	24848	halite, thenardite, minor gypsum, calcite, darapskite
surface of central salt area: blocks of salt 20mm thick with botryoidal surface, and sand and gravel included	24849	halite, minor calcite, gypsum
beneath central salt area: salt crystallised from sand taken from below saline water table	72/198A	halite, minor epsomite
salt in bottom of higher arm of depression, 30m SE of central salt area	24850	gypsum, minor halite

** unofficial name

TABLE 9 CRYSTALLINE SALT PHASES IN SALT COVERED DEPRESSION IN WEST FORK OF MAIN KENNAR VALLEY SYSTEM (LOCALITY NO.138)

Location or description of salt deposit	Sample No.	Phases present
surface of depression: white salt in layer up to 20mm thick, with botryoidal surface	76/35A	darapskite, bloedite, soda nitre, epsomite, halite, trace gypsum
translucent salt in layer up to 8mm thick underlying sample 76/35A and overlying damp coarse sand	76/35B	mirabilite, trace halite, gypsum, bloedite, epsomite
twinned crystals up to 5mm long beneath surface boulders and cobbles in the depression	76/35C	gypsum

TABLE 10 CRYSTALLINE SALT PHASES IN A 4 METRE WIDE SALT COVERED DEPRESSION CA 100M FROM TERMINUS OF WRIGHT UPPER GLACIER; LOCALITY NO.223

narrow salt fringe around main deposit	72/254B	gypsum, minor darapskite, halite, thenardite
central salt area, botryoidal surface	72/254A	epsomite, halite, minor gypsum, soda nitre

TABLE 11 CRYSTALLINE SALT PHASES IN A 15M WIDE SALT COVERED DEPRESSION ON NORTH SIDE OF LABYRINTH, CA 1.5KM FROM TERMINUS OF WRIGHT UPPER GLACIER; LOCALITY NO. 230

fringe of efflorescent salt around central salt area; 3 distinct zones		
(1) outer zone	72/270A	gypsum, halite, darapskite, bloedite, thenardite
(2) middle zone	72/270B	halite, darapskite, bloedite, thenardite
(3) inner zone	72/270C	halite, bloedite, gypsum, soda nitre
central salt area; 2 distinct zones		
(1) outer zone, 2-4m wide with strongly botryoidal surface	72/270D	halite, soda nitre, bloedite, gypsum
(2) inner zone, 2m wide, of translucent salt	72/270E	mirabilite

TABLE 12 IDENTIFICATION OF MELANTERITE BY INTERPRETATION OF X-RAY DIFFRACTION PATTERN (n.a. = REFLECTION PEAK NOT ASSIGNED)

VUW Sample No.24876		Melanterite; ASTM Card No.1-255	
d spacing (Å)	relative peak intensity	d spacing (Å)	relative peak intensity
-	-	8.0	2
6.7	5	6.8	5
-	-	6.0	2
5.47	15	5.5	13
4.88	100	4.90	100
4.54	12	4.55	8
4.01	14	4.02	8
3.75	47	3.78	64
3.24	40	3.23	20
3.20	15 n.a.	-	-
3.11	14	3.09	6
3.05	5 n.a.	-	-
3.00	9 n.a.	-	-
2.92	8	2.92	3
2.79	14 n.a.	-	-
2.75	12	2.75	11
2.72	18 n.a.	-	-
2.64	18	2.63	16
2.62	15 n.a.	-	-
2.48	10	2.50	3
2.43	9	2.42	2
2.309	11	2.31	10
2.176	7	2.17	2
2.117	2	2.11	2
2.076	11	2.07	5
2.059	5 n.a.	-	-
2.010	15	2.01	8
1.960	22	1.96	8
1.922	5	1.92	2
1.880	10 }		
1.861	17 }	1.87	8
1.812	5	1.81	2
1.754	10	1.75	5
1.701	5 }		
1.689	8 }	1.70	5
1.627	7	1.63	5
1.600	5 n.a.	-	-
1.555	13	1.56	3
1.530	7 }		
1.526	8 }	1.53	3
1.502	4 }		
1.497	4 }	1.50	3
1.467	1	1.47	2

TABLE 13 IDENTIFICATION OF BURKEITE BY INTERPRETATION OF X-RAY DIFFRACTION PATTERN (sh, SHOULDER ON PEAK; br, BROAD PEAK; na, UNASSIGNED PEAK WHICH DOES NOT DISAPPEAR AFTER OVEN DRYING; * HALITE PEAK POSITION)

