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by

K. R. Everett

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[1]This work was sponsored by the Department of the Army when the author was Research Geologist at the U.S. Army Natick Laboratories, Natick, Massachusetts; the work was completed at The Ohio State University after he terminated his government employment.

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ABSTRACT

Soils developed on the fine-grained sedimentary rocks of the Western Queen Elizabeth Islands illustrate well the weakening of the soil-forming processes with increasing latitude. Most of the soils of the Mould Bay area, Prince Patrick Island, are thin with weak morphological and chemical profiles. In contrast to the Tundra soils of northern Alaska and Victoria Island, the desertic soils of Prince Patrick Island are low in organic matter. They have developed largely under the processes of salinization and calcification. Their complex, mosaic associations reflect the dominant influence of subtle drainage changes.

The soils of the Isachsen area of Ellef Ringnes Island are similar to those of Prince Patrick Island. However, profile development is even less well defined. The degree of expression of the soil-forming processes here has been reduced to almost nothing.

The soils and soil-forming factors are expressed better on Prince Patrick Island, partly because of its more southerly latitude and somewhat more coarse-grained parent materials, and partly because the soil-forming factors there have had a greater uninterrupted period over which to operate.

ACKNOWLEDGMENTS

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INTRODUCTION

Until rather recently the soils of the North American polar regions have not received the critical attention which they deserve. The reasons for this are both logical and practical. The work of Tedrow and his associates in the Point Barrow area of Alaska might well be considered pioneering efforts toward systematic understanding of polar soil development. As far as is known, the work of Holowaychuk and others (1966) at Cape Thompson, Alaska, is one of the first attempts to map and classify polar soils and to understand their interrelationships over a broad area. Mapping and analytical techniques used in the temperate regions have been applicable, with some modifications to the polar areas (Holowaychuk and Everett, in preparation).

Classification of polar soils within the framework of the Seventh Approximation (Soil Survey Staff, 1960) has met with some difficulties (Holowaychuk and Everett, in preparation), but these result largely from the lack of adequate knowledge regarding polar soils and complete definition of criteria for some of the soils.

The present study is another phase in a continuing program designed to trace soil development longitudinally and latitudinally in the North American Arctic and in Greenland.

The choice of sites on Prince Patrick and Ellef Ringnes Islands was governed by a desire to study the development of soil at high latitudes on sedimentary rocks in specified environmental settings.

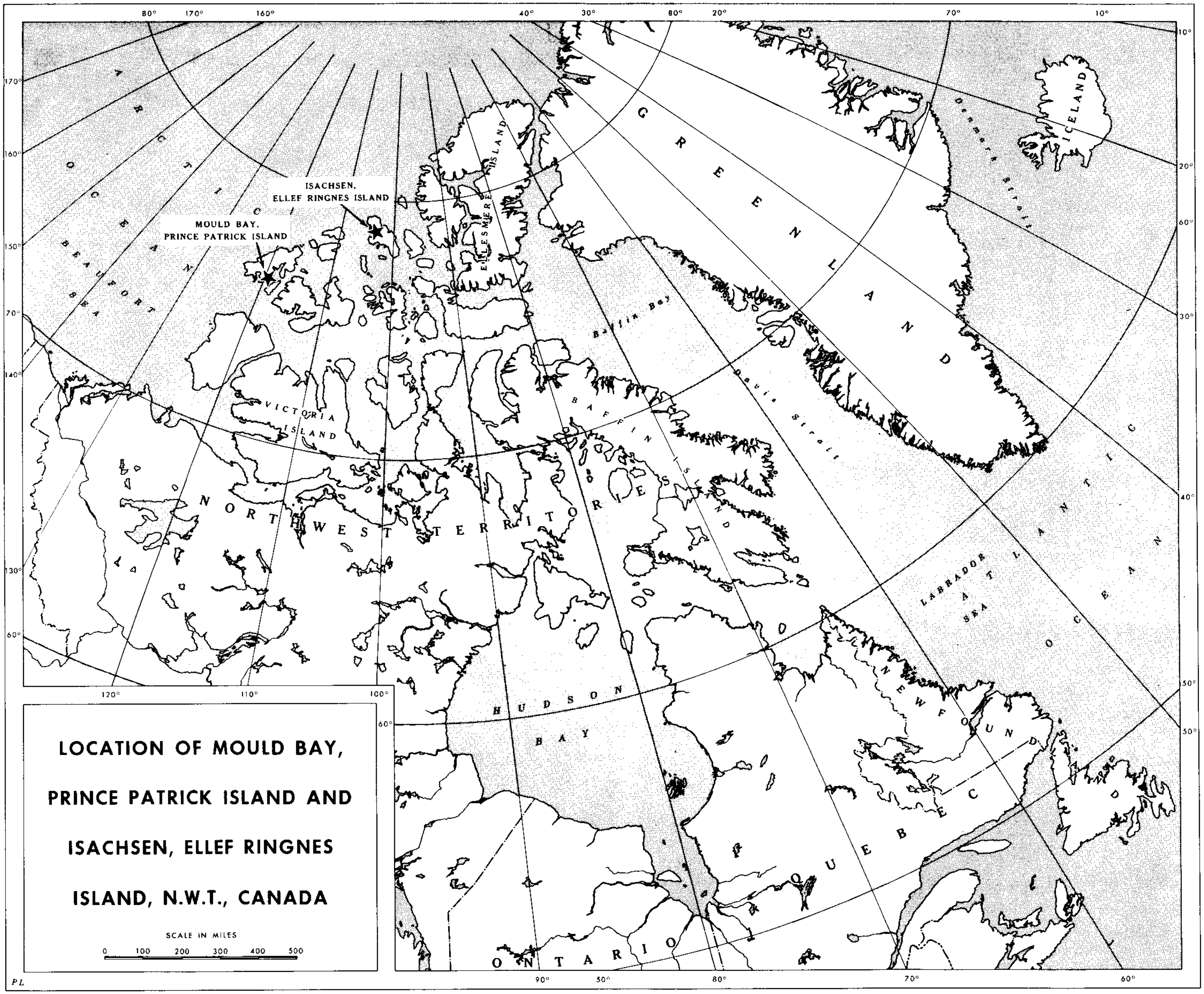
PHYSICAL SETTING

The two main areas considered in this report, Prince Patrick and Ellef Ringnes Islands, are members of the Queen Elizabeth Islands. Both islands are in the outer margin of the group, their western and northern shores in contact with the permanent polar pack ice (Fig. 1).

PRINCE PATRICK ISLAND

Prince Patrick Island, the most western of the group, is of generally low relief, particularly the western portion which is essentially an undulating plane composed of Tertiary sands and gravels (Beaufort Formation). The eastern portion of the island and the area around Mould Bay are moderately dissected with some cuestas, sea cliffs, and occasional buttes rising to 150 meters. The more pronounced topographic features are developed on the upper thick-bedded, light-colored, fine- to medium-grained sandstones of the Devonian Griper Bay Formation or the upper beds of the Jurassic Wilkie Point Formation. The latter is composed of light gray, very-fine-grained sands, sandstones and siltstones.

Rocks of the Griper Bay Formation form prominent cliffs on the west side of Mould Bay and appear as isolated inliers or fault blocks between



LOCATION OF MOULD BAY, PRINCE PATRICK ISLAND AND ISACHSEN, ELLEF RINGNES ISLAND, N.W.T., CANADA

SCALE IN MILES

0 100 200 300 400 500

Mould Bay and Crozier Channel to the south. Light-colored, thick-bedded, orange-weathering sandstones of this formation form talus-covered cliffs and felsenmeer-covered uplands south of the weather station and a prominent ridge 5 kilometers east of the station (Plate I).

The prominent sea cliffs just north of the Mould Bay weather station are composed of green carbonaceous sandstones with some dark shales. Other light-colored sandstones of the Griper Bay Formation crop out as narrow ridges north of the weather station.

The Jurassic Wilkie Point Formation crops out in a belt just east of the weather station. Poorly exposed, intermittent beds of dusky red sandstone and conglomerate of the lower Wilkie Point crop out about 1.4 kilometers north of the station. Lighy gray to white sands and sandstone of the upper Wilkie Point crop out in the lower part of the pronounced cuesta to the northeast. Lower, less resistant, medium grained, quartz sands and hard, dusky red, ferruginous sandstone appear as a lag gravel covering some of the lower relief features east of the station. The formation generally contains abundant shell fragments and phosphate nodules.

Overlying the Wilkie Point Formation are moderately resistant, fine- to medium-grained sandstone and pebbly sandstones of the Jurassic to Cretaceous Mould Bay Formation. These beds crop out as disconnected fault block inliers, scarps and cuestas south and east of the station. Characteristically they form poorly vegetated slopes of highly variegated color which may be dissected to a badlands topography, reminiscent of Arizona's Painted Desert. The overlying, nonmarine, Cretaceous Isachsen Formation occupies a small wedge-shaped outcrop area northeast of the weather station. The rocks are soft, gray and white sandstone, often slightly calcareous, with dusky red bands of ironstone. Stream gravels in the area indicate that pebble conglomerates constitute part of the section. Coal seams are known from the Isachsen Formation 10 kilometers north-northeast of the weather station. A highly fractured coal seam crops out east of the weather station in about the position of the fault contact between the Griper Bay and Isachsen Formations. Southward, and in line with the contact, the presence of an underclay is reflected in fine textured soils.

With the exception of recent alluvium, deposits younger than Cretaceous were not observed in the area studied.

Major drainage lines are well defined in most parts of Prince Patrick Island as well as the Mould Bay area. In this area the drainage ranges from modified trellis to dendritic. Most of it is tributary to Station Creek or the moderately large streams immediately to the south of it. The larger streams occupy relatively broad, flat-floored channels and, except during high-water periods, are anastomosing.

Evidence of Pleistocene glacial modification, either depositional or erosive, is lacking in the map area (Plate I). Evidence of late Pleistocene local glaciation occurs at the head of Mould Bay, in the form of striations. Erratics or diagnostic fragments brought in as till by a Pleistocene ice sheet would be difficult, if not impossible, to distinguish from fragments incorporated in the Jurassic and Cretaceous formations.

Much of the above discussion is based on Tozer and Thorsteinsson (1964). The reader is referred to their publication for a detailed treatment of the geology of the area.

ELLEF RINGNES ISLAND

The southern half of Ellef Ringnes Island is a gently undulating to nearly level plain. Maximum elevations probably do not exceed 60 meters above sea level except in and around dome structures where they may reach 300 meters (Heywood, 1957). The plains areas in the central portion of the island are marked by broad, low cuestas and escarpments developed on the sandstones and shales of the Isachsen and Christopher Formations, and reflect the low regional dip to the southeast. In the central part of the island from a little south of Station Bay, northwest to Deer Bay, including the map area (Plate IV) and eastward across the island to Marie Bay, is a dissected plateau region of buttes and escarpments. These features are developed on gabbro. Intervening long, low, molded cuestas are carved from the Isachsen Formation. Maximum relief in this area may reach 300 meters and local relief in the study area reaches 240 meters. The extreme northern and northwestern part of the island is essentially a partly emergent tidal flat and deltaic complex.

The major drainage is dendritic. The smaller streams, in some cases, occupy deep, narrow, steep gradient canyons. The larger streams occupy broad, flat-floored channels.

The primary sedimentary rock unit in the map area around Isachsen weather station is the Deer Bay Formation. This formation is, in part, correlative with the Mould Bay Formation of Prince Patrick Island (Tozer and Thorsteinsson, 1964).

The Lower Cretaceous Deer Bay Formation of Ellef Ringnes Island was originally described by Heywood (1957) from outcrops in the vicinity of Deer Bay. Here the upper 180 meters of the formation are exposed and consist of black, poorly consolidated, closely jointed, laminated shales and silty shales. Thick- to thin-bedded massive shale beds occur throughout, and buff, thin-bedded limestones are present near the top of the section. Calcite-center concretions and rosettes are characteristic of the lower part of the section and litter the ground surface approximately 2 kilometers northeast of the weather station.

Gabbro sills intrude both the Deer Bay and Isachsen Formations (the latter is not present in the study area). Many of the escarpment and butte relief forms result from these resistant sills which cap the easily weathered shales. In the Hydra Bay area east of Rat Lake two sills are exposed and produce rather complex slopes.

In places where the gabbro-shale contact is exposed the underlying shale is baked white for a thickness of several meters. Where columnar jointing is well developed, as on Sock Point, weathering and mass movement have produced a picturesque, serrated crest.

Relatively broad, gently sloping uplands developed on gabbro display a coarse felsenmeer with large (1-3 m) poorly developed rock polygons. There is considerable evidence of active frost action here. The slopes, especially those cut in gabbro sills and dark shales, display considerable mass movement, typically in the form of terraces and stripes. Low-lying shale slopes display a variety of desiccation polygons and evidence of sheet and rill-wash.

Pleistocene glacial deposits have not been identified with certainty on the island. St. Onge (1965) describes an esker-like form north of the weather station and erratic fragments from other parts of the island. He does not believe however, that the erratic fragments are till remnants.

CLIMATE

With the exception of synoptic data obtained over the last 17 years at the joint Department of Transport - U.S. Weather Bureau stations at Mould Bay and Isachsen, no quantitative data are available on which to judge the climate of the two islands. The general climate and climate elements significant to the understanding of soil development are plotted and compared in Fig. 2 and the following text.

Broadly speaking, the microclimate of the two islands is similar. Mean monthly temperatures at Isachsen tend to be slightly lower than at Mould Bay. This can be seen clearly in the freezing-point frequency diagrams (Fig. 2e-f). Perhaps the most significant differences in temperature between the two localities occur in the extreme maximums. They are greater at Isachsen than at Mould Bay in all months. This is particularly apparent for the summer months, June through August.

There is also a general similarity in total annual precipitation between the stations, ranging from nearly 10 cm at Isachsen to slightly more than 9 cm at Mould Bay. Both stations have a clearly defined summer maximum related to higher atmospheric moisture content. The higher moisture content of the atmosphere during this period is attributed to the presence of a considerable free-water surface, primarily in the form of melt pools on the sea ice surrounding the islands. St. Onge (1965) indicates that these melt pools represent two-thirds of the possible free-water surface. Much of the summer precipitation occurs in the form of moderate to light rains which may occur intermittently for several days and which are usually associated with fog. Snow

COMPARATIVE CLIMATIC DATA FOR MOULD BAY, PRINCE PATRICK ISLAND AND ISACHSEN, ELLEF RINGNES ISLAND, N.W.T., CANADA

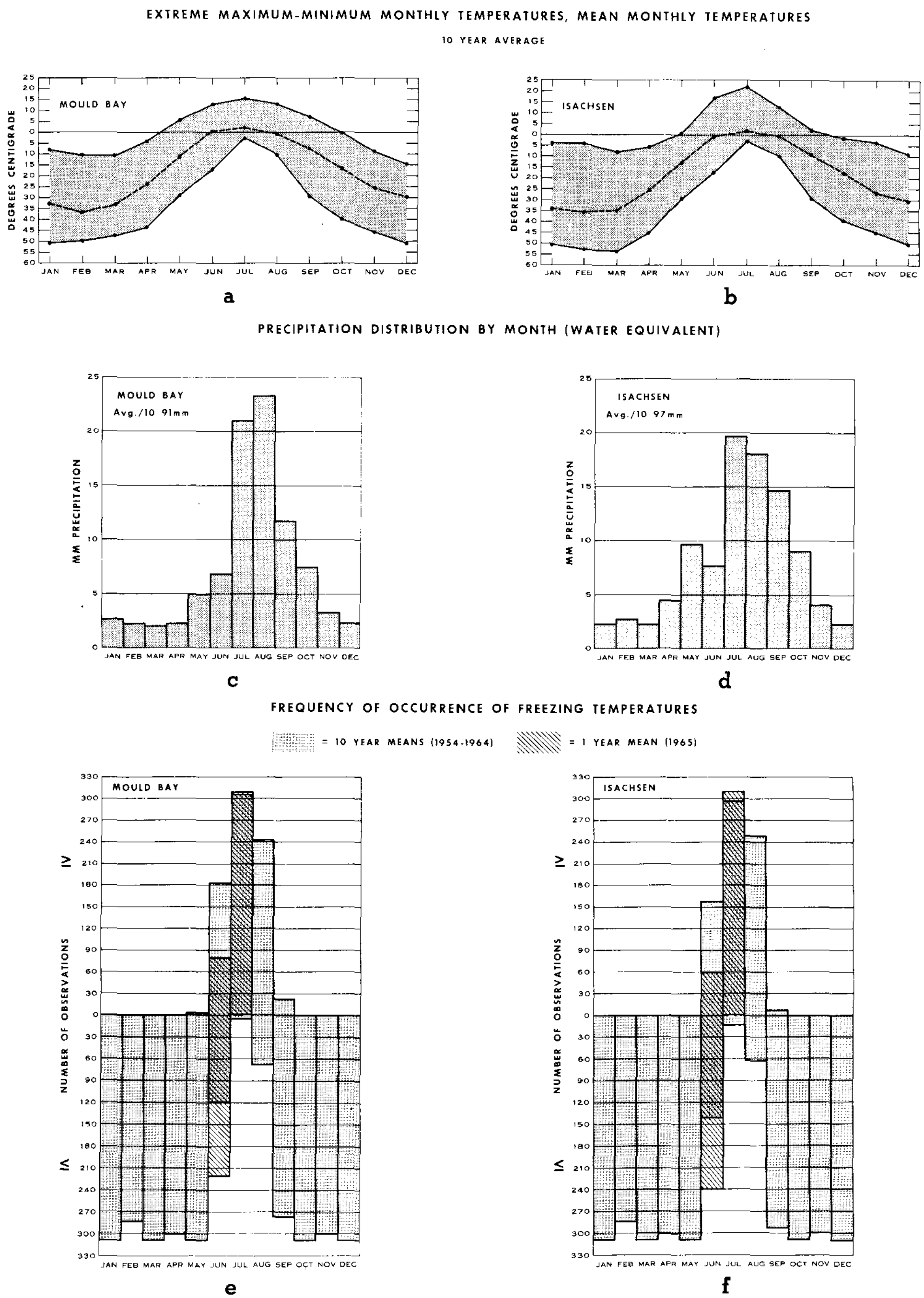


Fig. 2

showers can occur at any time. Although the 10 year averages for the two stations are similar, the distribution pattern differs in that the precipitation at Isachsen (Fig. 2d) is more evenly distributed from May through September, with larger amounts falling during the period of maximum thaw than at Mould Bay (Fig. 2c).

The gross climatic similarity of the two islands is again apparent in wind direction. During the winter months, October through May, the most frequent directions are in the quadrant, north through west, with maxima from the north and northwest. Strong winds, 21 knots or more, are from these directions.

As might be expected, the frequency of calms is rather high during the winter months, but calms are also common during the summer. Very sensitive instrumentation however, would greatly decrease the frequency of calms (Kosiba and Loewe, 1964). It is during these periods of relative calm that the high summer air temperatures are recorded and may explain in part the extremes recorded at both stations.

One final aspect of climate is evaporation. Few direct measurement data are available on this subject in high Arctic regions. The graphed data presented in Fig. 3 are the result of spot measurements using a Piche-type evaporimeter. The measurements were conducted on different days over different types of surfaces and are thus not strictly comparative.

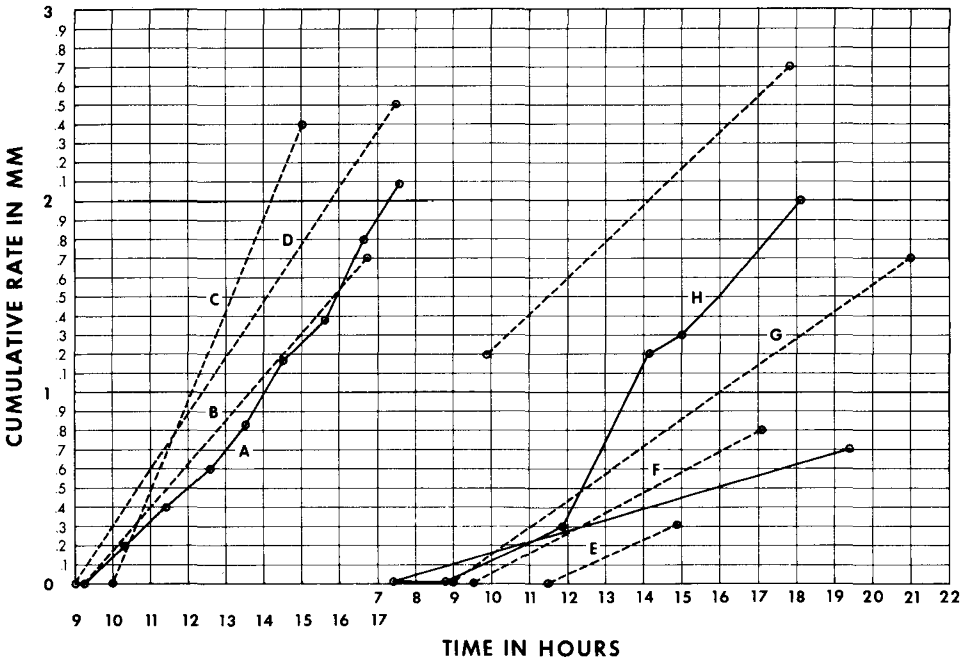
The data were taken to obtain some idea of surface evaporation rate as it affects the accumulation of salts and other surface characteristics of the soils. After the initial spring high-moisture period in Arctic soils a reversal of water circulation (i.e., a net upward movement) takes place in many soils. This results in the deposition of salts at the surface. In addition, some of the soils at Mould Bay and, more generally at Isachsen, develop hard surface crusts or granulated (self-mulching) surface horizons during periods of accelerated surface evaporation.

The curves presented in Fig. 3 are too few and too widely separated in space and time to allow any really valid interpretation. The curves for the two Arctic stations, taken in groups, show a general similarity in slope, despite rather widely ranging microclimate conditions. This is in contrast to the two curves obtained from the temperate region station where it appears that the microclimate changes have a more profound influence on surface evaporation rates.

The slope of line H, Fig. 3, represents a period when conditions were suitable for high surface evaporation at the temperate station and corresponds closely to the slopes obtained at Mould Bay. This further suggests that daytime surface evaporation rates in this Polar Cold Desert environment remain at a rather constant high rate at least during the period of thaw.

NEAR-SURFACE EVAPORATION RATES, MOULD BAY - ISACHSEN N.W.T.

(COMPARATIVE CURVE, FRAMINGHAM, MASSACHUSETTS)



ENVIRONMENTAL DATA

RELATED TO THE EVAPORATION RATE CURVES* SHOWN ABOVE

A 19 July 1965, broken altocumulus; wind light north; relative humidity** 68%, 57%; maximum temperature 5.5°C; microrelief 10-15cm; ground cover Carex, moss, lichens 75%; slope 5°; aspect, east-facing; Soil Group 3.

B 20 July 1965, partly cloudy; wind light south-southeast; relative humidity 68%, 65%; maximum temperature 4.4°C; microrelief 0-5cm; ground cover Carex, moss, lichens 50%; slope 3°; aspect, north-facing; Soil Group 2.

C 21 July 1965, clear; wind moderate to strong south-southeast; relative humidity 68%, 65%; maximum temperature 7.8°C; lag gravel surface; microrelief 0-1cm; ground cover lichens, scattered Carex 5%; slope 0°; aspect, crest.

D 22 July 1965, partly cloudy; wind moderate south; relative humidity 83%, 71%; maximum temperature 7.8°C; wet meadow area; microrelief 0-25cm; ground cover Carex-moss 100%; slope 0°; Soil Group 1.

E 8 August 1965, partly cloudy; wind northwest at 12 MPH; relative humidity 85%, 86%; maximum temperature 5.0°C; hummocks and desiccation polygons; microrelief 5-10cm; ground cover Carex-moss-lichens 75%; slope 5°; aspect, east-facing Soil Groups 2, 3.

F 12-13 August 1965, partly cloudy; wind east 9 and 16 MPH; relative humidity 72%, 75% --- 53%, 78%;maximum temperature 7.2°C --- 8.9°C; desiccation cracks; microrelief 2-3cm; ground cover Carex-moss-lichens 25-30%; slope 3°; aspect, northwest-facing; Soil Group 2.

G 15 August 1965, partly cloudy; wind north 17 MPH; relative humidity 80%, 75%; maximum temperature 4.4°C; subsequent data as above.

H 22 July 1966, clear to partly cloudy; maximum temperature 3.0°C; microrelief absent; ground cover short grass 100%; slope 0°.

* Piche evaporimeter, disc height above surface 3cm.

** Relative humidity measurements at station shelter height for the synoptic hours 1100 and 1700.

Fig. 3

SOIL TEMPERATURE

Published accounts of soil temperatures in the Canadian high Arctic are few and continuous records are indeed rare. The three-month record taken by St. Onge (1965) on Ellef Ringnes Island is the only continuous one available for the island and probably represents the only one available for the entire western Queen Elizabeth Islands. Air temperature alone cannot give a true indication of soil temperatures which exert such a strong influence on the rate of chemical reactions in the soil.

The curves presented in Fig. 4 and those accompanying Plate III represent only single points in time, but are sufficient, in the absence of more detailed and continuous information, to give a picture of soil temperature under different vegetation, topographic, and moisture environments within a single association of soils.

The influence of vegetation on temperature is apparent from the profiles at Mould Bay and Isachsen. In these areas vegetation coverage is much less complete than in other Arctic areas. In the Isachsen area, where coverage rarely exceeds 25 percent, soil temperatures are more nearly uniform from site to site, a fact of considerable importance in soil genesis.

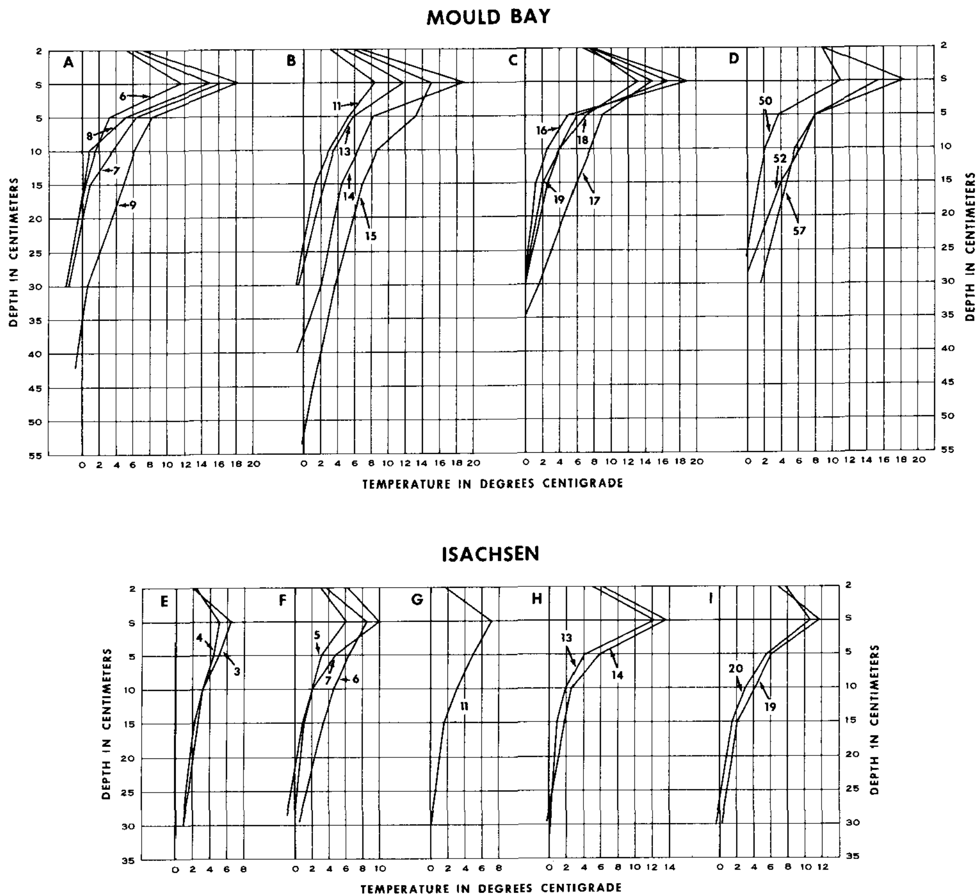
VEGETATION

Both the Mould Bay and Isachsen areas can be considered as having the heaviest vegetation cover and the greatest number of species of any areas on their respective islands. Savile (1961) lists 49 species from Ellef Ringnes Island, 48 of which can be found in the Isachsen area. Except for a slightly higher species count this relationship probably holds for the Mould Bay area as well. These numbers are low compared to Peary Land where Holmen (1957) cites 97 species, or the Lake Hazen area of Ellesmere Island where 110 species have been described by J. H. Soper (in Savile, 1961). These areas are farther north than Ellef Ringnes.

The small number of species reported from Ellef Ringnes and Prince Patrick Islands, in addition to the stunted morphology of many species, particularly those of Ellef Ringnes Island, probably reflects more than the severity of the present climate. Savile (1961) concludes that Ellef Ringnes Island has been suitable for plant colonization for only about the last 200-300 years. He bases this conclusion partly on the floristic composition and lack of endemics.

The numerous permanent snowbanks on Ellef Ringnes, and to a lesser extent on Prince Patrick Island, could easily be extended, according to Savile (1961), by a small increase in snowfall and cloudiness. The increased snowfall, which would still be meager, would be insufficient to produce a thick ice cap but enough to build an almost complete, immobile snow/ice cap a hundred or more meters thick. Such a cap could

SOIL TEMPERATURE PROFILES FOR SELECTED SITES, MOULD BAY AND ISACHSEN



A - 7 July, partly cloudy: 6&7 - soil 2, SW-facing slope; 8 - soil 2, NW-facing slope; 9 - soil 4, crest.

B - 8 July, cloudy: 11 - soil 2a, crest; 13 - soil 2, SW-facing slope; 14 - soil 2a, crest; 15 - soil 4, crest.

C - 9 July, partly cloudy: 16&17 - soil 3, S-facing slope; 18&19 - soil 3, NW-facing slope.

D - 24 July, partly cloudy: 50&52 - soil 3, W-facing slope; 57 - soil 1, valley flat.

E - 6 August, cloudy-fog: 3&4 - soil 2, S-facing slope.

F - 8 August, partly cloudy: 5&6 - soil 2, E-facing slope; 7 - soil 3, E-facing slope.

G - 11 August, clear: 11 - soil 1, depression, W exposure.

H - 12 August, partly cloudy: 13&14 - soil 2, NW-facing slope.

I - 17 August, partly cloudy: 19&20 soil 2, S-facing slope.

Fig. 4

be built and destroyed in a matter of centuries and produce no features commonly associated with mobile ice caps. If this interpretation is correct for Ellef Ringnes Island, it may also be applicable to Prince Patrick Island. Because of the lower latitude of Prince Patrick Island (somewhat higher solar incidence), the present snow/ice cap-free period may be somewhat longer.

The conclusion of the short time available for plant colonization on Ellef Ringnes Island receives support from studies of terrestrial invertebrates and insects (McAlpine, 1965). Thus, the soil-forming processes, if not obliterated by glacial action, have been halted during at least the later phases of the Pleistocene and Recent, perhaps many times. It is possible that soils of Ellef Ringnes Island may be the product of only a few hundred years development.

In the Mould Bay area, lush stands of vegetation, consisting of nearly pure stands of Carex sp., occur only on the wet to very poorly drained sites. The slopes generally have a heavy cover of fruticose lichens and mosses (Rhacomitrium sp. dominates), and scattered vascular plants, principally Saxifraga oppositifolia associated with Pedicularis sp., grasses, and Salix sp. The uplands are dominated by crustose lichens and scattered vascular plants. These basic assemblages are found in the Isachsen area. Here, however, pure stands of Carex sp. are rare and limited to small areas. The slopes have a partial cover of fruticose lichens and mosses interspersed with extensive unvegetated areas. Vascular plants are widely scattered with the highest densities on the better drained sites along stream banks. Papaver radicatum usually provides the only color on these shallow, somber slopes. The uplands on the intrusive gabbros and diabases have an incomplete cover of crustose lichens. The low, broad interfluves developed in the shales are often completely barren.

The greatest diversity of plants noted in the area occurs on Sock Point which forms the west cline of Station Bay (see Plate IV). Here stunted Saxifraga oppositifolia and Salix arctica may be found in association with other vascular plants, lichens, and mosses.

The sparsity of vegetation on these islands, as compared to the vegetation on Victoria Island, is reflected in the much lower organic carbon content of the surface soil horizon (compare Tables XV and XVI with Tables X and XI).

SOIL GROUPS

MOULD BAY AREA (76° 14'N, 119° 20'W)

Two general soil associations were recognized in the Mould Bay area: (1) those associated with Mesozoic sediments, and (2) those associated with Devonian sediments. Within these two associations five drainage or soil moisture categories were recognized. These categories are based on such morphological characteristics as color, quantity of organic matter accumulation, and degree of horizon development.

Waterlogged conditions produce gray colors and favor considerable accumulation of organic material because of inadequate drainage. Intermittent periods of excessive moisture produce mottled colors in which gray is generally intermingled with various shades of brown. Brown shades alone are associated with favorable aeration and oxidation conditions such as occur under adequate, but not excessive, moisture conditions. Paucity of moisture is reflected in weak development of colors. With the possible exception of isolated bird roost mounds, no excessively well-drained soils occur in the area.

The fine-grained texture of the soils and the close proximity of the permafrost table are the major factors which contribute to their overall poorly drained character.

Each of the five drainage categories described below is referred to as a class and follows, in general, the concepts outlined in the Soil Survey Manual (Soil Survey Staff, 1951) and that used by Holowaychuk and Everett (in preparation) in west Greenland.

Class I: Wet

This soil drainage class includes a soil moisture environment characterized by continuous waterlogged or submerged conditions throughout the soil. The soil is largely organic and if some mineral material is found in the subsoil it has a predominantly gray or dark gray color.

Class II: Very poorly drained

Soil moisture environment of this category is characterized by practically continuous excess of water throughout the solum. Such conditions are conducive to strong gleying which is reflected in the gray to dark gray colors of the subsoil. Many of these soils display bright orange mottling in the subsoil horizons. Surface horizons are generally organic.

Class III: Poorly drained

This class of drainage refers to conditions where the lower part of the solum is wet for prolonged periods and only the upper part of the soil is periodically free from excessive moisture. The subsoil has mottled colors in which gray or dark gray is a common component.

Class IV: Imperfectly or somewhat poorly drained

This group is not recognized in this report. Soils which might be included in the class have, in most cases, been placed in Class III.

Class V: Moderately well drained

This drainage class refers to conditions where the solum is subject to intermittent periods of excessive moisture. There are localized areas in the lower portion of the sola where grayish brown, gray, yellowish brown, and/or dark brown mottled colors are present. In permafrost areas these mottles may be close to the surface, 10 cm or less.

Class VI: Well drained

Conditions of excessive moisture are nearly absent; when they occur, they are infrequent and of short duration in these soils. Mottled colors caused by gleying are not present in soils of this soil moisture environment.

Seven kinds of soil were recognized in the Mould Bay area. A morphologic description is given for each and laboratory data presented for all except Soil Group 2A, which is considered too closely related to Soil Group 2 to require analysis. The Soil Survey Manual (Soil Survey Staff, 1951; 1962) was used as the basis for terminology used in the descriptions.

Soil Group 1 (drainage class I) is characterized by a series of 0 horizons ranging from 12 to more than 30 cm in thickness. The organic matter is dark brown or reddish to yellowish brown, and fibrous. It is composed largely of sedges and mosses. Most of it has undergone limited physical disintegration although, occasionally, one or more horizons display some humification. Organic matter and organic carbon contents are too low to define any of the 0 horizons as histic. The term histic is used solely on the basis of organic carbon content. Thickness requirements as defined in the Seventh Approximation would disqualify most of these soils as having a histic horizon (Table I). Considerable amounts of inwashed silts and fine sands are included with the organic material.

These soils occur on or adjacent to flood plains of the major drainages and bordering ponds, and some depressions receiving meltwater from prominent snowbanks (see Plate I for distribution and profile locations). Two profiles are presented to show the morphologic variation of this soil (Fig. 5). Pertinent chemical and physical data are presented in Table I.

Soil: MOL 55

Location: Prince Patrick Island - Mould Bay.

Topography: Floor of dried pond, pond probably still infrequently occupied by water.

Drainage: Wet.

Table I. Selected Chemical Properties for Profile MOL 55, Soil Group 1; Chemical Properties and Particle Size Distribution for MOL 3, Soil Group 1

Selected Chemical Properties

Profile	Horizon	Depth (cm)	pH[1]	Organic C[2]	Organic matter	Electrical conductivity[3]	Phosphorus[4]	Free Fe_2O_3	Exchangeable cations meq/100 g: H	Ca	Mg	K	Na	Σ exch. cations meq/100 g	Σ of bases meq/100 g	Base sat %	Calcite	Dolomite	$CaCO_3$ equiv
MOL 55	O11	69-65	6.3	6.7	11.5	0.3	8	1.5	9.7	10.6	3.6	0.20	0.25	24.4	14.7	60	--	--	--
	O12	65-63	5.7	5.0	8.6	0.2	3	0.9	11.0	8.2	2.6	0.13	0.15	22.1	11.1	50	--	--	--
	O15	58-47	5.9	7.4	12.7	0.2	6	0.5	14.6	6.5	1.6	0.13	0.16	23.0	8.4	37	--	--	--
	O16	47-44	5.1	9.4	16.2	0.3	6	0.8	24.6	11.3	3.7	0.17	0.18	40.0	15.4	39	--	--	--
MOL 3	O12	7-5	7.2	---	--	0.4	5	1.0	-------------Not Determined-----------------								T	T	T
	O13ir	5-3	6.9	4.5	7.7	0.2	3	2.4	6.7	13.8	3.0	0.17	0.11	23.8	17.1	72			
	O14	3-0	6.6	3.7	6.4	0.3	4	0.3	4.1	9.5	1.8	0.13	0.08	15.6	11.5	74			
	Bg	0-8	6.5	1.3	2.2	0.2	3	1.2	2.4	5.0	1.5	0.13	0.09	9.1	6.7	74			
	C	8-20	7.2	---	--	0.2	4	1.7	-------------Not Determined-----------------								T	T	T

Profile	Horizon	Depth (cm)	Particle Size (mm) / Distribution (percent)	2-1	1-0.5	0.5-0.25	0.25-0.1	0.1-0.05	Total sand > 0.05	Silt 0.05-0.002	Clay < 0.002	Class
MOL 3	Bg	0-8		1.3	3.4	3.1	6.2	18.7	32.9	51.8	15.6	SL
	C	8-20		1.9	3.9	2.7	4.8	19.4	32.6	50.9	16.6	SL

1 Glass electrode, 1:1 water dilution
2 Loss on ignition
3 Electrical conductivity of 1:5 water extract in mmhos/cm @ 25°C
4 Bray method

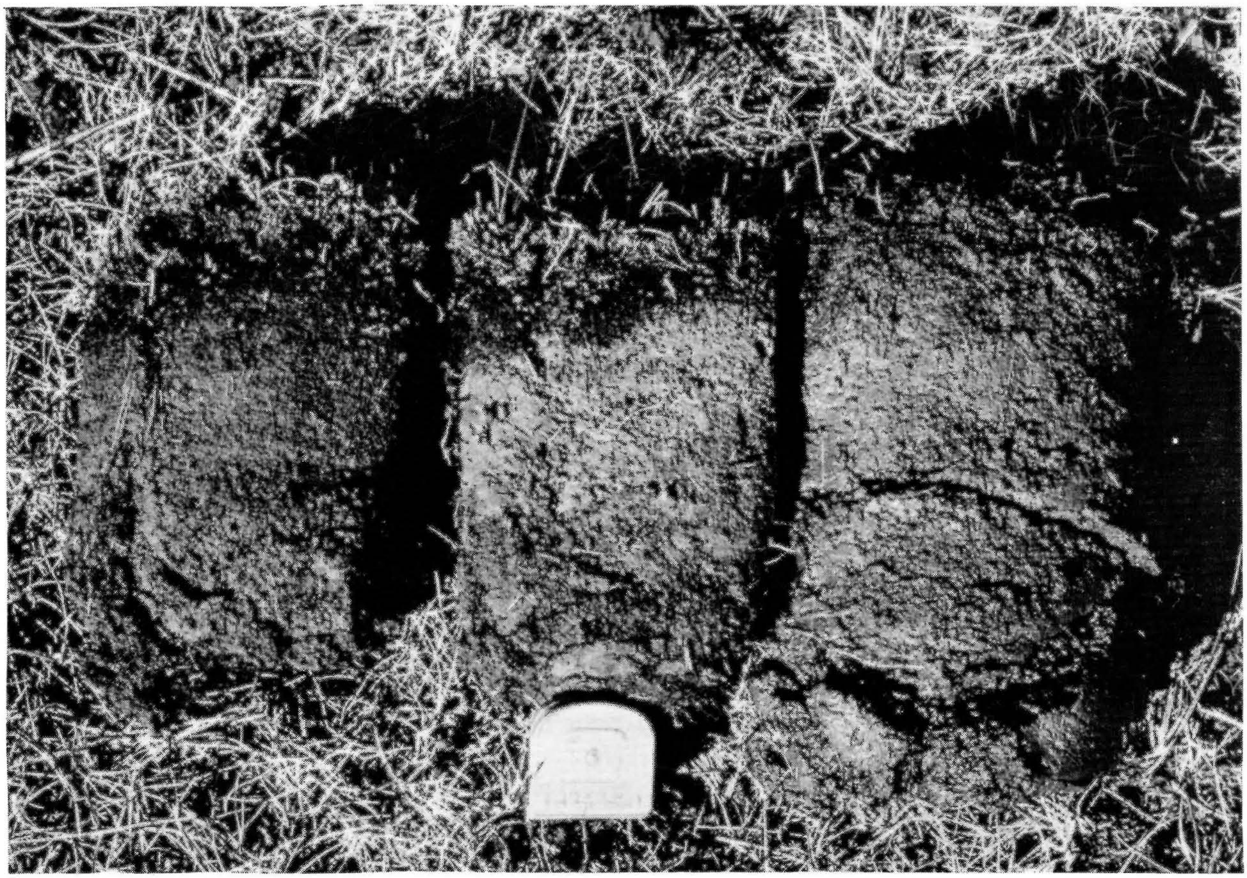


Fig. 5 - Comparative Profiles of Soil Group 1, Mould Bay. Profiles Range from an Exposed, Relatively Drier Hummock on the Left to One Representative of a Standing Water Situation on the Right. Organic Matter Content Decreases from Left to Right. Each Profile Represents the Depth of Thaw as of Mid-July 1965. Scale 5 cm

Vegetation: *Carex* sp. and moss, 100% cover.