burkeite; ASTM card no. 2-840		thenardite; ASTM card no. 5-631		WUW sample no. 24814		trona; ASTM card no. 11-643		thermonatrite; ASTM card no. 8-448	
d	I/I_1	d	I/I_1	d spacing (Å)	relative peak intensity I/I_1 (percent)	d	I/I_1	d	I/I_1
-	-	-	-	9.7	31	9.88	60	-	-
-	-	-	-	5.34	4	-	-	5.35	20
-	-	-	-	5.23	6	-	-	5.24	22
				4.93)	7				
-	-	-	-	4.89)	30	4.92	40	-	-
-	-	-	-	4.71 sh	1	-	-	4.72	2
-	-	4.66	73	4.65	14	-	-	-	-
-	-	-	-	4.50 na	7	-	-	-	-
-	-	-	-	4.14 br	4	4.12	5	4.12	9
-	-	-	-	3.98	8	4.00	20	-	-
3.88	70	3.84	18	3.85 br	15	-	-	-	-
3.78	80	-	-	3.79	32	-	-	-	-
3.51	70	-	-	3.52	28	-	-	-	-
-	-	-	-	3.44	11	3.43	20	-	-
-	-	-	-	3.26 br *	4	-	-	3.24	3
-	-	-	-	3.20	13	3.21	60	-	-
-	-	3.18	51	3.17	5	-	-	-	-
-	-	3.08	47	3.07	67	3.08	80	-	-
-	-	-	-	2.82 sh,na,*	3	-	-	-	-
-	-	-	-	2.794 sh	6	2.79	5	-	-
-	-	2.783	100	2.788	33	-	-	-	-
				2.782)	36				
2.78	100	-	-	2.776)	31	-	-	-	-
-	-	-	-	2.76(6) br	37	2.76	30	2.768	100
-	-	-	-	2.754 sh	14	-	-	2.753	61
2.64 br	100	2.659	100	2.64	70	2.646	48	{2.684 2.678 2.667 2.622	50 53 8 8
2.577	50	2.587	20	2.58	80	-	-	-	-
obscured	-	-	-	-	-	-	-	2.550	2
2.510	9	2.510	30	-	-	-	-	-	-
2.475	7	2.485	5	-	-	-	-	2.475	30
2.442	19	2.447	60	-	-	-	-	2.448	22
2.418	8	2.426	20	-	-	-	-	-	-
2.380 sh	2	-	-	-	-	-	-	2.386	10
2.371	13	-	-	-	-	-	-	2.372	62
obscured	-	-	-	-	-	-	-	2.356	<1

TABLE 13 Cont.

burkeite; ASTM card no. 2-840		thenardite; ASTM card no.		VUW sample no. 24814 5-631		trona; ASTM card no. 11-643		thermonatrite; ASTM card no. 8-448	
d	I/I_1	d	I/I_1	d spacing (A)	relative peak intensity (percent) I/I_1	d	I/I_1	d	I/I_1
2.326	4	-	-	-	-	2.329	21	-	-
2.301 na	7	-	-	-	-	-	-	-	-
2.253	28	2.259	40	-	-	-	-	-	-
2.243 sh	8	-	-	-	-	-	-	2.238	20
2.206	2	-	-	-	-	2.211	5	-	-
2.182	4	2.186	5	-	-	-	-	2.181	15
2.140 br	9	{2.149	20	2.13	30	-	-	-	-
		{2.119	20						
2.101	3	-	-	2.10	30	-	-	2.114	<1
2.053	8	2.060	20	-	-	-	-	2.065	17
2.037	14	2.040	40	-	-	-	-	2.036	1
2.027	19	2.032	40	-	-	-	-	-	-
2.008	6	-	-	-	-	-	-	2.010	26
2.004 sh	3	-	-	-	-	-	-	2.004	20
1.992 *	7	1.996	30	-	-	-	-	1.985	4
1.973	6	-	-	1.97	10	-	-	-	-
1.960 br	6	1.965	30	-	-	-	-	1.961	3
1.925 br	12	-	-	1.93	40	1.919	4	1.920	7
1.895 br	12	-	-	1.89	40	1.891	4	{1.905	3
								{1.898	4
1.884	7	1.886	20	-	-	-	-	-	-
obscured	-	(plus 30	-	-	-	-	-	1.875	3
1.863 br	3	peaks not		-	-	1.864	31	1.869	2
1.846	1	listed)		-	-	1.841	6	-	-
1.799	1			-	-	1.798	4	-	-
1.778	7	trona peak?		-	-	-	-	1.787	7
1.773 sh	2			-		-	-	1.770	5
1.759 br	3			1.75	30	-	-	1.750	4
1.740	7	trona peak?		-	-	-	-	1.741	7
1.736	7	trona peak?		-	-	-	-	-	-
1.716 br	4	trona peak?		-	-	-	-	{1.726	2
								{1.722	1
obscured	-			-	-	-	-	1.693	3
1.678	5			-	-	1.680	12	1.680	6

TABLE 13 Cont.

burkeite; ASTM card no. 2-840		thenardite; ASTM card no.		VUW sample no. 24814 5-631		trona; ASTM card no. 11-643		thermonatrite; ASTM card no. 8-448	
d	I/I_1	d	I/I_1	d spacing (A)	relative peak intensity I/I_1 (percent)	d	I/I_1	d	I/I_1
1.659	10	trona peak?		-	-	1.662	8	(plus 5 peaks to 1.608, not listed)	
1.619	1			1.62	5	-	-		
1.610	3			-	-	1.605	5		
1.594	12	trona peak?		-	-	-	-		
1.585 sh	3			-	-	1.589	3		
1.552	4			-	-	1.553	10		
1.544	1	trona peak?		-	-	-	-		
1.535	1			-	-	1.537	<1		
1.517	1			-	-	1.512	2		
1.508 br	1			1.50	10	1.497	5		
1.465	4			1.46	10	1.465	<1		

TABLE 14 RECONNAISSANCE ANALYSES OF MAJOR CATIONS IN SAMPLES FROM (1) ICING PRODUCED BY 1976 SALINE DISCHARGE FROM TAYLOR GLACIER DISCHARGE SITES, (2) SALINE SPRING OF NOVEMBER, 1976 (3) IRON-STAINED ENGLACIAL AND SUBGLACIAL LAYERS AND CLEAN GLACIAL ICE FROM TAYLOR GLACIER, (4) MELTWATER FROM TAYLOR AND RHONE GLACIERS (5) SALINE GROUND WATER FROM BENEATH SALT CRUST IN MAE WEST POND, PEARSE VALLEY. CONCENTRATIONS IN $g.m^{-3}$ ($mg.l^{-1}$) OF MELTED SAMPLE