Remarks: No standing water, but water rises nearly to surface in pit.

Profile description

O11 69-65 cm; dark yellowish brown (10YR 4/4)* with mottles of dark reddish brown (5YR 3/3 wet), dark brown (10YR 4/3 squeezed), fibrous peat with fine and medium sand; rubs down with difficulty; lower boundary smooth.

O12 65-63 cm; dark reddish brown (5YR 3/3 wet), dark brown (7.5YR 4/4 squeezed), coarse fibrous peat with some fine and medium sand; rubs down with difficulty; few roots; lower boundary smooth.

O13 63-58 cm; dark reddish brown (5YR 2/2 wet), dark brown (7.5YR 4/4 squeezed), coarse fibrous peat with some fine and medium sand; rubs down with difficulty; few roots; lower boundary smooth.

O14 63-58 cm; dark reddish brown (5YR 2/2 wet), dark brown (7.5YR 4/4 squeezed), moderately fibrous peat with small amount of medium sand; rubs down with moderate difficulty, few roots; lower boundary smooth.

O15 58-47 cm; black to dark reddish brown (5YR 2/1-2/2 wet), dark brown (7.5YR 3/2 squeezed) moderately coarse peat with some medium sand; rubs down moderately easily; very few roots; lower boundary smooth.

O16 47-44 cm; dark reddish brown (5YR 3/3 wet), dark yellowish brown (10YR 4/4 squeezed) coarsely fibrous, little decomposed peat with some medium sand; rubs down with great difficulty; roots absent; peat decreases in coarseness with depth; blebs and pod-shaped masses of dark gray (10YR 4/1) sand, fine and medium sand present; frozen except for upper 3 cm.

O17 44-10 cm; very dark grayish brown (10YR 3/2 wet), dark yellowish brown (10YR 4/4 squeezed), coarse fibrous peat with moderate amount of fine and medium sand; rubs down with difficulty and has gritty feel; plant material fragments identifiable as *Carex* sp. and moss; frozen.

---

* Color values according to Munsell designations and are for moist conditions unless otherwise noted.

018 10-0 cm; dark brown (7.5YR 3/2 wet), dark brown (10YR 3/3 squeezed), moderately fibrous peat; moderately decomposed but still identifiable as Carex-moss plant material; moderate amount of fine and medium sand; rubs down with difficulty; frozen.

Soil: MOL 3

Location: Prince Patrick Island - Mould Bay.

Topography: 10° slope, site next to stream and about 100 m downslope from snowbank.

Drainage: Wet.

Vegetation: Moss and Carex sp., 100% cover.

Remarks: Hummocky with microrelief of 10 to 15 cm. Soil of this site shows wide variability in thickness of O horizon being up to 14 cm thick in hummocks (see Table I for analytical data).

Profile description

011 9-7 cm; mat of roots and plant remains.

012 7-5 cm; very dark brown (10YR 2/2 wet), brown (10YR 4/3 squeezed), moderately well decomposed peat with considerable sand; rubs down with difficulty; lower boundary clear.

013ir 5-3 cm; yellowish red (5YR 4/6-4/8) peat with some silt and clay; rubs down with difficulty; lower boundary clear, smooth.

014 3-0 cm; dark grayish brown (10YR 3/2) peat or peaty sand; lower boundary clear, smooth.

Bg & 02 0-8 cm; light gray (N 6/) silt loam* or with few gray (N 5/) and reddish yellow (5YR 6/8) mottles and inclusions of large quantities of fibrous organic material, much of it derived from Carex sp.; lower boundary clear.

C 8-20 cm; light olive brown (2.5Y 5/4) silt loam; roots abundant; few pebbles.

Soil Group 2 is one of the most widely distributed in the area (see Plate I) and displays perhaps the greatest profile variability

* Textural classes have been adjusted to conform with laboratory data.

(Fig. 6 and 7). It occurs on slopes ranging from near 0° to 8° with an average of 5°. The soil normally occurs on Mesozoic rocks, although 2 kilometers northeast of the weather station a variety of this soil is developed on Devonian rocks. Profiles show three major variants, described below, which are the result of very slight changes in microrelief (drainage).

This soil typically displays a rather weak horizon differentiation. Significant horizon differences are associated with the development of a weak granular structure in the upper, drier 10 to 12 cm. With slightly drier conditions, some organic matter may occur in a very thin, weakly developed A1. Other profiles show rather extensive mixing of organic matter and mineral soil throughout. These soils characteristically occur in areas having rather long slopes which are polygonally cracked. The polygons have an average size of 24 cm. On slopes from 1° to 5° the polygons produce little microrelief and the soil normally does not display any appreciable mixing of organic matter.

Soil: MOL 8

Location: Prince Patrick Island - Mould Bay.

Topography: Northwest-facing slope, 4°, approximately 30 m upslope from pond area.

Drainage: Poorly drained.

Vegetation: Moss in low areas, *Carex* sp. on topographic highs. Coverage 50-70% *Rhacomitrium* moss. As slope increases to 8° large polygons occur with extremely hummocky surfaces.

Remarks: Polygonally cracked, superimposed with muted stripes.

Profile description

O1 5-0 cm; mostly moss, lichen, *Carex* mat.

A1d 0-6 cm; mixed horizon, (10YR 3/3) dark brown, very fine sandy loam - (10YR 2/2) very dark brown, very fine sandy loam/silt loam; high in organic matter, gives a blotched, smeared or incompletely mixed appearance. Lower boundary is gradual; roots common.

C1 6-25 cm; (10YR 3/2) very dark grayish brown loam, fine to very fine sand, massive, quite wet; roots common in upper part, few at 25 cm; occasional blebs or smears and intermixtures of (10YR 4/2) silty clay loam. The (10YR 3/2) material has organic matter (completely humified), occasional pebbles. Permafrost.

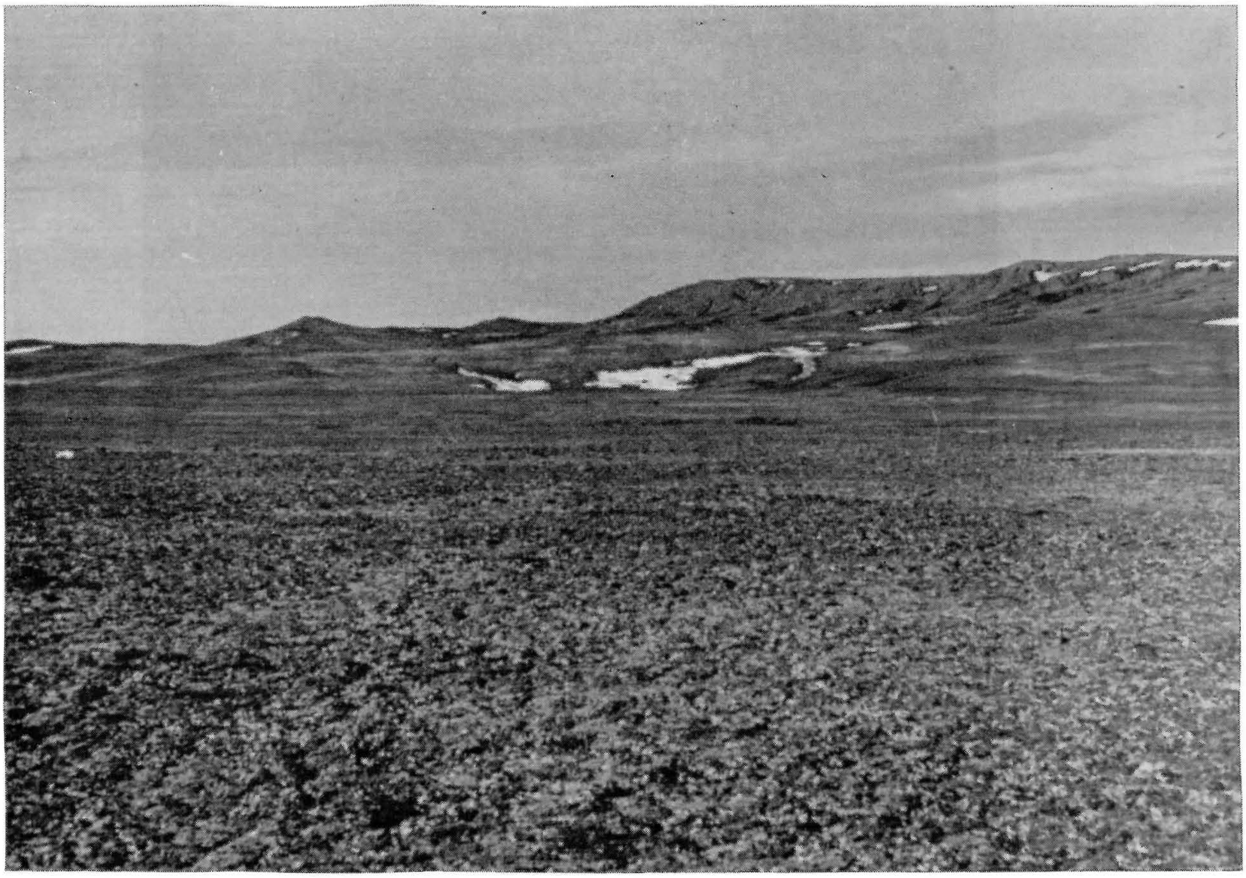


Fig. 6 - General Aspect of Terrain Southeast of Mould Bay Weather Station; Foreground Area Largely Soil Group 2 (July, 1965)

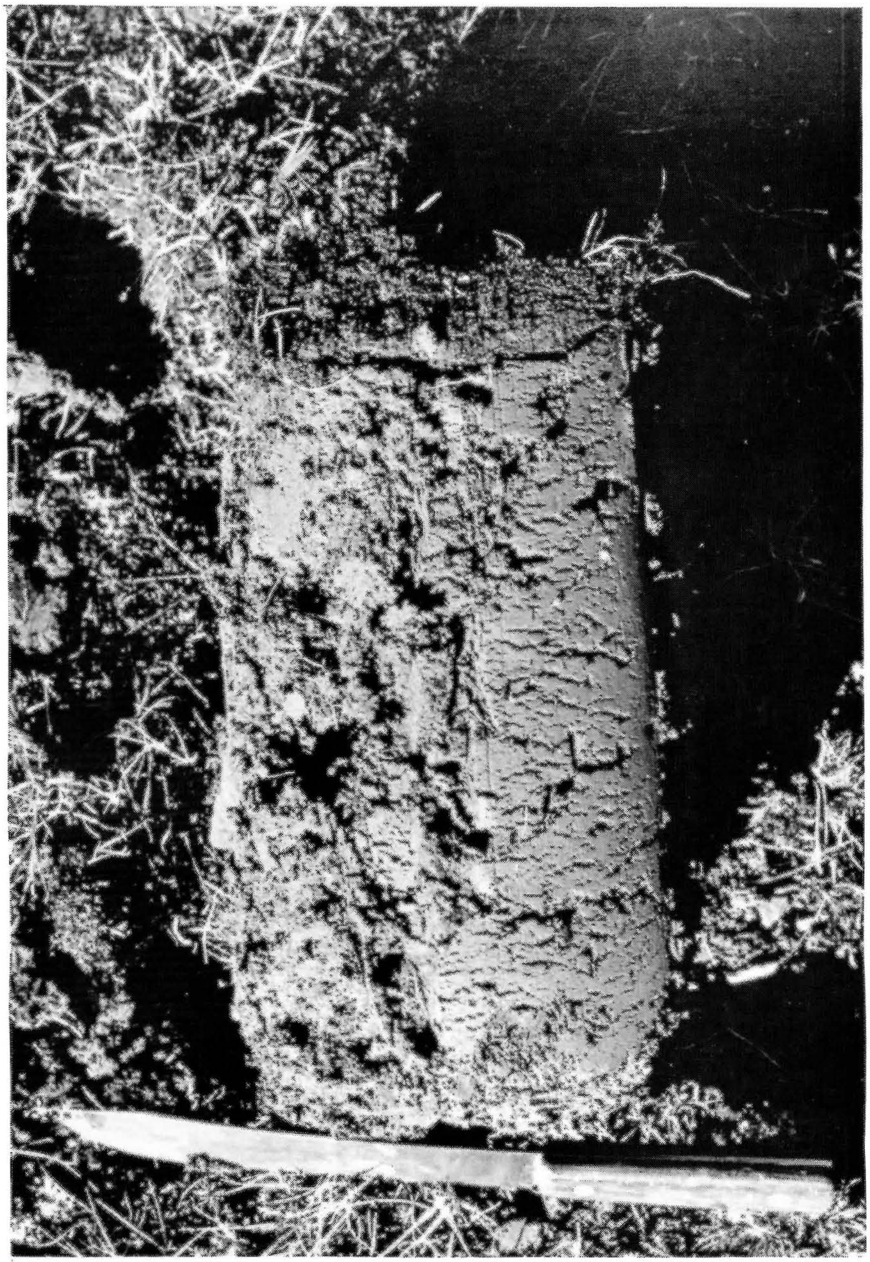


Fig. 7 - Selected Profile of Soil Group 2, Mould Bay. Note Thin A Horizon. Irregular Void Areas on Right Side of Core Indicate Positions of Seasonal Ice Accumulation and Weak Platy Structure in the Silty Clay (July, 1965)

Soil: MOL 30

Location: Prince Patrick Island - Mould Bay.

Topography: Southwest-facing slope, 6°.

Drainage: Poorly to very poorly drained.

Vegetation: Scattered Carex, Salix sp. (accounts for the green aspect), some of it appearing quite old, and generally occurring in slight depressions. Dryas octopetala, tube lichens, some moss with Salix.

Remarks: Microrelief approximately 5 cm, subdued desiccation cracks.

Profile description

A1 0-5 cm; (10YR 5/3) brown, very fine sandy loam with organic matter (largely roots), weak coarse granular to weak coarse subangular blocky structure, lower boundary is gradual.

C 5-30 cm; (2.5Y 4/4) olive brown, very fine sandy loam to silt loam, with a tendency to break to very weak, fine subangular blocky structure; intermixed with (10YR 3/2) very dark grayish brown silt loam which breaks easily to strong, coarse subangular blocky structure. Roots are abundant throughout. Permafrost [Salix stem, 6 mm diameter, found frozen at 30 cm; only slightly decomposed].

Soil: MOL 26

Location: Prince Patrick Island - Mould Bay.

Topography: Pediment footslopes below sandstone upland; slope 5°.

Drainage: Poorly drained.

Vegetation: Carex sp., moss, Rhacomitrium and tube lichens, 30 to 50% bare surface.

Remarks: Considerable amount of small rocks on surface (deflation pavement and hard crust). There is a tendency for striping on the drier areas. Surface is broken into polygonal cracks. Slight microrelief, 2-5 cm, due to Carex tufts (see Table II for analytical data).

Table II. Selected Chemical Properties and Particle Size Distribution for Profile MOL 26, Soil Group 2, Mould Bay

Profile	Horizon	Depth (cm)	pH[1]	Organic C[2]	Organic matter	Electrical conductivity[3]	Phosphorus[4]	Free Fe_2O_3	Exchangeable cations meq/100 g: H	Ca	Mg	K	Na	Σ exch. cations meq/100 g	Σ of bases meq/100 g	Base sat %	Calcite	Dolomite	$CaCO_3$ equiv
MOL 26	C1	0-9	6.9	2.1	3.6	0.2	6	2.5	4.2	9.6	4.8	0.41	0.08	19.1	14.9	78			
	C2	9-43	7.2	---	---	0.2	3	2.9	----------------Not Determined----------------								T	T	T

Profile	Horizon	Depth (cm)	Particle Size (mm)	2-1	1-0.5	0.5-0.25	0.25-0.1	0.1-0.05	Total sand > 0.05	Silt 0.05-0.002	Clay < 0.002	Class
MOL 26	C1	0-9	Distribution (percent)	0.5	0.6	0.5	2.5	6.6	10.7	41.9	47.4	SC
	C2	9-43		1.9	1.1	0.7	2.6	4.8	11.1	48.4	40.5	SC

1 Glass electrode, 1:1 water dilution
2 Loss on ignition
3 Electrical conductivity of 1:5 water extract in mmhos/cm @ 25°C
4 Bray method

Profile description

C1 0-9 cm; dark grayish brown (10YR 4/2) silty clay, broken into strong lower boundary gradual.

C2 9-43 cm; dark grayish brown (10YR 4/2) silty clay with occasional strong brown (7.5YR 5/6) mottles; massive; no roots evident; small stones 2% by volume. Permafrost.

Throughout most of the area occupied by Soil Group 2 an increase in slope angle from 5° to 8° results in the small, distinctly etched polygons, forming a microrelief from 10 to 15 cm. In these areas the profiles normally show mixing of organic matter and mineral soil throughout. This change in slope is apparent both on the ground and from the air as a general darkening of the surface with increase in slope. This darkening is due in part to a denser cover of lichens and mosses and to generally higher moisture conditions. The more moist condition is reflected in the profiles by some degree of mottling in the lower 10 to 20 cm (see abbreviated profiles accompanying Plate II).

Soil Group 2A is a very poorly drained soil and occupies crest positions, slopes from 0° to 1° (Fig. 8) and is associated with Soil Group 2. The major difference between these two soils is that mottling characterizes the entire 2A profile, and organic matter is much reduced or absent. Horizon division in the field is based largely upon size and degree of development of the mottles. In the upper 8-20 cm they tend to be fewer and smaller. Typically the C1 horizon is finer-textured, drier, and shows a weak, coarse subangular blocky structure in contrast to the more massive and moister C2 horizon. The C1 in general has lighter colors, light olive brown compared to very dark grayish brown for the C2. It should be noted here that a close parallel exists between the two groups, especially the 2A soil, and the majority of the soils developed in the Isachsen area of Ellef Ringnes Island (see page 42).

Soil: MOL 14

Location: Prince Patrick Island - Mould Bay.

Topography: 1° to 3° slope.

Drainage: Very poorly drained.

Vegetation: Vegetative cover only about 5%, largely *Carex* sp. with occasional *Papaver radicatum* and *Saxifraga* sp.

Remarks: Small polygonal desiccation cracks, polygons 24 cm across. The profile is typical in these uplands on Triassic and Jurassic rocks (see Table III for analytical data).

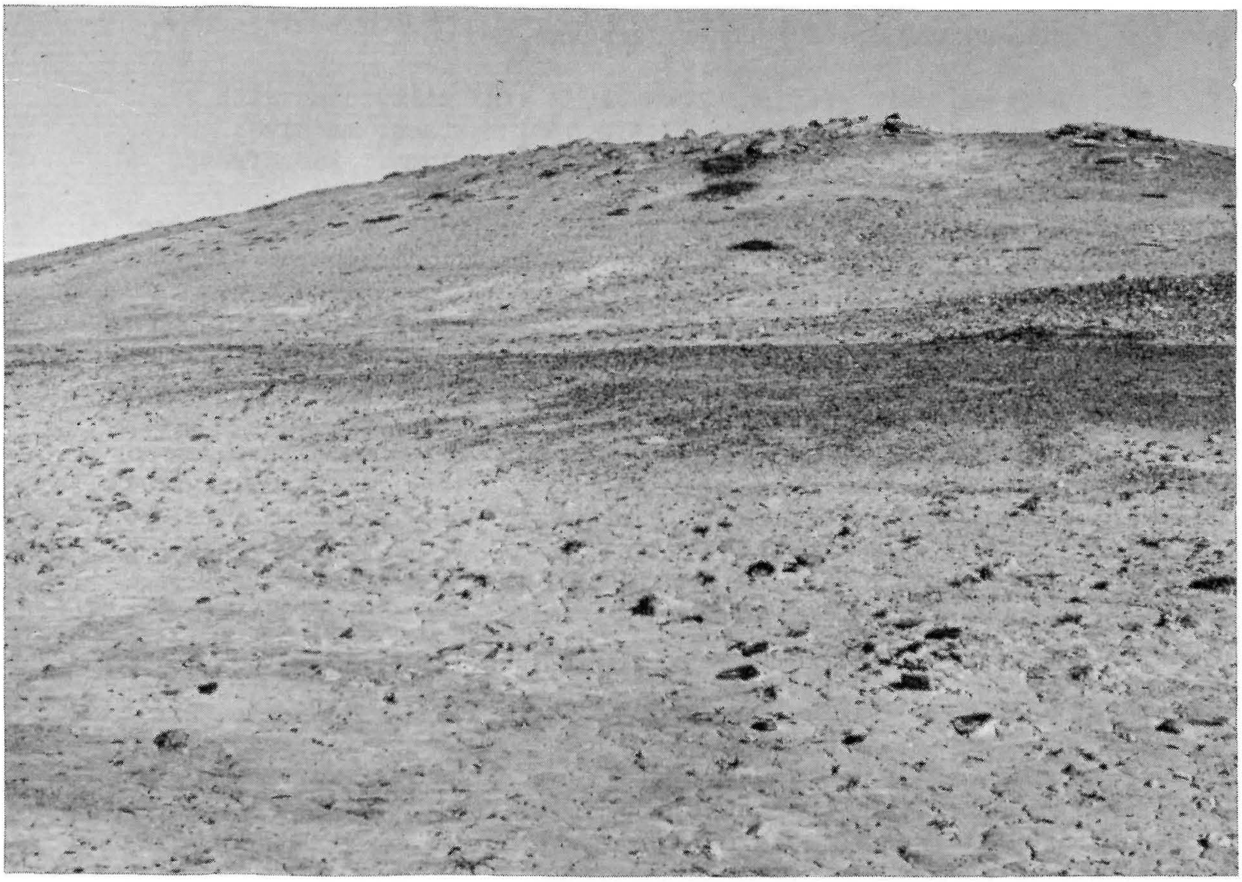


Fig. 8 - General Aspect of Wind-Blasted Surface Consistent with Soil Group 2A in Foreground, Mould Bay. Lag Gravel Surface in Center of Photograph Is Typical of Areas Having Polar Desert Soils, with Profiles Similar to Those Described by Tedrow (1966). Surface Fragments Are Ferruginous, Hard Sandstone Fragments (July, 1965)

Table III. Selected Chemical Properties and Particle Size Distribution for Profile MOL 14, Soil Group 2A, Mould Bay

	Horizon	Depth (cm)	pH[1]	Organic C[2]	Organic matter	Electrical conductivity[3]	Phosphorus[4]	Free Fe_2O_3	Exchangeable cations meq/100 g H	Ca	Mg	K	Na	Σ exch. cations meq/100 g	Σ of bases meq/100 g	Base sat %	Calcite	Dolomite	$CaCO_3$ equiv
MOL 14	C1	0-15	7.4	---	---	1.5	6	1.0	----------------Not Determined----------------								T	T	T
	C2	15-40	7.1	0.9	1.5	2.0	7	1.1	1.8	15.7	6.6	0.33	0.98	25.4	23.6	93	--	--	--

	Horizon	Depth (cm)	Particle Size (mm)	2-1	1-0.5	0.5-0.25	0.25-0.1	0.1-0.05	Total sand > 0.05	Silt 0.05-0.002	Clay < 0.002	Class
MOL 14	C1	0-15	Distribution (percent)	0.5	0.3	0.2	0.8	15.1	16.9	56.1	27.0	SCL
	C2	15-40		0.2	0.3	2.6	0.9	23.7	27.7	49.3	23.0	L or SL

[1] Glass electrode, 1:1 water dilution
[2] Loss on ignition
[3] Electrical conductivity of 1:5 water extract in mmhos/cm @ 25°C
[4] Bray method

Profile description

C1 0-15 cm; light olive brown (2.5Y 5/4) silty clay loam and some very dark grayish brown (2.5Y 3/2) silty clay loam; few mottles of yellowish red (5YR 4/8) and reddish yellow (7.5YR 6/8), the organic matter contains very fine sandy loam; occasional zones of pale brown (10YR 6/3) very fine sand; weak coarse subangular structure; roots few.

C2 15-40 cm; very dark grayish brown (2.5Y 3/2) silt loam with common yellowish red (5YR 4/8 and 5/8), reddish yellow (7.5YR 6/8) and pale brown (10YR 6/3) mottling; friable. Permafrost.

Soil Group 3 - These moderately well-drained soils are nearly always associated with sandstone outcrop areas of the Wilkie Point Formation. Typically they occupy slopes between 3° and 6° (average 5°), with widely ranging microrelief conditions. In contrast to Soil Group 2, these soils occur under a relatively complete cover of vegetation from 50 to 100 percent, and show three well-defined horizons. They are characterized by a thin (2 to 5 cm) A1 horizon whose color ranges from dark brown to black, reflecting high concentrations of organic matter (Fig. 9 illustrates three profiles). This material is in many cases finely divided and well humified. The lower boundary is clear and often wavy.

A dark brown to dark grayish brown B horizon is developed in all profiles. It regularly shows some evidence of mixing with A1 material. Unlike Soil Group 2, soils of Group 3 have a much higher proportion of coarse sand and granular material. The skeletal fragments of the B horizon frequently display iron staining on the undersides and silt coatings on the upper sides. Roots are abundant in this horizon. The lower boundary ranges from clear to, more commonly, gradual.

The C horizons range in color from dark grayish brown to brown, fine loamy sands, silt loams or loams. Mixing similar to that in the B horizon is common but the degree is much reduced. Mottling is common, particularly in slightly moister representatives. No positive carbonate reaction was noted in any profile of this soil. Descriptions and analyses for three representative profiles follow.

Soil: MOL 18

Location: Prince Patrick Island - Mould Bay.

Topography: $5\frac{1}{2}°$ slope below late snowbank.

Drainage: Moderately well drained.

Vegetation: Almost complete cover of *Carex* sp. and moss with some *Rhacomitrium* sp. on lower part of slope.

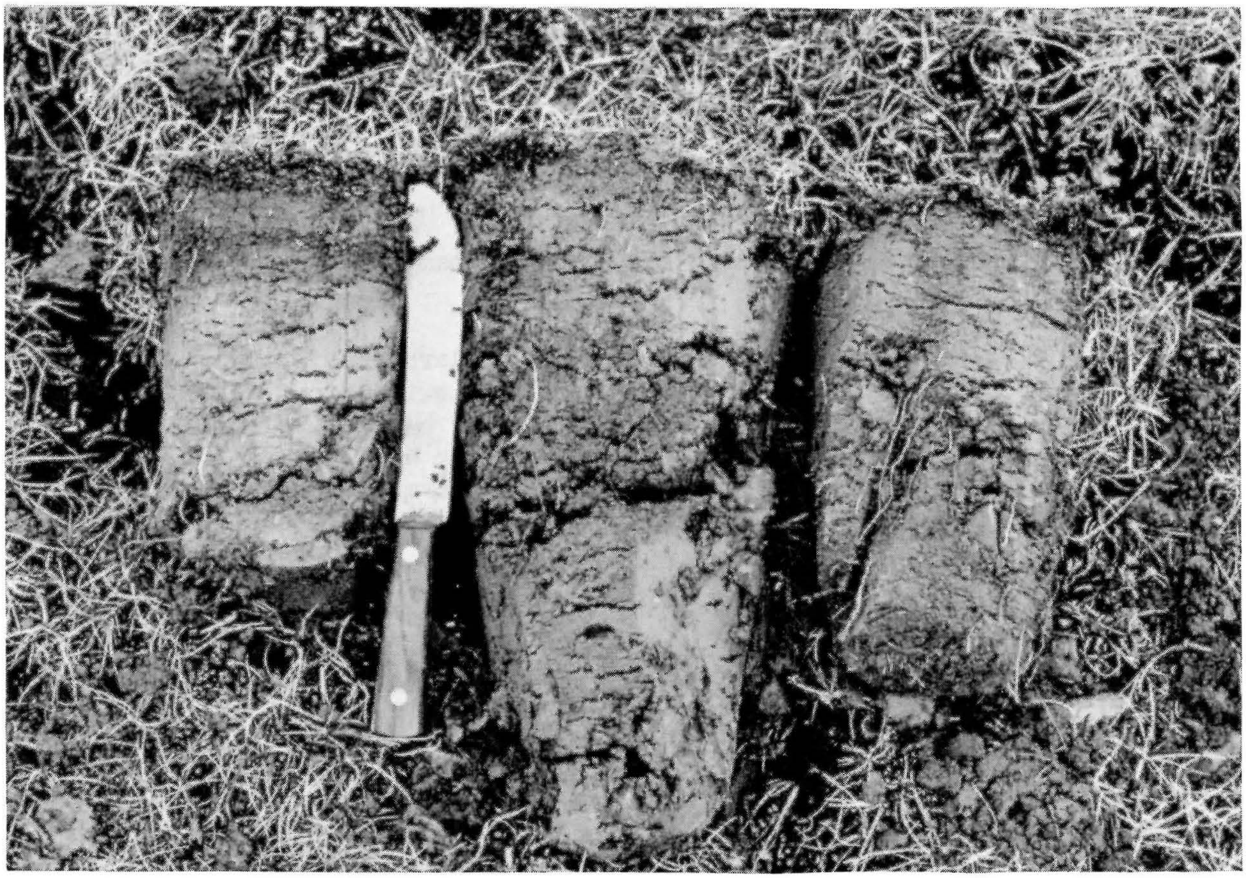


Fig. 9 - Profiles of Soil Group 3 Illustrating Range in Profile Characteristics and Horizon Development, Mould Bay. Profiles Were Taken within 1 m of Each Other on a Nearly Uniform Slope. Profile on the Right Is Slightly More Moist Than the Others. Each Profile Represents the Depth of Thaw As of Mid-July 1965

Remarks: Slightly hummocky microrelief, up to about 5 cm. Soil was wet (see Table IV for analytical data).

Profile description

A1 0-2 cm; very dark brown (10YR 2/2) to dark brown (7.5YR 3/2) silt loam with a high content of organic matter that rubs down easily. Thickness increases to 7 or 8 cm near the snowbank.

Bir 2-5 cm; dark brown (7.5YR 4/4) loam; massive; roots abundant; lower boundary clear.

B2 5-15 cm; intermingled masses of dark grayish brown (10YR 4/2) fine or medium sand and yellowish brown (10YR 4/3) sandy loam; roots abundant; lower boundary clear.

C 15-32 cm; intermingled masses of brown (10YR 4/3) fine sand and very dark gray (10YR 3/1) loam; roots few.

Soil: MOL 27

Location: Prince Patrick Island - Mould Bay.

Topography: 3° north-facing slope presently undergoing dissection. Site on long interfluve spur.

Drainage: Moderately well drained.

Vegetation: Carex sp., Rhacomitrium sp., mosses, tube and crustose lichens, some Salix sp. and scattered Dryas integrifolia.

Remarks: Weak polygonal development and striping. Microrelief about 5 cm. Soil wet below 4 cm, 1 to 0 cm; mat of vegetative material (see Table V for analytical data).

Profile description

A11 0-1 cm; very dark brown (10YR 2/2) loam mixed with organic matter; roots abundant; discontinuous.

A12 1-4 cm; dark brown (10YR 4/3) loam; massive; lower boundary clear.

A3 4-13 cm; dark grayish brown (10YR 4/2) loamy fine to very fine sand mixed with some dark brown (10YR 3/3) loam; massive; roots abundant; few scattered pebbles; lower boundary gradual.

Table IV. Selected Chemical Properties and Particle Size Distribution for Profile MOL 18, Soil Group 3, Mould Bay

	Horizon	Depth (cm)	pH[1]	Organic C[2]	Organic matter	Electrical conductivity[3]	Phosphorus[4]	Free Fe_2O_3	Exchangeable cations meq/100 g: H	Ca	Mg	K	Na	Σ exch. cations meq/100 g	Σ of bases meq/100 g	Base sat %	Calcite	Dolomite	$CaCO_3$ equiv
MOL 18	A1	0-2	5.3	16.6	28.6	0.5	9	3.3	33.4	20.8	4.5	0.64	0.34	59.6	26.4	44	--	--	--
	Bir	2-5	5.1	2.4	4.1	0.1	2	5.7	14.0	3.5	0.8	0.08	0.07	18.5	4.5	24	--	--	--
	B2	5-15	5.0	1.3	2.2	0.1	5	3.0	9.2	2.6	T	0.08	0.06	12.0	2.8	23	--	--	--
	C	15-32	5.3	1.6	2.8	0.1	14	2.3	8.2	4.1	0.4	0.13	0.06	12.9	4.7	36	--	--	--

	Horizon	Depth (cm)	Particle Size (mm) / Distribution (percent)	2-1	1-0.5	0.5-0.25	0.25-0.1	0.1-0.05	Total sand > 0.05	Silt 0.05-0.002	Clay < 0.002	Class
MOL 18	A1	0-2		--	--	--	--	--	--	--	--	--
	Bir	2-5		0.1	0.5	3.1	18.4	33.8	55.9	29.9	14.2	SdL
	B2	5-15		0.2	4.8	2.4	19.7	64.8	64.8	23.0	12.1	SdL
	C	15-32		1.4	1.4	4.3	20.1	35.3	62.6	27.7	10.1	SdL

[1] Glass electrode, 1:1 water dilution
[2] Loss on ignition
[3] Electrical conductivity of 1:5 water extract in mmhos/cm @ 25°C
[4] Bray method

Table V. Selected Chemical Properties and Particle Size Distribution for Profile MOL 27, Soil Group 3, Mould Bay

Profile	Horizon	Depth (cm)	pH[1]	Organic C[2]	Organic matter	Electrical conductivity[3]	Phosphorus[4]	Free Fe_2O_3	Exchangeable cations meq/100 g: H	Ca	Mg	K	Na	Σ exch. cations meq/100 g	Σ of bases meq/100 g	Base sat %	Calcite	Dolomite	$CaCO_3$ equiv
MOL 27	A11	0-1	5.9	7.8	13.4	0.2	8	1.9	13.0	17.3	4.7	0.29	0.12	35.4	22.4	63	--	--	--
	A12	1-4	5.7	1.4	2.4	0.1	2	1.8	6.2	4.6	1.5	0.10	0.09	12.5	6.3	50	--	--	--
	A3	4-13	5.7	1.5	2.6	0.1	2	2.0	6.0	4.9	1.4	0.13	0.11	12.5	6.5	52	--	--	--
	B	13-28	5.5	1.7	2.9	0.2	2	1.9	8.0	5.4	1.1	0.15	0.07	14.8	6.8	46	--	--	--
	02+C	28-37	5.4	2.4	4.1	0.1	15	0.7	10.0	5.3	1.0	0.15	0.10	16.6	6.6	40	--	--	--

Profile	Horizon	Depth (cm)	Particle Size (mm) / Distribution (percent)	2-1	1-0.5	0.5-0.25	0.25-0.1	0.1-0.05	Total sand > 0.05	Silt 0.05-0.002	Clay < 0.002	Class
MOL 27	A11	0-1		Not Determined								
	A12	1-4		0.8	0.9	1.7	13.3	16.8	33.5	48.0	19.5	L
	A3	4-13		5.4	1.1	1.7	13.5	16.3	38.0	45.7	16.3	L
	B	13-28		0.4	0.3	1.2	14.4	20.6	36.9	47.7	15.4	L
	02+C	28-37		1.8	0.4	1.3	15.0	21.3	39.7	46.4	14.0	L

1 Glass electrode, 1:1 water dilution
2 Loss on ignition
3 Electrical conductivity of 1:5 water extract in mmhos/cm @ 25°C
4 Bray method

B 13-28 cm; intermingled dark yellowish brown (10YR 4/4), dark brown (10YR 3/3), and very dark grayish brown (10YR 3/2) loam and dark brown to strong brown (7.5YR 4/4-5/6) loam; massive; roots abundant.

02 & C 28-37 cm; mixed very dark brown organic matter and streaks of brown (10YR 5/3-5/4) loam.

Soil: MOL 33

Location: Prince Patrick Island - Mould Bay.

Topography: Uniform 5° slope.

Drainage: Moderately well drained.

Vegetation: *Salix* sp., green moss and *Carex* sp. mats and *Carex* sp.-moss stripes alternating with *Rhacomitrium* sp. and lichens.

Remarks: Slight microrelief due to small hummocks and cracks generally less than 10 cm but one up to 20 cm. Few rocks at surface. Large cracks parallel to slope. Some tendency to develop small roots but little sign of activity (see Table VI for analytical data).

Profile description

01 1-0 cm; mat of vegetative material.

A11 0-2 cm; very dark brown (10YR 2/2) mixed organic matter; roots plentiful; sandy clay loam; thickness ranges from 1 to 3 cm weak coarse subangular blocky structure; lower boundary clear and uneven.

A12 2-5 cm; very dark grayish brown (10YR 3/2) fine to medium sandy loam, high in organic matter, roots plentiful; few scattered pebbles, granular to weak coarse subangular blocky structure; lower boundary clear and uneven.

C1 5-16 cm; dark brown (10YR 4/3) loamy fine sand; massive; roots abundant; granules and pebbles less than 5% by volume; lower boundary gradual.

C2 16-28 cm; dark brown (10YR 4/3) sandy clay loam; massive rocks about 5% by volume; some smears of very dark grayish brown (10YR 3/2) organic material. Permafrost.