Sample description	Locality No.	Sample No.	Na^+	K^+	Mg^{2+}	Ca^{2+}
1. 1976 icing						
light orange coloured "snowy" ice from 0-7cm	21	76/05A	7700	130	1100	1300
orange coloured hard ice from 7-14cm underlain by moat ice of L. Bonney	21	76/05B	8500	150	1200	2500
surface "snowy" ice, lighter coloured than sample 76/05A	22	76/07	6500	90	860	390
vertical to subvertical plate crystals of salty ice occupying void of breached, low profile, icing blister	23	76/06	5600	210	1500	790
2cm thick layer of white salt and ice in channel 13-15cm wide, in stream delta, overlain by lake moat ice and multi-layered icing blister	24	76/08	83000	740	8800	2900
orange coloured "snowy" ice on surface of icing blister at lateral discharge site	2	76/10	7100	220	1600	1200
orange coloured ice of 1976 discharge event infilling crevasse on glacier, then exposed after calving of ice block	25	76/12	5200	90	900	620
2. saline spring (liquid samples)						
salty water upwelling from 8 main "subsprings" in 6 x 1m area at lateral discharge site, 22/11/76: subspring 8	2	76/53A	34000	780	9400	2900
subspring 5	2	76/53B	30000	620	8100	2600
Sample from spring taken one week later on 29/11/76; sub-spring 15	2	76/72	30000	630	8400	2700
3. englacial and subglacial samples						
dark orange coloured englacial layer containing gypsum crystals; sampled just after calving from glacier	10	76/11	140	1.3	8.8	600
13cm thick orange coloured layer from basal dirt layer on south side of glacier, 180m from lake	35	76/03I	2000	20	560	520
orange coloured subglacial ice within marginal mound, 60m from glacier discharge site	19	76/17I	80	2.9	64	790

TABLE 14 Cont.

Sample description	Locality No.	Sample No.	Na^+	K^+	Mg^{2+}	Ca^{2+}
clean glacial ice from opposite southern ice cored moraine ridge at glacier terminus	33	76/66	3	0.04	0.6	3
clean glacial ice from 15m below surface of Taylor Glacier at drill hole no.3, opposite Pandora Spire, 40km up from snout	47	76/30	10	0.3	1.0	18
tephra-debris layer in ice from Ferrar Glacier, west of Kukri Hills	44	76/42	30	2.1	6.9	11
4. melt waters (liquid samples)						
dripping icicle on glacier below glacier discharge site, November 1976	4	76/54	1600	16	590	410
water in main crevasse at glacier discharge site, November 1972	1	72/214A	80	3.0	3.5	1
water flowing off glacier, 6m from main crevasse, November, 1972	3	72/214B	220	5.0	7.3	20
melt stream from east side of Rhone Glacier, November, 1976	32	76/62	20	1.2	8.4	12
5. saline ground water, Mae West Pond						
saline ground water from beneath salt crust in centre of salt covered depression. Water table 6cm below surface	94	72/200	60000	2400	5500	840

TABLE 15 COMPOSITION OF SALINE DISCHARGE BRINES FROM SALINE SPRING (LOCALITY NO.2) AND GLACIER DISCHARGE SITE (LOCALITY NO.1), AT TERMINUS OF TAYLOR GLACIER. Concentrations in kg m^{-3} (g l^{-1}) or moles kg^{-1} (*). (nd = not determined).

Ion	Analytical precision (approx %)	Sample					
		76/53A[1]	76/53B[1]	76/72	76/72*	78/01[2]	sea water[3]
Na^+	5	32.1	28.0	27.5	1.11	25.8	10.825
K^+	5	0.730	0.605	0.595	0.0141	0.74	0.390
Mg^{2+}	5	4.2	3.5	3.8	0.14	3.0	1.304
Ca^{2+}	10	2.4	2.1	2.2	0.050	2.2	0.410
Cl^-	1	59.2	51.5	49.8	1.30	45.1	19.455
SO_4^{2-}	5	nd	nd	4.98	0.0480	4.44	2.714
HCO_3^-	10	3.5	2.9	3.3	0.050	nd	0.144
δD (4)	0.6	-311ppt	-308ppt	nd	-	nd	0
$\delta^{18}O$ (4)	0.5	-39.2ppt	-38.7ppt	nd	-	nd	0

* Cations and anions agree within 4% (ie within analytical error) in electroneutrality equation; total ionic strength = 1.72 $\pm$ 0.08

1 Nitrate in stream from spring, was 0.25 g.l^{-1} as determined using specific ion electrode

2 Cation concentrations based on analyses by N.H. Holden (Chemical Services Laboratories Ltd, Wellington)

3 Calculated from Sverdrup et al., (1942)

4 Stable isotope analyses by G.L. Lyon (Institute of Nuclear Sciences, DSIR); $\delta^{18}O$ analysis corrected for Mg^{2+}, Ca^{2+} and K^+ content by method of Sofer and Gat (1972)

TABLE 16 BULK PROPERTIES OF SALINE SPRING AND GLACIER DISCHARGE BRINES (parentheses indicate that precipitation had occurred)

Property	Sample				
	76/53A[1]	76/53B[1]	76/72[1]	78/01[2]	sea water[3]
In situ temperature (± 0.3°C)	-7.5	-5.3	-5.1	-5.5	-
Freezing point depression (± 0.2°C)	(-7.9)	(-5.6)	nd	-5.5	-1.9
Specific conductance at 25°C ($mmhos.cm^{-1}$, ± 1%)	127	115	112	99	53
Density at 20°C ($Mg\ m^{-3}$, $kg\ l^{-1}$)	(1.1)	(1.078)	(1.08)	(1.069)	1.025

1 *In situ* pH 6 measured using Whatman BDH pH papers

2 pH 6.2 ± 0.2 measured using Beckman Zeromatic II pH meter at +23°C, 24 hours after sampling