Table VI. Selected Chemical Properties and Particle Size Distribution for Profile MOL 33, Soil Group 3, Mould Bay

Profile	Horizon	Depth (cm)	pH[1]	Organic C[2]	Organic matter	Electrical conductivity[3]	Phosphorus[4]	Free Fe_2O_3	Exchangeable cations meq/100 g H	Ca	Mg	K	Na	Σ exch. cations meq/100 g	Σ of bases meq/100 g	Base sat %	Calcite	Dolomite	$CaCO_3$ equiv
MOL 33	A11	0-2	6.1	13.3	22.4	0.3	14	1.5	13.3	27.8	5.0	0.60	0.21	46.9	33.6	72	--	--	--
	A12	2-5	6.0	5.1	8.8	0.1	6	2.4	Not Determined										
	C1	5-16	6.3	2.3	2.6	0.2	5	2.6	4.4	6.8	0.7	0.15	0.08	12.2	7.8	64	--	--	--
	C2	16-28	6.1	2.3	4.0	0.1	6	2.8	7.0	11.0	1.2	0.26	0.10	19.6	12.6	64	--	--	--

Profile	Horizon	Depth (cm)	Particle Size (mm) / Distribution (percent): 2-1	1-0.5	0.5-0.25	0.25-0.1	0.1-0.05	Total sand > 0.05	Silt 0.05-0.002	Clay < 0.002	Class
MOL 33	A11	0-2	Not Determined								
	A12	2-5	3.2	3.3	7.1	21.7	20.6	56	18.3	26.7	SdCl
	C1	5-16	2.3	2.4	5.9	23.9	26.1	60.7	27.2	12.1	SdL
	C2	16-28	2.4	2.7	5.1	19.4	21.8	51.4	24.2	24.4	SdCL

1 Glass electrode, 1:1 water dilution
2 Loss on ignition
3 Electrical conductivity of 1:5 water extract in mmhos/cm @ 25°C
4 Bray method

Soil Group 4 - These well drained soils occur in isolated patches on crest positions, mainly within outcrop areas of the Wilkie Point Formation. Slope segments are generally short and of low gradient, from 1° to 3°. This soil thaws deeper than any other in the area, commonly to 0.5 meters or more. It is characterized by a relatively well-developed, dark brown A1 horizon under mosses, lichens, and scattered vascular plants. The horizon thickness ranges from 2 to 10 cm and is frequently interrupted by large sandstone fragments. Calcium carbonate encrustations are common on the underside of the larger skeletal fragments.

In some profiles a thin (1 centimeter or less) discontinuous horizon of bleached fine sand is developed below the A1. This horizon is believed to represent an A2.

The B horizon is characterized by a dark grayish brown and dark yellowish brown medium and fine loamy sand with variable amounts of organic material. The proportion of skeletal material frequently reaches 50 to 70 percent and usually shows iron staining on the underside. Silt coatings occur on the upper surfaces of most fragments. Carbonate reaction of the encrustations weakens with depth and is absent altogether in the brown to light gray, medium and fine sands of the C horizon. Skeletal material in the C horizon may reach 90 percent and constitutes an open boxwork with scattered concentrations of sands. Two typical profiles are presented below.

Soil: MOL 9

Location: Prince Patrick Island - Mould Bay.

Topography: Low, felsenmeer-covered ridge crest, slope 3°.

Drainage: Well drained.

Vegetation: Tufts of *Carex* sp., *Cerastium* sp., scattered mosses and grasses. Coverage 50%.

Remarks: Small soil island near sandstone outcrop; area pockmarked with lemming burrows and used as a bird roost (see Table VII for analytical data).

Profile description

O1 1-0 cm; mat of vegetation, roots and leaves.

A1 0-6 cm; dark brown (10YR 4/3-4/4) to dark yellowish brown (10YR 4/4) very fine sandy loam; high in organic matter; massive with scattered pebbles and rocks; roots abundant; lower boundary clear, uneven to interrupted.

Table VII. Selected Chemical Properties and Particle Size Distribution for Profile MOL 9, Soil Group 4, Mould Bay

Profile	Horizon	Depth (cm)	pH[1]	Organic C[2]	Organic matter	Electrical conductivity[3]	Phosphorus[4]	Free Fe_2O_3	Exchangeable cations meq/100 g: H	Ca	Mg	K	Na	Σ exch. cations meq/100 g	Σ of bases meq/100 g	Base sat %	Calcite	Dolomite	$CaCO_3$ equiv
MOL 9	A1	0-6	6.3	3.3	5.7	0.1	9	0.8	6.2	8.4	1.5	0.10	0.11	16.3	10.1	62	--	--	--
	A12	6-9	6.0	3.5	6.0	0.2	15	0.9	9.4	7.7	0.9	0.10	0.11	18.1	8.1	48	--	--	--
	A2	9-10	Not Determined																
	B12	10-16	5.8	1.5	2.6	0.1	22	1.3	4.6	3.3	0.3	0.10	ND	8.3	3.7	45	--	--	--
	B2	16-24	5.9	1.8	3.1	0.1	13	0.9	5.2	4.1	0.9	0.10	0.05	10.4	5.2	50	--	--	--

Profile	Horizon	Depth (cm)	Particle Size (mm) / Distribution (percent)	2-1	1-0.5	0.5-0.25	0.25-0.1	0.1-0.05	Total sand > 0.05	Silt 0.05-0.002	Clay < 0.002	Class
MOL 9	A1	0-6		1.10	19.9	42.6	29.7	5.2	80.9	12.5	6.5	LSd
	A12	6-9		Not Determined								
	A2	9-10		0.6	0.8	4.5	66.3	19.5	91.7	4.4	3.9	Sd
	B12	10-16		0.7	0.7	3.4	53.4	21.0	79.2	12.3	8.6	LSd
	B2	16-24		1.7	0.7	3.2	54.6	20.9	81.1	10.1	8.8	LSd
	C	24-41		0.4	0.6	3.6	67.3	20.9	92.8	5.9	1.2	Sd

1 Glass electrode, 1:1 water dilution
2 Loss on ignition
3 Electrical conductivity of 1:5 water extract in mmhos/cm @ 25°C
4 Bray method

A12 6-9 cm; dark brown (7.5YR 3/2) very fine sandy loam; high in organic matter; massive to weak fine granular structure; roots common; lower boundary clear, uneven and discontinuous.

A2 9-10 cm; grayish brown (10YR 5/2) fine sand or loamy fine sand; single grained; lower boundary clear, discontinuous to contorted.

B2 10-16 cm; dark yellowish brown (10YR 3/4) loamy fine sand, with occasional iron-stained pebbles; single grained; roots common; lower boundary clear, discontinuous and contorted.

B21 16-24 cm; dark yellowish brown (10YR 4/4) loamy fine sand with occasional smears of organic material; single grained; roots common; lower boundary clear, uneven.

C 24-41 cm; brown (10YR 5/3) fine sand in a boxwork of rocks, most of which show iron staining on lower surface. No carbonate reaction. Permafrost at 43 cm.

Soil: MOL 4

Location: Prince Patrick Island - Mould Bay.

Topography: Crest, slope 4°.

Drainage: Well drained.

Vegetation: Scattered Saxifraga oppositifolia; Carex sp., Papaver radicatum, lichens and mosses. Coverage 80%; 5-10% vascular plants.

Remarks: Rubble surface with scattered outcrops and soil islands.

Profile description

A1 0-10 cm; dark brown (7.5YR 3/2) organic material with very fine sand and a few granules (very fine sandy loam); roots common. Occasional inclusions of (10YR 2/1) black organic matter. Coarse skeleton 20-30%. Lower boundary clear, uneven, discontinuous.

A12 10-11 cm; dark brown (10YR 3/3) very fine sandy loam. Very coarse, weak subangular blocky structure. Usually best developed under and around rocks. Lower boundary clear, uneven, discontinuous. Occasional flecks and zones of yellowish red (5YR 5/8) sand.

B1 11-25 cm; dark grayish brown (10YR 4/2-4/3) to brown loamy fine to coarse sand; roots abundant, pebbles and rocks 50%. Rocks iron stained on undersides. Very fine silt coatings on top of stones. Lower boundary clear, uneven, discontinuous.

B2 25-32 cm; yellowish brown (10YR 5/4) fine to medium sand in a matrix of coarse sand and gravel. Material fills in around large rocks or may lie directly under 10-11 cm horizon. Rock surfaces have coatings of calcareous dark brown (10YR 4/3) silt and/or clay. Undersides of rocks have light colored $CaCO_3$ encrustations. No iron stain. Lower boundary discontinuous.

C 32-43 cm; light gray (10YR 7/1-7/2) medium sand with some coarse sand. In some cases material is absent and an open boxwork of coarse rocks occurs. Permafrost.

Discussion

The soils described in the preceding pages are representative of the major soil groups to be found at Mould Bay and probably Prince Patrick Island in general. It is likely that the Mould Bay area displays the greatest concentration of different soil groups of any locality on the island. This discussion will consider the soil groups in order of the degree of profile development.

The general uniformity of the morphology and chemical properties of the soil groups and the range in properties within a single group are striking. Plate I is of too large a scale to show the ranges encountered, but it is sufficient to represent the major associations. Plates II and III are attempts to illustrate the interrelationships of varieties within two soil groups.

Polar Desert soils have been described from Prince Patrick Island by Tedrow (1966). These soils certainly represent the largest percentage of the area of the island. Within the concept of zonality they can be considered the zonal soils for this island and perhaps for most of the western Queen Elizabeth Islands.

Much of the area designated Soil Group 2A on Plate I must be considered as "not soil." This material, for the most part, occupies interfluve areas where it is subject to almost continual windblast (Fig. 8). The fine-grained nature of the bedrock, which is largely shale and very-fine-grained sandstone, is not conducive to the production of a protective lag gravel. Ordinarly such crest positions are among the most stable from the standpoint of gravity mass movement. Desiccation due to wind produces polygonal cracks in the upper 10 to 15 cm of the material, which increases its susceptibility to deflation. The moisture status in the lower part of the profile remains in a saturated to moist condition because of restricted drainage. This situation is the result of the fine-textured character of the mineral soil and shallow thaw zone; hence gleying is common.

There may be some recycling of mineral soil because of freeze-thaw but the largest amount of mixing must surely result from finer material dropping into the open polygonal cracks. The dry nature of the surface horizon coupled with strong winds severely restricts vegetation and accounts for the very low concentration of organic matter.

Considerable variations in chemical properties occur from profile to profile, but within any one profile they remain quite uniform. Regarding horizon differentiation, little more can be done with these profiles than to recognize structural and/or slight color differences across a gradual boundary. The profile is divided, then, somewhat arbitrarily into C1 and C2 horizons. The C1 is continually truncated by wind action. A semblance of profile development such as Tedrow and Douglas (1964) and Tedrow (1966) describe for the Polar Desert soil is found only where a sufficient quantity of large rock fragments contribute to a lag gravel cover and thus add a degree of stability to the environment, designated on Plate I as 2A-Lg.

The sloping soils, designated Soil Group 2 on Plate I, differ from those just discussed in that a clearly defined A horizon is developed. In most instances the profile consists of an A1 which shows considerable mixing and which grades into a C horizon. In areas where only a C1-C2 sequence is recognized, the C1 horizon will have a larger amount of organic matter. In this poorly drained soil the degree of mixing is most pronounced on the steeper slopes (5° to 8°). On these slopes microrelief in the form of small polygons is most pronounced. The mixing which characterizes the A horizon is attributed to the construction and destruction of the polygonal columns. Typically, the crowns of the columns are covered with lichens and the deeply depressed, moister margins are occupied by mosses and scattered vascular plants. In-blown organic chaff* probably contributes significantly to the organic matter content.

In Soil Group 2, the mineral soil is fine grained. The permafrost table is somewhat shallower than in Soil Group 2A. In Soil Group 2 the depth of permafrost table averages 30 cm in early August and its configuration is the mirror image of the soil surface. Although the soils are less stable, they do show horizon development, primarily because the profile is not subject to the intense drying which occurs on crests. This allows a meager vegetation cover to develop.

* 2500 cm^3 of mineral soil and organic chaff were taken from an area of 0.5 m^2 of a snowbank. This material had a dry weight of 320 g. Of this weight 12.8 g, or 4%, was organic matter.

On the lower portions of these same slopes (2° to 5°), in-mixing in the A horizon is much less apparent because of the less intense cracking of the surface. Polar Desert soils can occur on these slopes if exposure allows wind blast. It is unlikely that any of these soils become sufficiently stable (partly the influence of slope and partly the fine texture of the soil) to allow more than incipient profile development. Yet this degree of development is considered a sufficient basis on which to recognize these soils as definitive for the region.

The somewhat coarser textured, sloping soils, designated Soil Group 3 on Plate I, show rather well-developed horizons and probably represent optimum soil development on sloping terrain. These profiles are clearly divisible into A, B, and C horizons having rather distinct chemical dissimilarities. The pH profile is more acid than any except the waterlogged valley bottom soil, Soil Group 1. Vegetation cover is more luxuriant and this is reflected in thicker A horizons and higher organic matter values.

The B horizons are clearly separable from A horizons on the basis of color. Texturally they show an increase in clay content. Some incipient eluviation is indicated by increases in both free iron oxide and phosphorus which show a secondary peak in the B2 horizon. Ordinarily the phosphorus values are high in the A horizon. It is probable that most of the phosphate is of organic origin. Rather high values found in A horizons of many Arctic soils likely reflect decreased leaching. The secondary values in the B2 probably result from eluviation and in-mixing of A horizon material. No phosphorus-free iron oxide association was noted. Other chemical properties remain rather uniform throughout the profiles. Base saturation in these profiles exceeds that for those of other soil groups. They more closely approach values obtained on profiles collected in west Greenland as reported by Holowaychuk and Everett (in preparation).

From the standpoint of expression of the zonal soil-forming processes, soils of the coarser-grained sandstone upland, Soil Group 4, Plate I, display the maximum. These soils develop in the most stable environments, generally small areas, and are associated with bedrock outcrops. Thaw is deep, 0.5 to 1.0 m. The pH profile is minimum in the B horizon and increases again in the C.

Frequently profiles of this well-drained soil show a very thin, discontinuous, bleached A2 horizon. Chemical and physical evidence for an A2 is largely in the form of low free-iron values and a marked decrease in clay. Unfortunately, the horizon is usually so thin and discontinuous that adequate samples for complete analyses are difficult, if not impossible, to obtain.

The B horizon is characterized by an increase in free iron, phosphorus, and organic matter over the A2 and C horizons. In this, as well as some other coarse-grained soils, $CaCO_3$ encrustations are common on the underside of surface fragments and larger skeletal material in the B2 horizon; exchangeable calcium values have corresponding peaks in the A and B2 horizons.

The wet or waterlogged soils, designated Soil Group 1, Plate I, are associated with the thermokarst flood plains and snowbank melt areas. Normally these soils show a succession of only slightly decomposed peat (Fig. 5 illustrates profile characteristics). Neither the percentage of organic matter nor the organic carbon content are sufficient to qualify these soils as histic. The included mineral matter is the result of inwash from streams and snowbanks and of wind-blown debris.

The pH profile ranges from very slightly acid to very slightly alkaline. Free-iron values are low except in areas with sufficient relief (hummocks) to develop an Oir horizon. Extractable phosphorus values are uniformly low, perhaps indicating removal from the profile and low organic matter decomposition. Extractable sodium is high relative to other soils, probably because these depressed areas act as catchments for snow and runoff and are thus collection points for sodium. Salt crusts are well developed in these areas when subjected to surface drying in late summer. The chemical composition of the salts has not been determined. They appear to be a combination of calcium carbonate and a relatively insoluble salt, perhaps similar to thenardite, Na_2SO_4, described by Tedrow (1966).

The soils described from the Mould Bay area show uniformly low conductivity values. Values obtained by Tedrow (1966) for several Polar Desert soils in the same region show much higher values. A partial explanation of this difference lies in the analytical methods used. Tedrow's (1966) values were obtained on a 1:1 soil-water paste while those presented in the preceding tables were obtained from a 1:5 soil-water dilution. The data are not strictly comparable.

It appears likely that the carbonate is derived from bedrock. This is probably also true for some phosphates, particularly where occasional high values are recorded for C horizon material. Probably most of the sodium is also derived from bedrock sources. The atmospheric contribution of the sodium must be very small because of the nearly complete ice cover surrounding the island, even during the melting season. For example, compare the sodium values for the Prince Patrick area soils with those from Victoria Island (Tables XIV to XVI), which is surrounded by considerable open sea water. The same comparison can be made with southern Baffin Island. The sodium and magnesium values for ice-locked Ellef Ringnes Island are higher than those for Prince Patrick, but this can readily be explained as contributions from autochthonal sodium and magnesium in the bedrock which is relatively rich in sulfates.

ISACHSEN AREA (78° 17' N, 103° 22' W)

A single soil association occurs in the Isachsen area composed of four drainage categories: category I, wet: category II, very poorly drained; category III, poorly drained to somewhat poorly drained; category IV, well drained. The basis for these categories is the same as that outlined on pages 12 and 13. With the exception of small, isolated areas of wet and well-drained soils all others fall within categories II and III. Very slight changes in microrelief and texture are sufficient to shift soil drainage from one category to another. For this reason no attempt has been made to differentiate those slight changes on Plate IV.

Although the gabbro and diabase sills provide some coarse materials, it is usually insufficient to overshadow the influence on soil texture of the clays and silts derived from the parent material. Heavy textures combined with a very shallow thaw zone, large semi-permanent snowbanks, and subdued microrelief result in the dominance of very poorly and poorly drained soils.

Four kinds of soil are recognized in the Isachsen area. A description and some pertinent laboratory data are presented for each type. The Soil Survey Manual (Soil Survey Staff, 1951; 1962) was used as the basis for the terminology employed in the descriptions.

Soil Group 1 is characterized by a thin, histic surface horizon. This horizon seldom exceeds 5 cm. A thin O2ir horizon is ordinarily developed except in areas of flowing water. This horizon lacks sufficient organic matter to qualify as histic. Organic matter throughout the profile ranges from undecomposed to slightly decomposed. In areas slightly less waterlogged, decomposition is somewhat more advanced. It is not uncommon to find quantities of fibrous organic material in the underlying strongly gleyed subsoil.

These soils are very restricted in areal extent, occurring in small depressions associated with permanent or semi-permanent snowbanks. They are most frequent in areas with thick gabbro outcrops.

The following profile is considered typical. See Plate IV for location and Table VIII for chemical and mechanical properties.

Soil: ISN 11

Location: Ellef Ringnes Island - Isachsen.

Topography: Small depression surrounded by basalt outcrops. Slope 0°-1°.

Drainage: Wet.

Table VIII. Selected Chemical Properties and Particle Size Distribution for Profile ISN 11, Soil Group 1, Isachsen

Profile	Horizon	Depth (cm)	pH[1]	Organic C[2]	Organic matter	Electrical conductivity[3]	Phosphorus[4]	Free Fe_2O_3	Exchangeable cations meq/100 g: H	Ca	Mg	K	Na	Σ exch. cations meq/100 g	Σ of bases meq/100 g	Base sat %	Calcite	Dolomite	$CaCO_3$ equiv
ISN 11	O1	7-2	5.2	33.1	56.9	0.5	90	2.0	39.3	19.1	10.0	2.73	0.70	71.8	32.5	45	--	--	--
	O2ir	2-0	4.9	6.7	11.5	0.2	7	4.2	26.4	5.6	4.0	0.39	0.18	36.6	10.2	28	--	--	--
	B1g	0-6	4.9	3.8	6.5	0.1	5	3.4	21.0	3.6	3.2	0.31	0.12	28.2	7.2	26	--	--	--
	B2g	6-16	4.9	2.7	4.6	0.2	3	3.4	19.0	3.5	2.4	0.41	0.11	25.4	6.4	25	--	--	--
	B3g	16-28	4.7	2.4	4.1	0.2	4	3.3	17.2	3.6	2.5	0.44	0.14	23.9	6.7	28	--	--	--

Profile	Horizon	Depth (cm)	Particle Size (mm)	2-1	1-0.5	0.5-0.25	0.25-0.1	0.1-0.05	Total sand > 0.05	Silt 0.05-0.002	Clay < 0.002	Class
ISN 11	B1g	0-6	Distribution (percent)	0.0	0.3	0.9	2.4	3.1	6.8	57.8	35.4	SCL
	B2g	6-16		0.3	0.5	1.5	4.1	4.2	10.6	47.9	41.5	SC
	B3g	16-28		0.1	0.4	1.7	4.4	4.7	11.3	50.4	38.3	SC

1 Glass electrode, 1:1 water dilution
2 Loss on ignition
3 Electrical conductivity of 1:5 water extract in mmhos/cm @ 25°C
4 Bray method

Vegetation: Carex sp., mosses and algal scum. Ranunculus sp., becomes prominent where there perceptible water movement. 100% cover.