3 Sverdrup *et al.*, (1942)

TABLE 17 SPECIFIC CONDUCTANCE CHLORIDE CONCENTRATION AND FREEZING POINT DEPRESSION OF MELTED SAMPLES FROM 1976 ICING FROM SALINE DISCHARGE (nd NOT DETERMINED)

Locality No.	Sample No.	Specific conductance[1] at 25°C ($m.mho.cm^{-1}$)	Chloride concentration[1] ($kg.m^{-3}$)	Freezing Point depression[2] (°C)
21	76/05A	53.9	16.0	-2.5
21	76/05B	57.9	17.7	-2.7
22	76/07	36.4	7.39	-1.5
23	76/06	nd	14.5	nd
24	76/08	(38.2)[3]	145	nd
2	76/10	54.4	16.7	nd
25	76/12	31.6	6.82	nd

1 analytical precision ± 1%

2 These values are up to 0.2°C too high owing to precipitation before measurement; analytical precision ± 0.2°C

3 Specific conductance for sample 76/08 diluted 10 times.

TABLE 18 SPECIFIC CONDUCTANCE, CHLORIDE CONCENTRATION AND FREEZING POINT DEPRESSION OF MELTED SAMPLES OF IRON-STAINED AND CLEAN GLACIAL ICE FROM TAYLOR GLACIER (nd = NOT DETERMINED) (UD = UNDETECTABLE)

Locality No.	Sample No.	Specific conductance ($m.mho.cm^{-1}$)	Chloride concentration ($kg.m^{-3}$)	Freezing Point depression (°C)
orange coloured englacial layers in ablation valley near glacier discharge site				
10	76/11	1.85	0.053	0.0
26	76/13	1.47	0.076	nd
27	77/02C	4.81	0.071	nd
27	77/02D	3.48	0.264	ca-0.1
28	77/03D	1.36	0.128	nd
orange colouredd layer from basal dirt layers on south side of glacier				
35	76/03I	15.6	1.76	-0.5
orange coloured subglacial ice within marginal mound, 60m from glacier discharge site				
19	76/17I	1.77	0.010	0.0
clean glacial ice				
33	76/66	0.0127	UD	0.00
47	76/30	0.0208	UD	0.00

TABLE 19 SPECIFIC CONDUCTANCE AND CHLORIDE CONCENTRATION OF MELTWATER FROM TAYLOR AND RHONE GLACIERS, LAKE BONNEY WATER AND SALINE GROUND WATER FROM MAE WEST POND

Location and description	Locality	Sample	Specific conductance ($m.mho.cm^{-1}$)	Chloride concentration ($kg.m^{-3}$)
meltwater from vicinity of glacier discharge site				
from melt stream on marginal mound below glacier discharge site, sampled 22/12/73	5	73/256	8.62	2.15
dripping icicle on glacier below glacier discharge site, 22/11/76	4	76/54	nd	1.72
runnoff from ablation valley, sampled below glacier discharge site 30/11/77	3	77/04	2.62	0.146
runnoff from glacier, 6m from main crevasse 28/11/72	3	72/214B	nd	0.136
meltwater in main crevasse at glacier discharge site 28/11/72	1	72/214A	nd	0.047
melt flowing over ice at glacier discharge site, 30/11/77	1	77/05	1.64	0.097
meltwater from Taylor and Rhone Glaciers, dammed by ice block fall and supplying fresh water spring which was issuing 150m west (up glacier) from lateral discharge site				
sampled by P.H. Robinson 2/1/78	30	77/01	0.758	<0.002

TABLE 19 Cont.

Location and description	Locality	Sample	Specific conductance $(m.mho.cm^{-1})$	Chloride concentration $(kg.m^{-3})$
meltwater from Rhone Glacier				
melt stream from east side of Rhone Glacier sampled 10m above stream delta adjacent to Taylor Glacier discharge site, 22/12/73	31	73/257	0.195	<0.002
same melt stream sampled beside Rhone Glacier, 25/11/76	32	76/62	0.179	0.028
water from west lobe of Lake Bonney				
lake water welling up through a hole in the moat ice below a pressure ridge in front of Taylor Glacier, sampled 22/11/76	29	76/52	2.36	0.596
saline ground water, Mae West Pond				
saline ground water from beneath salt crust in centre of salt covered depression	94	72/200	167	91.7

TABLE 20 SPECIFIC CONDUCTANCE AND CHLORIDE CONCENTRATION OF MELTED SAMPLES OF BASAL AND ENGLACIAL DIRT LAYERS FROM TAYLOR GLACIER UP GLACIER FROM TERMINUS. CLEAN ICE SAMPLE INCLUDED FOR COMPARISON (UD = UNDETECTABLE)

debris rich ice in englacial layer 10m from south side of glacier, 13.5 km from snout	42	76/23	0.429	<0.002
northernside of glacier, below eastern end of Friis Hills: two samples (1) lowest debris layer	43	76/25	0.240	<0.002
2m from moat ice, (2) englacial debris layer, 8 m east of (1)	43	76/26	0.251	<0.002
tephra-debris (englacial) layer in ice from Ferrar Glacier, 1km west of Kukri Hills	44	76/42	0.163	0.012
basal debris layer, northeast side of Cavendish Rocks	45	76/90	0.859	<0.002
series of diffuse, low concentration englacial debris layers, 3km SSE of Cavendish Rocks; 2	46	76/29A	0.759	UD
samples from different layers	46	76/29B	0.776	UD
basal debris layer, in Beacon Valley lobe of glacier	48	76/40	0.294	UD
upper part of basal debris layer in Kennar Valley lobe	49	76/36	0.0597	UD
clean ice 1m above previous sample	49	76/37	0.0695	UD
clean glacial ice from 15m below surface, drill hole 3, opposite Pandora Spire	47	76/30	0.0208	UD