Remarks: Slight microrelief approximately 10 cm, in the form of hummocks (see Table VIII for analytical data).

Profile description

01 7-2 cm; living moss, Carex sp., and coarsely fibrous organic matter. Some intermixed silt. Lower boundary clear.

021ir 2-0 cm; dark reddish brown (2.5YR 3/6, wet); very dark brown (7.5YR 3/2); coarsely fibrous organic matter and silt. Lower boundary clear, smooth.

03-B1g 0-6 cm; dark brown (7.5YR 4/4, wet); silty clay loam; massive; yellowish red (5YR 4/8); dark red (2.5YR 4/2) mottles. Roots, stems and moderately decomposed leaves present, lower boundary clear to gradual.

B2g 6-16 cm; dark gray; dark gray brown (10YR 4/2-4/3) silty clay. Finely gleyed; roots abundant; some raw leaf material; massive; wet. Lower boundary gradual to clear.

B3g 16-28 cm; strong brown (7.5YR 5/6); very dark gray (10YR 3/1) silty clay loam or clay, coarsely mottled; strong brown color becomes dominant as depth increases; massive; roots few; wet. Permafrost.

Soil Group 2 is a very poorly to poorly drained soil and is typically developed in shallow swales, inter-polygonal depressions, slopes adjacent to drainage channels and over extensive areas between the Isachsen River and Hydra Bay (Fig. 10 and 11). Slopes range from 3° to 10°. The soil is closely related to Soil Group 3. The representation of soils classed as 2 and 3 on Plate IV is done on the basis of dominance.

Soil Group 2 is characterized by a moderately high concentration of organic matter in the A1 horizon. Subhorizons are silty clay loams or silty clays which only rarely show mottling. The B1 and B2 horizons display weak structure in the form of medium to coarse granular units or, occasionally, medium to coarse subangular blocky units. Small amounts of organic material are distributed throughout the profile. In many respects these soils are similar to Soil Group 2 described from Prince Patrick Island although they do not show as much surface evidence of erosion and desiccation polygons.

Profiles ISN 6 and 15 are considered generally typical for Soil Group 2 in the Isachsen area (Fig. 11). Profile ISN 4 is typical only

Fig. 10 - General Aspect of Terrain Northeast of Isachsen Weather Station. Mesas in Background Are Gabbro. Semi-Permanent Snowbanks Keep the Long Relatively Uniform Slope in the Foreground near Saturation Throughout the Melt Season. Soil Group 2. Note Near Absence of Vascular Plants (August, 1965)

Fig. 11 - General Aspect Consistent with Soil Group 2. ISN 7 Left and Center Middle Ground and Soil Group 3 ISN 6 Foreground. View Typical of Much of the Area Surrounding Isachsen Weather Station (August, 1965)

in areas which receive a strong in-wash of sands and gravels from adjacent basalt cliffs over short slopes.

Soil: ISN 6

Location: Ellef Ringnes Island - 0.5 km WSW of Isachsen station.

Topography: Swale, $3\frac{1}{2}°$ slope.

Drainage: Very poorly drained. Wet but no free water.

Vegetation: Carex sp. and Rhacomitrium sp.; scattered black and white crustose lichens. 100% ground cover.

Remarks: Slight microrelief (about 5 cm) of small mossy hummocks and Carex sp. tufts. Some surface cracking 3 cm deep in rough polygonal form. Wet below 3 cm (see Table IX for analytical data).

Profile description

O1 1-0 cm; mat of moss.

A1 0-3 cm; dark brown (7.5YR 3/2) silty clay with fibrous organic material; massive; rubs easily with slick greasy feel; roots abundant; lower boundary clear, discontinuous.

B1 3-7 cm; dark grayish brown (10YR 4/2) silty clay with high content of fibrous organic material; medium coarse granular to subangular blocky structure; massive; roots abundant; lower boundary clear.

B2 7-14 cm; dark grayish brown (10YR 4/2) silty clay; medium coarse granular to subangular blocky structure; massive; sticky; roots plentiful; lower boundary gradual.

B3 14-28 cm; very dark grayish brown (10YR 3/2) silty clay; massive; very sticky; roots few to plentiful; common shale and occasional basalt fragments. Permafrost.

Soil: ISN 15

Location: Ellef Ringnes - SSW of Isachsen station at head of Station Bay.

Table IX. Selected Chemical Properties and Particle Size Distribution for Profile ISN 6, Soil Group 2, Isachsen

Profile	Horizon	Depth (cm)	pH[1]	Organic C[2]	Organic matter	Electrical conductivity[3]	Phosphorus[4]	Free Fe_2O_3	Exchangeable cations meq/100 g: H	Ca	Mg	K	Na	Σ exch. cations meq/100 g	Σ of bases meq/100 g	Base sat %	Calcite	Dolomite	$CaCO_3$ equiv
ISN 6	A1	0-3	5.1	5.8	10.0	0.3	8	3.3	16.8	8.7	6.2	0.72	0.34	32.8	16.0	49	--	--	--
	B1	3-7	4.8	3.1	5.3	0.2	9	3.8	12.9	6.3	4.8	0.56	0.23	24.8	11.9	48	--	--	--
	B2	7-14	5.0	2.9	5.0	0.2	16	4.0	11.9	5.8	4.5	0.56	0.21	23.0	11.1	48	--	--	--
	B3	14-28	5.2	2.6	4.5	0.2	20	4.2	11.7	5.3	5.0	0.51	0.17	22.7	11.0	48	--	--	--

Profile	Horizon	Depth (cm)	Particle Size (mm) / Distribution (percent)	2-1	1-0.5	0.5-0.25	0.25-0.1	0.1-0.05	Total sand > 0.05	Silt 0.05-0.002	Clay < 0.002	Class
ISN 6	A1	0-3		0.3	0.4	1.2	1.7	1.1	4.7	46.7	48.7	SC
	B1	3-7		0.0	0.3	0.8	2.2	2.8	6.1	45.8	48.2	SC
	B2	7-14		0.4	0.8	0.8	1.1	0.9	3.9	46.3	49.8	SC
	B3	14-28		0.4	0.9	1.0	1.3	1.0	4.6	49.4	46.0	SC

[1] Glass electrode, 1:1 water dilution

[2] Loss on ignition

[3] Electrical conductivity of 1:5 water extract in mmhos/cm @ 25°C

[4] Bray method

Topography: Area has little relief; 3° slope.

Drainage: Very poorly drained.

Vegetation: Sparse stand of individual plants of Carex sp. Cover 1-2% of surface.

Remarks: Surface consists of incomplete cover, about 30% of lag gravel of moderate size (basalt fragments of 7-9 cm and smaller). Area has little microrelief, about 2 to 4 cm, being largely the difference between rock fragments and the clay surface. Large soil polygons. Some soil cracking, both parallel and normal to contour, which may be secondary polygonal fracturing, 0.5 to 0.8 m across. Surface was moderately dry (see Table X for analytical data).

Profile description

A1 0-10 cm; very dark grayish brown to dark brown (10YR 3/2-3/3) clay; moderate fine granular structure; somewhat friable, not sticky, upper 3-4 cm friable with some disseminated organic matter; roots few to absent; less than 5% skeletal material by volume; lower boundary gradual, wavy.

B1 10-28 cm; intermingled very dark grayish brown (10YR 3/2) and dark brown (10YR 3/3) silty clay; massive with tendency to break into medium platy or weak fine granular structure; slightly sticky; roots few to absent; 5 to 10% skeletal material by volume; lower boundary gradual.

B2 28-42 cm; very dark grayish brown (10YR 3/2) clay; strong medium platy structure; moderately sticky; skeletal material less than 5% by volume. Permafrost.

Soil: ISN 4

Location: Ellef Ringnes Island - Isachsen.

Topography: Short 10° south-facing slope, below Basalt Cliffs.

Drainage: Poorly drained.

Vegetation: Rhacomitrium sp., other mosses, some crustose and fruticose lichens, occasional Salix sp. and Carex sp.

Table X. Selected Chemical Properties and Particle Size Distribution for Profile ISN 15, Soil Group 2, Isachsen

									Exchangeable cations meq/100 g										
	Horizon	Depth (cm)	pH[1]	Organic C[2]	Organic matter	Electrical conductivity[3]	Phosphorus[4]	Free Fe_2O_3	H	Ca	Mg	K	Na	Σ exch. cations meq/100 g	Σ of bases meq/100 g	Base sat %	Calcite	Dolomite	$CaCO_3$ equiv
ISN 15	A1	0-10	4.0	2.0	3.4	0.5	8	4.3	21.0	2.0	4.7	0.41	0.76	28.9	7.9	27	--	--	--
	B2	28-42	3.1*	2.4	4.1	2.0	9	3.6	20.2	18.4	6.0	0.20	1.04	45.8	25.6	56	--	--	--

			Particle Size (mm)								
	Horizon	Depth (cm)	2-1	1-0.5	0.5-0.25	0.25-0.1	0.1-0.05	Total sand > 0.05	Silt 0.05-0.002	Clay < 0.002	Class
			Distribution (percent)								
ISN 15	A1	0-10	1.6	1.6	1.5	1.8	1.1	7.5	38.6	53.9	C
	B2	28-42	T	0.2	0.2	0.4	0.6	1.4	52.6	46.0	SC

* 1:1 water dilution, pH 2.9 KCl dilution
[1] Glass electrode, 1:1 water dilution
[2] Loss on ignition
[3] Electrical conductivity of 1:5 water extract in mmhos/cm @ 25°C
[4] Bray method

Remarks: Moist to 8 cm; wet below (see Table XI for analytical data).

Profile description

A1 0-5 cm; very dark brown (10YR 2/2) loam mixed with organic matter; massive; roots abundant, coarse gravel 20 to 40% by volume; lower boundary clear, wavy.

A3 5-8 cm; very dark grayish brown (10YR 3/2) silt loam; loose; roots abundant; coarse gravel 10 to 15% by volume; lower boundary clear.

B1 8-17 cm; dark grayish brown (10YR 4/2) sandy loam massive; roots plentiful; gravel 15 to 20% by volume; lower boundary clear to gradual.

B2 17-24 cm; very dark grayish brown to dark brown (10YR 3/2-3/3) gravel and loamy sand; loose; roots few to plentiful; lower boundary abrupt.

IIB3 24-43 cm; very dark gray (10YR 3/1) loamy sand; massive; roots few to plentiful; fine shale fragments about 5% by volume.

Soil Group 3 occurs on interfluve areas and slopes ranging up to 5°. It is largely confined to areas of shale outcrop and is analogous to Soil Group 2A described from the Mould Bay area (page 23). The soil surface has little vegetation which is mainly composed of scattered vascular plants. It is usually dry and hard with an incomplete cover of gabbro lag gravel and displays well-developed small desiccation polygons and occasional large diameter polygons (Fig. 11 and 12 show topographic relations and representative profiles for Soil Groups 2 and 3).

The upper 10 to 15 cm of the profile is a silty clay and is low in organic matter. It is dark to very dark grayish brown and breaks easily into coarse and medium subangular units. The upper 1 to 2 cm under a silt-clay crust has a spongy structure. From approximately 15 cm in depth to the permafrost this fine textured soil increases in shale skeleton and the soil becomes massive. Horizon differentiation is based primarily on structure. When wet the soil loses all structure and becomes very sticky. The following profile is typical and the pertinent chemical and physical data are presented in Table XII.

Soil: ISN 7

Location: Ellef Ringnes Island - Isachsen.

Table XI. Selected Chemical Properties and Particle Size Distribution for Profile ISN 4, Soil Group 2, Isachsen

ISN 4

Horizon	Depth (cm)	pH[1]	Organic C[2]	Organic matter	Electrical conductivity[3]	Phosphorus[4]	Free Fe_2O_3	Exchangeable cations meq/100 g: H	Ca	Mg	K	Na	Σ exch. cations meq/100 g	Σ of bases meq/100 g	Base sat %	Calcite	Dolomite	$CaCO_3$ equiv
A1	0-5	5.8	7.2	12.4	0.3	8	2.1	13.1	18.4	6.0	0.15	0.30	38.0	24.9	66	--	--	--
A3	5-8	5.7	3.7	6.4	0.2	4	2.0	9.5	12.6	4.1	0.28	0.20	26.7	17.2	64	--	--	--
B1	8-17	6.0	1.0	1.7	0.1	2	2.7	5.7	8.4	2.8	0.18	0.14	17.2	11.5	67	--	--	--
B2	17-24	5.9	0.9	1.5	0.1	4	2.1	4.6	5.8	1.8	0.18	0.12	12.5	7.9	63	--	--	--

ISN 4

Horizon	Depth (cm)	Particle Size (mm) / Distribution (percent)	2-1	1-0.5	0.5-0.25	0.25-0.1	0.1-0.05	Total sand > 0.05	Silt 0.05-0.002	Clay < 0.002	Class
A1	0-5		8.93	10.25	11.30	12.60	4.66	47.75	32.99	19.26	L
A3	5-8		2.22	3.41	3.18	3.78	1.96	14.55	66.37	19.08	SL
B1	8-17		7.40	11.66	13.79	20.14	11.66	64.65	26.17	9.18	SdL
B2	17-24		22.48	23.08	15.82	13.56	5.92	80.86	13.44	5.70	LSd

1 Glass electrode, 1:10 water dilution
2 Loss on ignition
3 Electrical conductivity of 1:5 water extract in mmhos/cm @ 25°C
4 Bray method

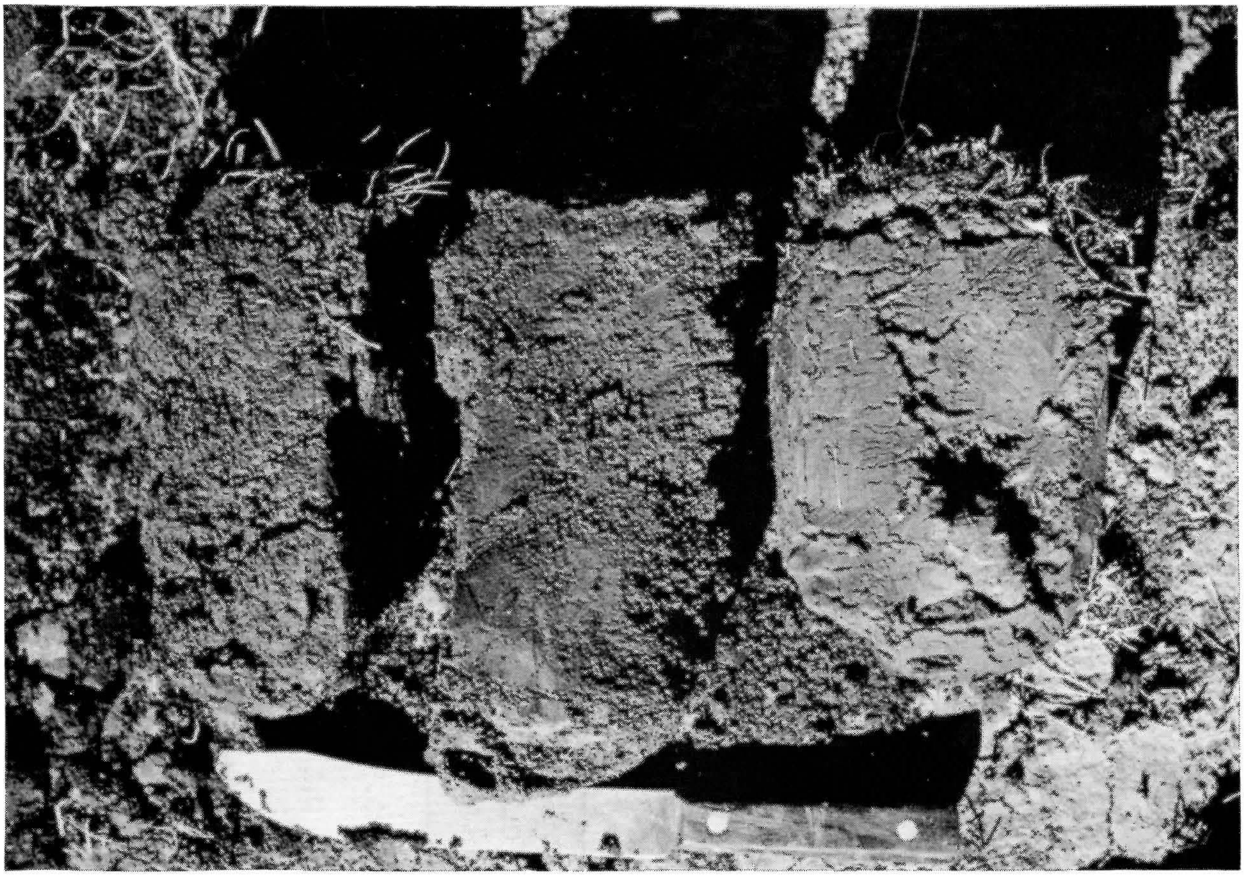


Fig. 12 - Profiles Showing Range in Soil Character, Isachsen. Center Profile Typical of Soil Group 2 and Corresponding to Position of Spade Handle in Fig. 11. Left Profile Typical of Soil Group 3 and Corresponding to Position of Spade Point. Right Profile Is Intermediate Between the Above (August, 1965)

Table XII. Selected Chemical Properties and Particle Size Distribution for Profile ISN 7, Soil Group 3, Isachsen

Profile	Horizon	Depth (cm)	pH[1]	Organic C[2]	Organic matter	Electrical conductivity[3]	Phosphorus[4]	Free Fe_2O_3	Exchangeable cations meq/100 g: H	Ca	Mg	K	Na	Σ exch. cations meq/100 g	Σ of bases meq/100 g	Base sat %	Calcite	Dolomite	$CaCO_3$ equiv
ISN 7	A1	0-12	6.0	2.6	4.5	0.2	10	4.5	8.0	7.8	4.4	0.54	0.16	20.9	12.9	62	--	--	--
	C	12-37	4.7	2.8	4.8	0.2	10	3.7	9.4	5.2	4.1	0.54	0.17	19.4	10.0	52	--	--	--

Profile	Horizon	Depth (cm)	Particle Size (mm) / Distribution (percent): 2-1	1-0.5	0.5-0.25	0.25-0.1	0.1-0.05	Total sand > 0.05	Silt 0.05-0.002	Clay < 0.002	Class
ISN 7	A1	0-12	0.02	0.1	0.1	0.3	0.5	1.0	49.0	50.0	SC
	C	12-37	0.04	0.1	0.0	0.1	0.1	0.3	47.3	52.4	SC

[1] Glass electrode, 1:1 water dilution
[2] Loss on ignition
[3] Electrical conductivity of 1:5 water extract in mmhos/cm @ 25°C
[4] Bray method

Topography: Crest of an interfluve, 5° slope.

Drainage: Well drained.

Vegetation: White crustose lichens, green and black moss; <u>Papaver</u> <u>radicatum</u> and <u>Carex</u> sp. and scattered grasses.

Remarks: Microrelief 5 to 10 cm; well-developed desiccation type cracking (polygons 24 cm). Polygon surfaces bare and checked, 5 to 10% covered with some shale fragments (0.5-1 cm size), occasional basalt fragments (see Table XII for analytical data).