TABLE 21 SPECIFIC CONDUCTANCE THROUGH IRON-STAINED LAYERS IN ABLATION VALLEY, ABOVE GLACIER DISCHARGE SITE

Locality No.	Sample No.	Location	Distance from clean ice on southside of layer (m)	Specific conductance (mmho .cm^{-1})
27	77/02A	clean ice	0	0.181
"	77/02B	"	0.4	0.257
"	77/02C	inside layer	0.8	4.81
"	77/02D	"	1.1	3.48
"	77/02E	clean ice	1.4	0.256
"	77/02F	"	1.7	0.221
28	77/03A	clean ice	0	0.106
"	77/03B	clean ice	0.4	0.179
"	77/03C	just inside layer	0.6	0.765
"	77/03D	centre of layer	0.8	1.36

TABLE 22 TRACE ELEMENT ANALYSIS (ppm) OF CARBONATE PRECIPITATE SAMPLE NO. 24822 FROM 1972 SALINE ICING (ANALYSIS BY P. KENNEDY, VUW, USING X-RAY FLUORESCENCE: ANALYTICAL UNCERTAINTY IN LAST FIGURE)

Rb	16
Sr	1110
Y	9
Zr	9
Nb	<2
V	<2
Cr	<2
Ni	5
Cu	<2
Zn	13
Ba	<5
Pb	19
Th	<1

TABLE 23 MAJOR ELEMENT ANALYSES (% BY WT.) OF VOLCANOGENIC SALTS FROM MT. EREBUS. (ANALYSIS BY W. ZOLLER, UNIVERSITY OF MARYLAND, USING NEUTRON ACTIVATION: ANALYTICAL UNCERTAINTY IN LAST FIGURE)

Element	Sample No. 24880[1]	24885[2]	24886[3]
Na	8.2	3.9	1.8
Mg	2.4	0.2	4.0
K	0.30	2.5	1.1
Ca	0.21	1.6	0.9
Si	2.0	10.8	1.7
Al	10.4	8.8	12.2
Fe	1.9	2.5	0.27
Mn	0.17	0.11	0.17
Ti	0.080	0.30	0.04
H	3.9	3.0	3.6
F	<1	4.8	1.1
Cl	17.6	5.3	1.2
S	0.87	0.28	10
S as SO_4^{2-}	2.6	0.84	31

1 Yellow salt in joints and under cobbles on crater-facing side of Nausea Knob; locality no. 342

2 Yellow salt in massive deposit on wall of Inner Crater near Main Crater floor; locality no. 330

3 White salt on surface of rock around steam fumerole in Main Crater; locality no. 331.

TABLE 24 TRACE ELEMENT ANALYSES (ppm) OF VOLCANOGENIC SALTS FROM MT. EREBUS (ANALYSIS BY P. KENNEDY, V.U.W., USING X-RAY FLUORESCENCE)

Element	Sample No. 24880	24884[1]	24885
Rb	76	15	22
Sr	158	39	89
Y	26	2	14
Zr	642	182	340
Nb	171	7	41
V	<2	<2	5
Cu	8	<2	12
Zn	112	134	200
Ba	266	17	40
Pb	87	4	154
Th	11	5	3

1 Light yellow sample from beneath cobbles and lava blocks on Eastern Cone.

TABLE 25 RARE EARTH ELEMENT ANALYSES (PPM) OF VOLCANIC SALTS FROM MT EREBUS (ANALYSIS BY W. ZOLLER, UNIVERSITY OF MARYLAND, USING NEUTRON ACTIVATION)

Element	Sample No. 24880	24885	24886
Sm	7.4	10.4	11.6
Gd	5.6	7.5	9.6
Yb	2.2	3.0	40
Lu	0.2	1.3	190

TABLE 26 ACCUMULATIONS OF SALT WITH TIME IN TAYLOR AND BEACON VALLEYS

1. TAYLOR VALLEY: GREATEST ACCUMULATIONS OF SALT BENEATH COBBLES ON FLAT TERRAIN OF THREE BASALTIC CINDER CONES, DATED BY ARMSTRONG (1978)

Sample No.	Total salt in sample (g)	Percent salt in sample	Total halides (g)	Percent halides in sample	Percent halides in salt
(1) 1.53 ± 0.06 million year old cone between Born and Calkin Glaciers, locality no.77					
76/47A	88.3	17.8	33.8	6.8	38.3
76/47B	157.8	26.6	58.2	9.8	36.9
(2) 2.00 ± 0.18 million year old cone beside Rhone Glacier, locality no. 78					
76/63A	14.8	1.1	1.05	0.08	7.1
76/63B	8.6	0.5	0.32	0.02	3.7
76/63C	8.8	0.8	-	-	-
(3) 3.33 ± 0.14 million year old cinder beside Matterhorn Glacier, locality no. 79					
76/64A	178.0	7.9	80.0	3.5	44.9
76/64B	164.1	15.2	85.1	5.2	51.9
76/64C	262.9	16.6	113.6	7.2	43.2

2. BEACON VALLEY, LOCALITY NUMBER 80: REPRESENTATIVE SAMPLES OF SOIL (SURFACE TO FROZEN LEVEL) FROM CENTRE OF FROST POLYGONS ON EITHER SIDE OF YOUNGEST MORAINE OF LOBE OF TAYLOR GLACIER. THIS IS ONE OF BLACK'S (1973) SAND WEDGE GROWTH SITES

Northside of moraine (i.e. younger surface)

Sample No.	Specific conductance of 1:5 soil-water extract (mmho . cm^{-1})
76/38A	2.30
76/38B	1.17
76/38C	1.04

average 1.50, standard deviation 0.69

TABLE 26 Cont.

Southside of moraine (i.e. older surface)

Sample No.	Specific conductance of 1:5 soil-water extract (mmho . cm^{-1})
76/39A	2.78
76/39B	1.28
76/39C	2.66

average 2.24, standard deviation 0.83

TABLE 27 PREFERRED TYPES OF DEPOSIT OF SALT PHASES

(a) Per cent occurrences of various salts in specific deposit types

(1) Soluble salts in Taylor, Wright, Ferrar Valleys, Skelton Névé, Mt Kempe

Salt Phase	Deposit Type: surface efflorescence or encrustation (type (2A)	deaquation deposit (type 2B)	accumulation beneath cobble or in soil (4,5)
soda nitre	4	16	8.6
darapskite	4	16	11.7
epsomite	4	8	11.0
hexahydrite	0	0	1.2
bloedite	2	12	11.7
halite	26	28	11.0
thenardite	49	12	30.1
mirabilite	0'	8'	14.7
number of occurrences	45	25	163

' ambiguous locality 89 (Pearse Valley) not included

(2) Soluble salts on Mt's Discovery and Morning, Black and White Islands, Cape Bird, Hoopers Shoulder

Salt Phase	surface efflorescence or encrustation (type (2A)	deaquation deposit (type 2B)	accumulation beneath cobble or in soil (4,5)
soda nitre	0	-	0
darapskite	0	-	0
epsomite	3	-	4
hexahydrite	3	-	4
bloedite	10	-	4
halite	32	-	16
thenardite	39	-	48
mirabilite	13	-	24
number of occurrences	31	0	25

TABLE 27 Cont.

(3) calcite, gypsum and soluble salts as in (1)

Salt	Deposit Type			
	Surface encrustation (1A, 1B, 1C)	Surface efflorescence and encrustation (2A)	Deaquation deposit (2B)	Subsurface accumulation (3, 4, 5)
calcite	44.0	no data	3	13.4
gypsum	48.0	(50.5)	19	34.5
solubles	8.0	(49.5)	78	52.1
no.	75	(91)	32	313

(4) Frequently occurring soluble phases in Aztec, Kennar and Labyrinth areas only (70-80 km from coast)

Salt	Deposit Type				Ratios*	
	surface efflorescence (2A)	subsurface accumulation (4,5)	deaquation deposit (2B)	2A+4+5	$\frac{2B}{4+5}$	$\frac{2B}{2A+4+5}$
soda nitre	10	19	21	17	1.1	1.2
darapskite	10	19	16	17	0.8	0.9
epsomite	0	14	10	11	0.8	1.0
bloedite	0	14	16	11	1.2	1.5
halite	20	5	21	8	3.9	2.5
thenardite	60	30	16	36	0.53	0.44
no.	10	37	19	47		

* ratios of percent of occurrences in types as indicated

(b) Percent occurrences of various deposit types of specific salts

(1) as in (a) (1)

Deposit type	Salt					
	soda nitre	darapskite	epsomite	bloedite	halite	thenardite
2A	10	8	9	4	39	29.7
2B	20	16	9	13	17	4.1
4,5	70	76	82	83	44	66.2
number of occurrences	20	25	22	23	41	74
ratio* $\frac{2B}{4+5}$	0.29	0.21	0.11	0.16	0.39	0.061
$\frac{2B}{2A+4+5}$	0.25	0.19	0.10	0.13	0.21	0.042

* ratio of number of occurrences in types as indicated

TABLE 27 Cont.

(2) as in (a) (3)

Deposit Type	calcite	Salt gypsum	solubles
1A, 1B, 1C	44.3	18.4	2.5
2A	no data	23.5	18.8
2B	1.3	3.1	10.5
3, 4, 5	55.3	55.1	68.2
no.	76	196	239
ratio* 2B/(3+4+5)	0.024	0.056	0.153
2B/(2A+4+5)	-	0.039	0.120

* ratio of number of occurrences in types as indicated

(3) as in (a) (4) (Number of occurrences, not per cent occurrences)

Deposit Type	soda nitre	darapskite	epsomite	Salt bloedite	halite	thenardite
2A	1	1	0	0	2	6
2B	4	3	2	3	4	3
4,5	7	7	5	5	2	11
2A+4+5	8	8	5	5	4	17
ratios 2B/(4+5)	0.6	0.4	0.4	0.6	2	0.27
2B/(2A+4+5)	0.5	0.4	0.4	0.6	1	0.18

TABLE 28 PREFERRED ASPECT OF SOLUBLE SALT ACCUMULATIONS (UNITS: PERCENT IN QUARTERS). DATA FOR TAYLOR, WRIGHT, FERRAR VALLEYS, SKELTON NÉVÉ AND MT KEMPE (p, significance level)

a) aspect bias of surface efflorescences (deposit type 2A)

Aspect (quarter)	thenardite[1]	Salt phase halite, soda nitre, darapskite, bloedite, epsomite[1]	all soluble salts
north	42	47	44
east	19	16	18
south	10	26	16
west	29	11	22
total no. of aspect data	31	19	50
p = 0.05	31	40	25
p = 0.01	39	49	30

1. Mirabilite or hexahydrite counted as thenardite or epsomite but only one phase of each salt counted per sample; eg deposit with mirabilite, epsomite, hexahydrite counted as containing thenardite once and epsomite once.