Profile description

A1 0-12 cm; dark grayish brown (10YR 4/2, dry) silty clay with very dark grayish brown (10YR 3/2) surfaces; massive and hard, upper few centimeters somewhat friable and breaks to coarse and medium subangular blocky units; roots few; very small (4 mm) shale fragments, 20% by volume; lower boundary clear to gradual.

C 12-37 cm; dark grayish brown (10YR 4/2) silty clay; massive; shale fragments (4 to 8 cm) 25 to 30% by volume. Soil is moist in upper part and wet and sticky in lower.

<u>Soil Group 4</u> is developed on relatively stable areas associated with gabbro-diabase intrusions. The profile described below represents the only one encountered in the map area. This soil does not appear to develop to the same degree on the gabbro-diabase uplands. Debris islands associated with felsenmeer on these areas are too active to allow much profile development.

This soil is somewhat analogous to Soil Group 4 described in the Mould Bay area (page 33). It is characterized by a thin A1 horizon, low in organic material, and a high percentage of coarse skeletal material. The lower side of most of the larger fragments is iron stained but no calcium carbonate encrustations were noted. In the very dark grayish brown silty clay loam B horizon the skeletal content remains high and shows both iron stain and silt-clay coatings.

The B3 is largely an open boxwork of large skeletal fragments which have thick, noncalcareous silty clay or clay coatings on their upper surfaces and calcareous crusts on the lower side. These crusts are absent just above the permafrost. The profile shows the highest pH values of any described in the area. Detailed morphology, and chemical and physical properties are presented below.

Soil: ISN 1

Location: Ellef Ringnes Island - Isachsen.

Topography: Nearly level crest, slope 0°.

Drainage: Well drained.

Vegetation: Black and white crustose, some fruticose, lichens, and some moss. Vegetation covers 5 to 20% of surface.

Remarks: Basalt felsenmeer and basalt outcrop; intruded into black shale (baked gray), fragment size usually in the 5 to 15 cm range. Permafrost at 38 cm (see Table XIII for analytical data).

Profile description

A1 0-4 cm; dark grayish brown (10YR 4/2, dry) silt loam; very thin platy structure breaking to weak medium granular, slightly vesicular; friable; roots few to absent, sparse root mat and concentration of fine black shale fragments under rocks; surface rocks show no effervescence with HCl but usually show ferruginous staining; coarse skeleton 50 to 75% by volume; lower boundary clear.

B2 4-10 cm; very dark grayish brown (10YR 3/2 moist) silty clay loam; massive, breaking to strong to moderate angular and subangular units; roots few to occasional; about 50% rocks by volume; rocks show ferruginous staining on lower surface and clay skins on top; lower boundary clear to gradual.

B3 10-38 cm; largely an open boxwork of rock fragments with very dark grayish brown (10YR 3/2) sticky clayey accumulation on upper surfaces; clayey material has a granular structure and a crushed color of dark brown to dark yellowish brown (10YR 4/3-4/4); roots not evident, calcareous coatings appear below 25 cm and terminate at 38 cm depth; clayey material does not effervesce with HCl.

Discussion

The area examined probably represents the optimum conditions for soil formation on Ellef Ringnes Island. The soils themselves are probably very close to any theoretical northern limit of development, at least on fine-grained bedrock. They reflect the simplicity of the lithologic and biologic environment. It is likely that greater lithologic

Table XIII. Selected Chemical Properties and Particle Size Distribution for Profile ISN 1, Soil Group 4, Isachsen

Profile	Horizon	Depth (cm)	pH[1]	Organic C[2]	Organic matter	Electrical conductivity[3]	Phosphorus[4]	Free Fe_2O_3	Exchangeable cations meq/100 g: H	Ca	Mg	K	Na	Σ exch. cations meq/100 g	Σ of bases meq/100 g	Base sat %	Calcite	Dolomite	$CaCO_3$ equiv
ISN 1	A1	0-4	6.1	1.4	2.4	0.2	9	2.9	5.5	8.5	3.2	0.45	0.10	17.8	12.3	69	--	--	--
	B2	4-10	6.6	1.0	1.7	0.1	6	3.3	3.8	17.0	4.5	0.55	0.13	26.0	22.2	85	--	--	--
	B3	10-38	7.2	---	---	0.2	6	3.4	---	----	---	----	----	----	----	--	T	T	T

Profile	Horizon	Depth (cm)	Particle Size (mm) / Distribution (percent)	2-1	1-0.5	0.5-0.25	0.25-0.1	0.1-0.05	Total sand > 0.05	Silt 0.05-0.002	Clay < 0.002	Class
ISN 1	A1	0-4		3.00	4.61	4.29	5.11	2.65	19.66	57.68	22.66	SL
	B2	4-10		1.88	3.29	3.40	4.49	2.75	15.81	48.34	35.85	SCL
	B3	10-38		4.05	5.04	5.04	5.54	2.86	22.53	34.56	42.91	C

[1] Glass electrode, 1:10 water dilution
[2] Loss on ignition
[3] Electrical conductivity of 1:5 water extract in mmhos/cm @ 25°C
[4] Bray method

variability would result in a greater diversity of soil groups. The dual soil association of Prince Patrick Island does not exist here, although analogs occur.

Soil Group 2 on Plate IV represents less-well-drained soils occurring along drainage ways, snowbank areas and broad lowland shale areas. Although not differentiated on Plate IV, these soils are closely related to the Soil Group 2 soils (Plate I), especially in the depressions surrounding large tundra polygons. Characteristically these soils are moderately acid, and all display a thin A horizon. The presence of a more complete cover of vegetation is reflected in the relatively higher organic carbon values for this horizon. These soils are best developed in areas most likely to receive wind-blown organic material which may add significantly to the total organic matter content.

Exchangeable sodium values are uniformly high. It is unlikely that this is the result of additions of atmospheric sodium, for reasons cited on page 39, but results from bedrock-derived sodium. Profiles ISN 6 and 4 both show a progressive decrease in exchangeable sodium with depth which indicates a surface concentration due to evaporation of upward moving soil water. Electrical conductivity values are rather uniform throughout the area except in profile ISN 15, where they, along with the sodium and magnesium values, reach a maximum. This profile is poorly drained and very close to Station Bay. Sufficient melting occurs along the margin of the bay so that small waves can be generated. The increase in both of these values can be attributed to sea salts, either derived from spray or more likely, past inundation.

Phosphorus values are low and show little significant variation from profile to profile, with the exception of ISN 6. The increase in phosphorus level in the B2 and B3 horizons (Table IX) cannot be attributed to organic material. It probably represents a contribution of inorganic phosphate from the bedrock. This explanation is also applicable to profile ISN 7.

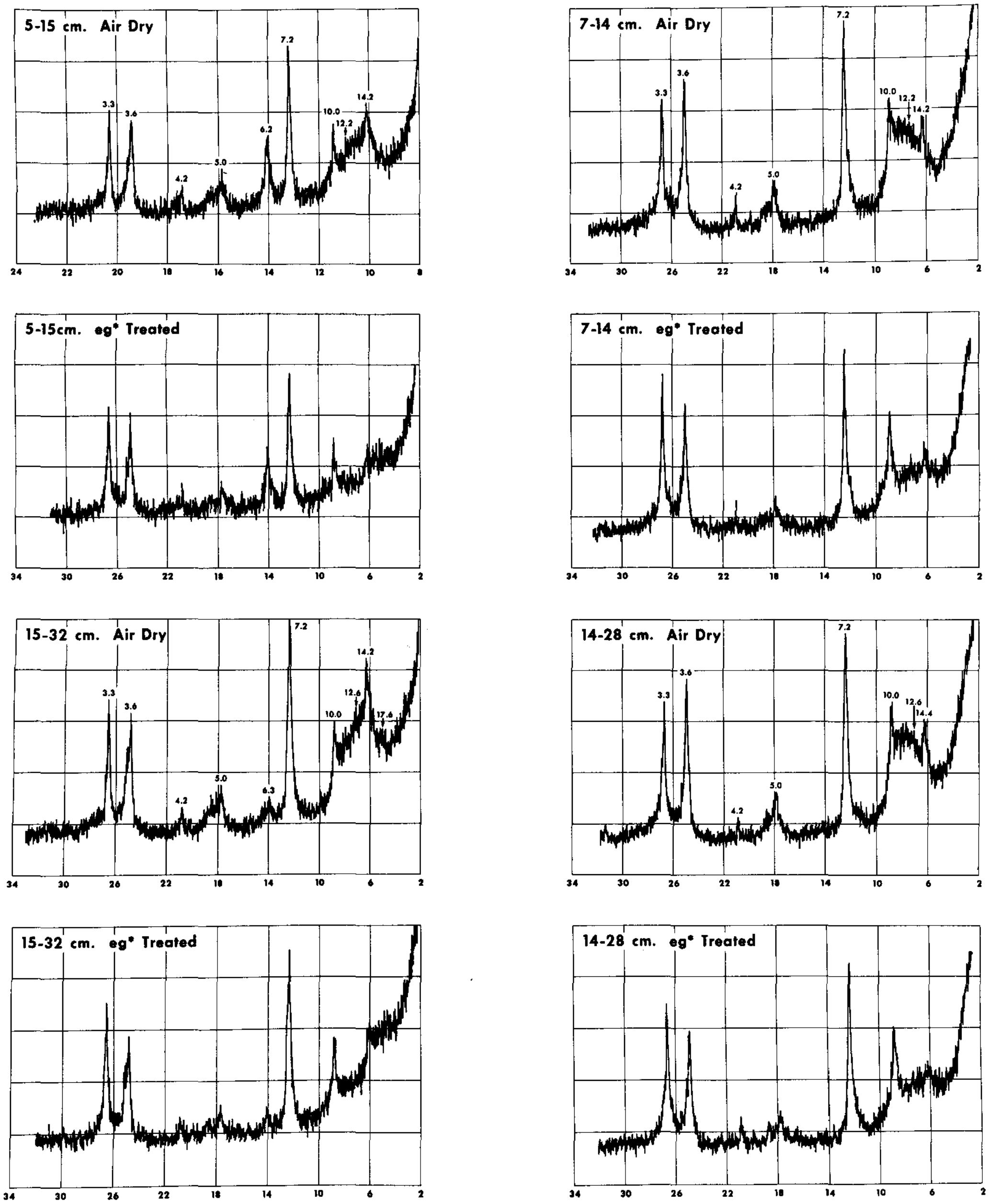
The X-ray diffractograms (Fig. 13) show no significant differences in the clay between the B2 and C horizons. When this is considered with the chemical uniformity of the profile it is apparent that little intensive weathering and profile development has taken place.

The area designated Soil Group 3 on Plate IV is analogous to the Soil Group 2A of Plate I. It occupies interfluve areas on shale. These areas are subject to nearly continual wind abrasion and periodic intense desiccation which manifests itself in the form of small (24 cm) polygons. Large tundra polygons are also present and some of their depressed borders may contain semi-permanent ponds.

The permafrost table is shallow, even on interfluve areas. This, combined with the fine texture of the soil, produces restricted drainage in the lower 15 to 20 cm of the profile and is responsible for moist to

X-RAY DIFFRACTOGRAMS FOR SOIL 3 (MOL 18) MOULD BAY

X-RAY DIFFRACTOGRAMS FOR SOIL 2 (ISN 6) ISACHSEN



All Clays Mg Saturated; CuKα Radiation N Filter; Scan Speed 2°2θ/min.; Counting Rate 1000c/s.

* Ethylene Glycol Treated.

Fig. 13

saturated conditions of that zone. The upper 10 to 15 cm of the profile may become desiccated during the summer. The two horizons which were defined mainly on structural differences, are similar in all recorded chemical properties. The only significant difference occurs in the pH values of the A1 and C1 horizons where they are among the highest in the area. These high values reflect the pronounced upward movement of soil moisture. Sodium values are about average for the study area as a whole. No salt efflorescence was noted on the surface of these soils and it is likely that desiccation is not sufficiently intense to cause any appreciable buildup of salts in the upper horizon.

The organic soils show great variability from place to place in high northern latitudes, both in mechanical and chemical properties. In a general way, as one proceeds north the quantity of organic carbon decreases and the organic horizons become thinner. Typically, the organic soils developed in the Isachsen area (Soil Group 1, Plate IV) are only moderately to slightly acid. Sodium and potassium values are usually much higher than in adjacent soils because the organic soils occupy small depressions which receive large quantities of influent meltwater and drifted snow. This condition serves to concentrate salts. Phosphorus values range widely from site to site and area to area depending upon the amount and type of organic material present. It ranges, for example, from 90 ppm in ISN 11, Soil Group 1 (Ellef Ringnes Island), which is a very high value, to as low as 5 ppm for the equivalent soil on Prince Patrick Island.

The only well-drained profile obtained in the Isachsen area (ISN 1, Soil Group 4) is similar to MOL 9 (Prince Patrick Island) in many ways, although it is less well developed. The pH values for ISN 1 are the highest obtained for any soil in the area. Base saturation is high, reflecting the influence of the gabbro intrusives. An A2 horizon was not discernible either in the field or from chemical analyses.

CLAY MINERALS

The diffractograms for ISN 6 (Soil Group 2, Ellef Ringnes Island) and MOL 18 (Soil Group 3, Prince Patrick Island) indicate that vertical and horizonal differences in the two profiles are negligible (Fig. 13). Kaolinite exhibited a strong 7.2 Å peak which disappeared upon heating to 550° C. Definite peaks occur also at 10 Å and 14 Å. A broad diffuse 10 to 14 Å region appears in the air-dry treatment but is sharply reduced upon glycolation. A relatively large proportion of the 14 Å peak is shifted to 10 Å upon heating to 400° C but is stable upon glycolation. The 10 to 14 Å region is probably characterized by randomly interstratified illite, vermiculite, and montmorillonite since it readily collapsed upon heating to 400° C. The 10 Å component is considered to be illite. The remaining 13.5 Å material after heating to 550° C is considered to represent chlorite.

In only one sample, ISN 6, at 7 to 14 cm (B2), did the 13.5 Å peak disappear at 550° C (Fig. 13). A trace of chlorite still remained in the B3 horizon. This may indicate the weathering of chlorite to vermiculite or an interstratified component in the B2 horizon of this soil.

The tracings for samples of profile MOL 18 which had been glycolated and heated indicate a sharp 7.2 Å peak for kaolinite, a distinct 10 Å peak of illite, and a well-defined 14 Å peak of vermiculite and montmorillonite. The presence of an interstratified 10 to 14 Å region is less prominent than in profile ISN 6. The 10 Å and 14 Å components are more intense for the C horizon of this soil than the B2 horizon suggesting possible clay alterations.

GENERAL DISCUSSION AND SUMMARY

The less intensive soil-forming processes with increasing latitude have been amply demonstrated by Tedrow and Brown (1962). As these authors point out, there is a considerable difference between soils of the Tundra Zone and those of higher latitudes. The line separating these two areas coincides roughly with the 40° F July isotherm (Conover, 1960; Tedrow and Brown, 1962), although there exist a transition zone and possibly interfingering of areas governed by local conditions. Following Tedrow and Cantlon (1958) the terms Polar Desert and Tundra are used, respectively, to designate soil areas north and south of the 40° F line.

Within the Tundra Zone numerous kinds of soils differing in morphology and in chemical properties have been recognized and described. These differences in soils appear to result primarily from the drainage environment in which each of the soils has developed. Principal among these is the Arctic Brown soil (Tedrow, Drew, Hill and Douglas, 1958). This soil is considered to represent the maximum expression of the soil-forming process prevailing under a well-drained environment, in this case calcification.

Soils of this type have been described from the Point Barrow Area (Tedrow, Drew, Hill and Douglas, 1958). Other well-drained soils similar to the Arctic Brown, but showing an A2 horizon, have been noted from the Okpilak River area, Alaska (Brown, 1966), southwest Baffin Island (Everett, unpublished data), and west Greenland (Holowaychuk and Everett, in preparation). Soils of this type are very localized and account for a very small percentage of the soils of any area within the Tundra Zone.

The most widespread soils of the Tundra Zone show little if any evidence of podzolization. They commonly show a thin, well-humified A1 or O1 horizon with organic carbon values from 16 to 35%. The pH values tend to increase slightly with depth and range from moderately to slightly alkaline, depending upon the parent material. Unlike the

Arctic Brown soil the Tundra soils are subject to some substantial degree of frost action. They usually have a nearly complete cover of vegetation which ranges widely in composition, they occur on sloping terrain ranging from 0 to 20 percent or more, and they are seasonally wet. It has been noted that pH values tend to rise as the summer progresses and the soils dry. Salts (sodium sulfate and calcium carbonate) have been noted on the surfaces of many soils in late summer. It is likely that two processes are operating; i.e., calcification in the early summer and salinization during late summer.

The third major group of soils encountered in the Tundra Zone are the wet soils. These soils commonly have a series of surficial and upper O horizons composed of slightly to well-decomposed organic matter. The pH distribution tends to be quite erratic from horizon to horizon. Such soils occupy nearly level to basin areas and, in certain places, can be quite extensive. They are densely vegetated and have a shallow thaw zone.

Tedrow and Douglas (1964), working on Banks Island in an area of relatively coarse-grained parent material, describe an Arctic Brown profile similar in morphology to those farther south (Point Barrow) but having substantially higher pH values and carbonate encrustation, which he attributes to the increasing aridity of the Polar Desert zone. Free-iron values are uniform in this soil. Tedrow and Douglas do not consider it to be podzolic.

Tundra soils on Banks Island (Kellett series) appear to be closely related to Tundra soils in the Tundra Zone, both morphologically and chemically. (See Profiles CAM 1, 2, and 3 and Tables XIV-XVI for chemical analyses of a Tundra Zone toposequence.) Tedrow and Douglas (1964) noted no bog soils but cite their existence. The frequency, degree of development, and extent of bog soils decrease markedly north of the Tundra Zone.

The soils of Prince Patrick Island are for the most part Polar Desert. Large areas of western Prince Patrick, at least as far north as Satellite Bay, have soils which Tedrow (1966) considers equivalent to the Storkerson series (Tedrow and Douglas, 1964) of Banks Island. In the Mould Bay area, which certainly represents one of the less austere areas of the island, desert pavement soils, which may be closely related to the Storkerson series, are present on some of the uplands (Fig. 6).

Other soils which are tundra in character occupy extensive areas at Mould Bay, but are probably rare elsewhere on the island.

Soil: CAM 1

Location: Victoria Island - Cambridge Bay.

Vegetation: *Dryas integrifolia*, lichen and *Polygonum* sp., *Carex* sp., and some scattered *Salix* sp. cover about 95% of surface.

Drainage: Well drained.

Remarks: Surface uneven consisting of sorted nets and, near margin of crest, poorly defined small (1 m) polygons and active frost scars. Microrelief averages about 15 cm but ranges from 3 to 25 cm. Many large rocks and sandstone flags occur at the surface (see Table XIV for analytical data).

Profile description

O1 1-0 cm; mat of roots, leaves, stems.

A11 0-4 cm; dark reddish brown (5YR 2/2 dry) very fine sandy loam mixed with organic matter; loose, structureless; roots plentiful; large sandstone fragments 30 to 40% by volume; lower boundary clear to gradual, wavy.

A12 4-7 cm; dark reddish brown (5YR 3/3 dry) very fine sandy loam high in organic matter or commonly dark brown (7.5YR 4/2 dry) very fine sandy loam with coarse sand and high in organic matter; very weak fine granular structure to structureless; friable; roots abundant; pebbles and rocks 20 to 40% by volume; lower boundary clear to gradual, wavy.

B 7-21 cm; pale brown (10YR 6/3 dry) coarse to medium sand or loamy sand with pockets of light yellowish brown (10YR 6/4 dry) medium to coarse loamy sand; single grained; very friable; grit and pebbles about 20% by volume; lower boundary gradual.

C 21-40 cm; light brownish gray (2.5Y 6/2 moist) loamy fine to very fine sand; somewhat massive with tendency to platiness, breaks to weak, medium and coarse subangular; grit, pebbles and some large rock fragments, about 20% by volume; some silt skins on upper surfaces and calcareous coatings on under surfaces, latter not evident below 40 cm. Permafrost.