TABLE 28 Cont.

b) subsurface deposits (types 4 and 5)

(i) aspect bias

Aspect (quarter)	soda nitre	darapskite	both nitrates	epsomite	bloedite	halite	thenardite	all six phases
north	20	32	27	29	33	23	31	29.2
east	15	14	14	29	30	36	21	24.0
south	50	45	48	25	22	36	28	32.2
west	15	9	11	17	15	5	20	14.6
number of aspect data	15	22	37	24	27	22	61	171
p = 0.05	45	37	29	35	33	37	22	13.2
p = 0.01	55	46	35	44	41	46	28	16.4

(2) Salt Separation

Salt	north	east	south	west
soda nitre	6	5	14	8
darapskite	14	7	18	8
epsomite	14	17	11	16
bloedite	18	20	11	16
halite	10	20	15	4
thenardite	38	32	31	48
number of occurrences	50	41	55	25

TABLE 29 PREFERRED ASPECT OF GYPSUM ACCUMULATIONS (UNITS : PERCENT IN QUARTERS) DATA FROM TAYLOR WRIGHT, FERRAR VALLEYS, SKELTON NÉVÉ AND MT KEMPE (p, significance level)

Aspect (quarter)	Deposit Type: surface encrustation on rock (1A,1B)	surface encrustation on regolith (2A)	subsurface accumulation (4,5)
north	36	46	35.2
east	16	21	23.1
south	29	15	22.2
west	19	18	19.4
number of aspect data	31	33	108
p = 0.05	31	30	16.7
p = 0.01	39	37	20.6

TABLE 30 PREFERRED ASPECT OF CALCITE ACCUMULATION (UNITS : PERCENT IN QUARTERS) (p, significance)

Aspect (quarter)	Deposit Type surface encrustation (1A,1B)	veneer (3)
north	49	52
east	18	19
south	12	10
west	21	19
number of aspect data	33	42
p = 0.05	31	27
p = 0.01	37	33

TABLE 31 ASPECT COMPARISONS BETWEEN ACCUMULATIONS OF SOLUBLE, SPARINGLY SOLUBLE, AND INSOLUBLE SALTS (UNITS : PER CENT IN QUARTERS)

Salt	Aspect north	east	south	west
(1) surface encrustation (2A)				
soluble salts[1]	59	55	60	65
gypsum	41	45	40	35
number of occurrence data	37	16	13	17
(2) subsurface encrustations (3,4,5)				
soluble salts[1]	45.5	55.4	66.2	46.3
gypsum	34.5	33.8	28.9	38.9
calcite	20.0	10.8	4.8	14.8
number	110	74	83	54

1 includes soda nitre, darapskite, epsomite, bloedite, halite, thenardite as on Table 28.

TABLE 32 SALT DISTRIBUTION AS A FUNCTION OF ROCK TYPE (PERCENT OCCURRENCE) (SALTS ON MT EREBUS EXCLUDED)

Salt	Dominant Rock Type						
	volcanics	Dolerite	plutonics	Beacon Supergroup			metasediments
				all	Taylor Group	Victoria Group	
soda nitre	0	5.2	0	6.3	8	0	5
darapskite	1.2	8.5	5	7.9	11	0	0
epsomite[1]	2.4	10.5	0	0	0	0	0
bloedite	4.9	9.8	0	0	0	0	0
halite	22.0	5.2	32	0	0	0	15
thenardite[1]	31.7	19.6	23	20.6	19	26	20
gypsum	30.5	29.4	23	49.2	49	57	45
calcite	7.3	11.8	18	15.9	14	17	15
number	82	153	22	63	37	23	14

1 hexahydrite and mirabilite included as epsomite or thenardite but only one per sample (see footnote to Table 28a).

TABLE 33 SALT DISTRIBUTION IN WRIGHT, TAYLOR, AND FERRAR VALLEYS - SKELTON NÉVÉ, WHERE DOLERITE IS DOMINANT OR ONLY ROCK TYPE PRESENT (PERCENT). SOLUBLE SALTS ONLY

Salt	Wright Valley	Taylor Valley	Ferrar Valley and Skelton Névé
soda nitre	14	4	7
darapskite	11	14	19
epsomite	11	25	19
bloedite	14	18	19
halite	11	7	7
thenardite	37	32	30
number	35	27	28

TABLE 34 SALT DISTRIBUTION AS A FUNCTION OF ELEVATION (PERCENT OF OCCURRENCES INDICATED ELEVATION RANGE). ROSS, BLACK AND WHITE ISLAND LOCALITIES NOT INCLUDED

Salt	Elevation (m)						
	0-399	400-799	800-1199	1200-1599	1600-1999	2000-2399	≥2400
(a) frequently occurring salts							
soda nitre	0	1.8	6.7	11.8	5.8	1.7	0
darapskite	0	7.3	5.6	7.8	8.7	3.4	0
epsomite[1]	3	3.6	2.2	2.0	6.8	10.3	14
bloedite	3	3.6	4.4	3.9	6.8	8.6	5
halite	32	27.3	17.8	3.9	1.9	1.7	0
thenardite[1]	16	23.6	18.9	25.5	15.5	27.6	16
gypsum	29	30.9	36.7	41.2	36.9	36.2	47
calcite	16	1.8	7.8	3.9	17.5	10.3	19
total no. of occurrences	31	55	90	51	103	58	43

1 hexahydrite and mirabilite included as epsomite or thenardite but only one per sample

(b) frequently occurring soluble phases only							
soda nitre	0	3	12	21	13	3	0
darapskite	0	11	10	14	19	7	0
epsomite	6	5	4	4	15	19	40
bloedite	6	5	8	7	15	16	13
halite	59	41	31	7	4	3	0
thenardite	29	35	35	46	34	52	47
number	17	37	50	28	47	31	15

(c) anions							
nitrates (soda nitre (darapskite	0	14	22	36	32	10	0
chlorides (halite)	59	41	32	7	4	3	0
sulphates (epsomite (bloedite thenardite	41	45	46	57	64	87	100

(d) frequently occurring soluble phases in Taylor, Pearse, Wright Valleys below 1600m and within 70 ± 5 km of the coast							
soda nitre	0	3	13	25	-	-	-
darapskite	0	12	11	15	-	-	-
epsomite	0	6	2	0	-	-	-
bloedite	0	6	7	5	-	-	-
halite	70	41	33	15	-	-	-
thenardite	30	32	33	40	-	-	-
number	14	34	45	15	-	-	-

TABLE 34 Cont.

(e) frequently occurring soluble phases in Aztec, Kennar, Lashly, Ferrar, Skelton, Fleming and Shapeless areas, above 1600 metres elevation

Salt	Elevation (m)						
	0-399	400-799	800-1199	1200-1599	1600-1999	2000-2399	≥2400
soda nitre	-	-	-	-	13	3	0
darapskite	-	-	-	-	19	7	0
epsomite	-	-	-	-	15	21	45
bloedite	-	-	-	-	15	17	10
halite	-	-	-	-	4	0	0
thenardite	-	-	-	-	34	52	45
number	-	-	-	-	47	29	11

(f) frequently occurring soluble phases in Aztec, Kennar, Labyrinth Fleming, Shapeless areas (70-80 km from coast)

Salt	Elevation		
	800-1399	1400-1999	≥2000
soda nitre	23	21	4
darapskite	15	14	8
epsomite	4	10	32
bloedite	12	17	16
halite	23	0	0
thenardite	23	38	40
number	26	29	25

TABLE 35 SALT DISTRIBUTION AS A FUNCTION OF MAP DISTANCE INLAND FROM COAST (PERCENT OF OCCURRENCES IN INDICATED DISTANCE RANGE) DATA FROM TABLE 7 (McMURDO SOUND) EXCLUDED. DATA DERIVED FROM NISHIYAMA (1977) INCLUDED (VIZ TAYLOR VALLEY, 0-35KM INLAND; AND WRIGHT VALLEY, 45-60 KM INLAND)

Salt	Map distance inland up valleys (km) (see footnotes)									
	0-5	5-15	15-25[3]	25-35	35-45[4]	45-55	55-65	65-75[5]	75-85	≥100
a) Taylor Valley										
soda nitre	0	0	0	0	0	2	-	9.7	9.8	0
darapskite	0	0	0	0.9	1.6	10	-	8.3	9.8	0
epsommite[1]	0	0	0	0	0	5	-	6.9	6.6	13
bloedite	0	0	0	0	0	5	-	6.9	8.2	4
halite	15.5	32.1	21.5	39.4	36.9	27	-	1.4	1.6	0
thenardite[1]	12.4	25.5	6.2	26.6	25.4	20	-	19.4	19.7	17
trona,[2] thermonatrite	17.5	8.5	0	0	0	0	-	0	0	0
gypsum	2.1	0	9.2	13.8	16.4	27	-	38.9	36.1	52
calcite	52.6	34.0	63.1	19.3	19.7	5	-	8.3	8.2	13

TABLE 35 Cont.

Salt	Map distance inland up valleys (km) (see footnotes)									
	0-5	5-15	15-25[3]	25-35	35-45[4]	45-55	55-65	65-75[5]	75-85	≥100
total no.	97	106	65	109	122	41	no data	72	61	23
b) frequently occurring soluble phases (Taylor, Wright, Ferrar Valleys and Skelton Névé										
soda nitre	0	0	0	0	2.1	4.3	7	23	21.1	12
darapskite	0	0	0	2.4	3.2	9.4	9	15	14.0	6
epsomite[1]	0	0	0	0	0	2.6	0	7	10.5	41
bloedite	0	0	0	1.2	1.1	5.1	9	10	17.5	12
halite	56	55.7	60.8	53.7	53.7	43.6	43	20	1.8	0
thenardite[1]	44	44.3	39.2	42.7	40.0	35.0	33	25	35.1	29
number	27	61	79	82	95	117	44	40	57	17
c) gypsum and calcite, percent of total occurrences in Taylor, Wright Ferrar Valleys and Skelton Névé										
gypsum	1.7	0	9.2	16.1	39	28.8	34.9	32.4	35.9	45.6
calcite	44.0	34.0	63.1	17.7	12	9.9	12.0	8.8	8.7	17.4
number	116	106	65	124	26	191	83	68	103	46

1 hexahydrite and mirabilite included as epsomite or thenardite but only one occurrence per sample

2 occurrences of trona and thermonatrite (Nishiyama 1977) added together but only one per sample

3 percent occurrences in 5-25 km distance range calculated for soluble phases (b) because of insufficient numbers in 15-25 km range

4 percent occurrences in 25-45 km range calculated for Taylor Valley (a) and soluble phases (b) because of insufficient numbers in 35-45 km range

5 percent occurrences in 65-85 km range calculated for Taylor Valley (a) because of insufficient numbers in 65-75 km range

TABLE 36 SALT DISTRIBUTION ALONG A NORTH-SOUTH SECTION FROM CAPE BIRD (NORTH) TO MT DISCOVERY (SOUTH) (PERCENT OCCURRENCE). DATA FROM KEYS (1972) INCLUDED (VIZ CAPES ROYDS, BARNE AND EVANS, AND HUT POINT (PENINSULA). SOLUBLE SALTS ONLY INCLUDED

Salt	Cape Bird	Capes Royds, Barne & Evans	Hut Point Peninsula	Black and White Is.	Mt Discovery area (up to 1000m a.s.l.)
nitrate phases	0	0	0	0	0
epsomite	0	0	10	0	18
bloedite	9	0	0	0	18
halite	48	51	20	20	9
thenardite	43	49	70	80	55
no. of occurrences of soluble phases	21	37	14	9	11
gypsum	9	0	21	8	50
calcite	0	3	21	17	8
total no. of occurrences	23	38	24	12	26
median distance south from Cape Bird, projected onto 166° meridian	0	35	63	90	123