Soil: CAM 2

Location: Victoria Island - Cambridge Bay.

Topography: At base of 5° slope, site 2°.

Vegetation: *Salix* sp. and *Carex* sp., moss and *Dryas integrifolia*. Vegetation covers 100% of surface. *Salix* sp. occurs as scattered shrubs. *Dryas octopetala* on hummocks.

CAM 1

Table XIV. Selected Chemical Properties for Profile CAM 1, Cambridge Bay, Victoria Island

Horizon	Depth (cm)	pH[1]	Organic C[2]	Organic matter	Electrical conductivity[3]	Phosphorus[4]	Free Fe_2O_3	Exchangeable cations meq/100 g					Σ exch. cations meq/100 g	Σ of bases meq/100 g	Base sat %	Calcite	Dolomite	$CaCO_3$ equiv
								H	Ca	Mg	K	Na						
A11	0-4	7.6	--	3.7	0.5	10	0.3	--	--	--	--	--	--	--	--	1.3	20.8	23.8
A12	4-7	8.0	--	6.2	0.3	3	0.2	--	--	--	--	--	--	--	--	1.7	33.5	38.1
B	7-21	8.3	--	0.7	0.2	4	0.3	--	--	--	--	--	--	--	--	3.2	35.6	41.8
C	21-40	8.4	--	0.4	0.2	3	0.3	--	--	--	--	--	--	--	--	5.3	37.5	46.0

[1] Glass electrode, 1:1 water dilution
[2] Loss on ignition
[3] Electrical conductivity of 1:5 water extract in mmhos/cm @ 25°C
[4] Bray method

Drainage: Poorly drained. This soil is intermediate between well drained and wet soils.

Remarks: Hummocky, microrelief about 10 cm (see Table XV for analytical data).

Profile description

O1 10-0 cm; dark reddish brown (5YR 3/3 moist) moderately decomposed organic matter; little identifiable material; rubs down moderately easily, roots plentiful to abundant; lower boundary irregular with pendants extending 10 cm.

A1 0-3 cm; black to dark reddish brown (5YR 2/1-2/2 moist) decomposed organic material that rubs down moderately easily; roots plentiful to abundant; lower boundary abrupt, irregular (with pendants).

B1 3-6 cm; dark grayish brown (10YR 4/2 moist) loamy very fine sand; massive; roots few to plentiful; occasional very small pebbles; lower boundary clear.

B2g 6-16 cm; olive gray (5Y 5/2) loamy very fine sand with very large mottles of olive gray (5Y 4/2) very fine sand; massive; roots plentiful to abundant; lower boundary gradual to clear, wavy with zones of black (5Y 2/1) organic matter.

B3 16-21 cm; prominently mottled dark brown (7.5YR 4/4) and dark grayish brown (10YR 4/2) very fine sand; massive; smears and inclusions of black (5Y 2/1) organic matter. Permafrost.

Soil: CAM 3

Location: Victoria Island - Cambridge Bay.

Topography: Interpolygonal depression.

Drainage: Very poorly drained although no standing water present at time of examination.

Vegetation: Wet meadow type. *Carex* sp. and tall grasses with an understory of short grasses. 100% vegetative cover.

Remarks: Little or no microrelief. Pit did not fill up with water (see Table XVI for analytical data).

Table XV. Selected Chemical Properties for Profile CAM 2, Cambridge Bay, Victoria Island

	Horizon	Depth (cm)	pH[1]	Organic C[2]	Organic matter	Electrical conductivity[3]	Phosphorus[4]	Free Fe_2O_3	Exchangeable cations meq/100 g					Σ exch. cations meq/100 g	Σ of bases meq/100 g	Base sat %	Calcite	Dolomite	$CaCO_3$ equiv
									H	Ca	Mg	K	Na						
CAM 2	O1	10-0	7.0	34.8	59.9	0.6	14	0.2	19.1	62.5	28.1	0.77	0.51	111.0	91.9	83	---	----	----
	O2	0-3	7.6	--	3.6	0.2	4	0.3	--	--	--	--	--	--	--	--	1.7	20.6	24.1
	B2g	6-16	7.6	--	2.8	0.3	5	0.2	--	--	--	--	--	--	--	--	0.6	24.2	26.9
	B3	16-21	7.7	--	2.8	0.3	2	0.3	--	--	--	--	--	--	--	--	1.3	25.9	29.4

[1] Glass electrode, 1:1 water dilution
[2] Loss on ignition
[3] Electrical conductivity of 1:5 water extract in mmhos/cm @ 25°C
[4] Bray method

Table XVI. Selected Chemical Properties for Profile CAM 3, Cambridge Bay, Victoria Island

Profile	Horizon	Depth (cm)	pH[1]	Organic C[2]	Organic matter	Electrical conductivity[3]	Phosphorus[4]	Free Fe_2O_3	Exchangeable cations meq/100 g: H	Ca	Mg	K	Na	Σ exch. cations meq/100 g	Σ of bases meq/100 g	Base sat %	Calcite	Dolomite	$CaCO_3$ equiv
CAM 3	O11ir	16-11	5.8	38.1	65.5	1.7	20	2.6	43.4	38.2	18.9	2.12	2.34	104.9	61.5	58	--	--	--
	O12	11-0	6.2	35.1	60.4	0.7	70	1.1	38.5	47.5	21.3	0.79	1.57	109.7	71.2	65	--	--	--
	Bg	0-5	7.0	5.7	9.8	0.4	5	0.3	4.2	12.0	5.7	0.25	0.44	22.6	18.3	81	--	--	--

[1] Glass electrode, 1:1 water dilution
[2] Loss on ignition
[3] Electrical conductivity of 1:5 water extract in mmhos/cm @ 25°C
[4] Bray method

Profile description

Ollir 16-11 cm; dark reddish brown (5YR 2/2 wet, 5YR 3/3 squeezed) coarsely fibrous, partially decomposed peat in which roots, stems, and leaves are barely identifiable; rubs down moderately easily; roots plentiful to abundant; lower boundary clear, smooth.

O12 11-0 cm; black (5YR 2/1 wet), dark reddish brown (5YR 3/3 squeezed) fibrous, moderately decomposed peat; rubs down moderately easily; roots plentiful to abundant; lower boundary abrupt, smooth.

Bg 0-5 cm; frozen, sirloin ice evident; olive gray (5Y 4/2) loamy very fine sand with some fibrous, organic material (largely of Carex sp. or grass) present; fine roots plentiful to abundant, impart a peaty appearance to the soil; massive with tendency to platiness. Permafrost.

The most extensive soils in the Mould Bay area are those designated as Soil Groups 2 and 2A. Soil Group 2 has many features in common with soils belonging to the Bernard series (Tedrow and Douglas, 1964) of Banks Island. They appear to occupy similar topographic positions and have similar microrelief, although soils of Soil Group 2 develop on slightly steeper slopes than those of Banks Island. The pH values for Soil Group 2 are lower than those of the Bernard series. Both surface horizon organic matter and moisture regime are higher in Soil Group 2. Surface salt encrustations are common.

Soil Group 2A of the Mould Bay area occurs on gentle interfluve crests and approximates the "zero level" of profile development mentioned by Tedrow and Douglas (1964) for the Storkerson series and may well represent its counterpart on fine-grained parent material.

Wet or bog soils are rather extensive in the Mould Bay area, but their thickness and particularly their organic matter content are gently reduced in comparison to areas of northwest Alaska (Holowaychuk, Petro, Finney, Farnham and Gersper, 1966) or southwest Baffin Island (Everett, unpublished data). They are more closely related to the soils of west Greenland (Holowaychuk and Everett, in preparation).

Two small areas of very weakly developed podzol-like soils were noted on Prince Patrick Island. They are significant because they illustrate that the process of calcification is still a factor well into the Polar Desert zone.

Farther north, the soils of Ellef Ringnes Island show a marked decrease in intensity in already incipient soil-forming processes. It becomes increasingly difficult to differentiate soil classes as to their morphology. As on Prince Patrick Island, the composition of the parent material and microrelief are dominant controls in soil development. The high clay content of the soil, shallow thaw zone, and desiccating winds all but prevent downward moisture movement. Few significant chemical differences exist from one horizon to the next. The pH values indicate slight to moderate acidity but few show a significant increase in the upper horizon.

Almost all vestiges of the Tundra Zone soils are absent. Bog or organic soils are very rare and restricted. Significant organic matter accumulation is thin though yielding high organic carbon values.

Well-drained environments are rare and nothing was found to indicate that leaching was significant. Those soils occupy positions analogous to the Storkerson series. Soil development on this island is very close to the "zero" end of the continuum in the western Arctic. The change in character and intensity of the development of the major genetic soils and soil forming processes in the western Arctic is suggested in Fig. 14.

CLASSIFICATION

The soils described from the Mould Bay and Isachsen areas are classified tentatively in Table XVII according to the Seventh Approximation (Soil Survey Staff, 1960).

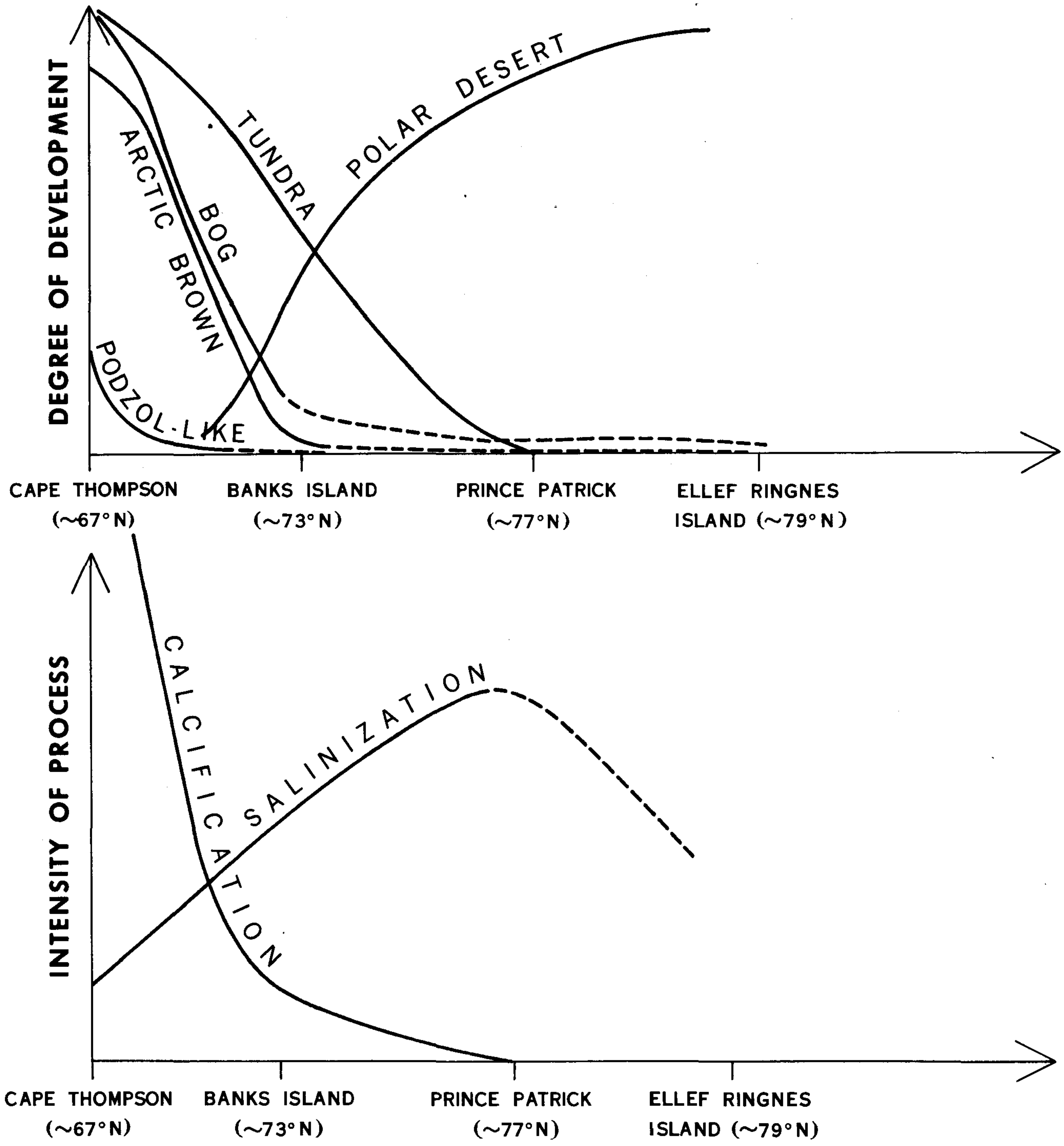


Fig. 14 - Graph Showing Suggested Trends in Character and Intensity of Development and Major Soil Forming Processes with Latitude in the Western Canadian Arctic

Can you call a soil Entisol if it has that much OM to a mollic or umbric epipedon?

Table XVII - Classification of Major Soil Groups at Mould Bay and Isachsen According to the Seventh Approximation

	Soil	Great Soil Group	Order	Suborder	Subgroup
Mould Bay	1	Tundra	Inceptisol	Aquept	Pergelic Cryumbreptic Cryaquept*
	2	Polar Desert	Entisol	Udent	Ruptic Pergelic Orthic Cryudent
	2a	Polar Desert	Entisol	Udent	Ruptic Pergelic Cryudent
	3	Tundra	Inceptisol	Aquept	Ruptic Pergelic Orthic Cryaquept Ruptic Pergelic Histic Cryaquept
	4	Polar Desert	Entisol	Ochrept	Pergelic Orthic Cryochrept
Isachsen	1	Tundra	Inceptisol	Aquept	Pergelic Histic Cryaquept
	2	Polar Desert	Entisol	Udent	Pergelic Ruptic Orthic Cryudent
	3	Polar Desert	Vertisol**	Ochrept	Pergelic Orthic Cryochrept
	4	Polar Desert	Entisol	Ochrept	Pergelic Orthic Cryochrept

* Holowaychuk (personal communication) has suggested the use of the term Pergelic in the Great Group nomenclature to clearly establish these soils as subject to freeze-thaw instability rather than merely cold soils.

** The Polar Desert soils all display polygonal surface cracking. Those of Mould Bay, specifically Soil Group 2A, are classified with the Entisols because clay contents are too low to show self-mulching characteristics. Soil Group 3 at Isachsen has sufficient expandable clay as suggested by the diffractograms for ISN 6 (Soil Group 2) along with other characteristics to place it in with the Vertisols. Soil Group 2 with which Soil Group 3 intergrades never dries sufficiently to develop a self-mulching surface, although most other morphologic properties are similar, and as a consequence has been placed with the Entisols. The 24-cm-diameter polygons associated with these soils are so characteristic that it is suggested that these features be included in their classification.

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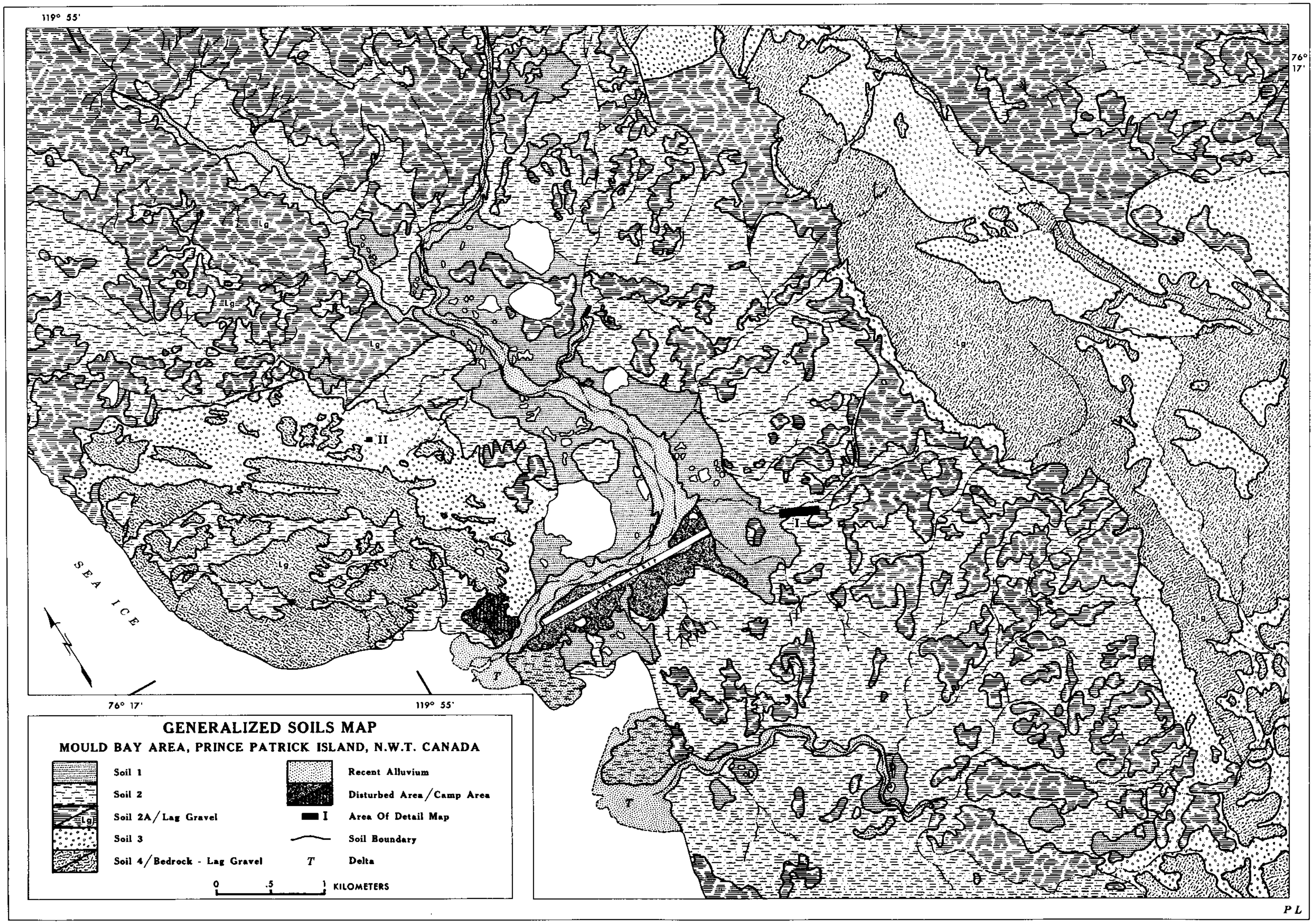


119° 55'
76° 17'
SEA ICE
II
I
Lg
T
76° 17'
119° 55'
GENERALIZED SOILS MAP
MOULD BAY AREA, PRINCE PATRICK ISLAND, N.W.T. CANADA
Soil 1
Soil 2
Soil 2A / Lag Gravel
Soil 3
Soil 4 / Bedrock - Lag Gravel
Recent Alluvium
Disturbed Area / Camp Area
Area Of Detail Map
Soil Boundary
Delta
0 .5 1 KILOMETERS
PL

Plate I

R Large polygons with depressed borders; surface subject to desiccation cracking; microrelief 5 to 15cm: lichens, moss, Salix sp., and Carex sp. on centers and edges; moss and Carex sp. in depressions. Coverage 75%.

- 0-37cm Thoroughly mixed brown (10YR5/3) very fine to fine sand. Moderate platy structure, breaks to weak, fine subangular blocky structure; mixed with very dark brown (10YR2/2) organic matter and silt. Permafrost.

S Polygon centers, no surface cracking, hummocky, average microrelief 12cm: Carex sp. moss; coverage 100%.

- 2-4cm Vegetation mat.
- 4-0 Very dark grayish brown (10YR3/2), dark yellowish brown (10YR4/4) squeezed, organic matter.
- 0-1 Reddish brown to yellowish red (5YR4/4-4/6) clay; lower boundary clear, uneven, discontinuous.
- 1-17 Mottled; gray (10YR5/1), yellowish red (5YR5/8), clay loam; massive or weak platy structure; lower boundary clear.
- 17-25 Mottled, dark gray (10YR4/1), strong brown (7.5YR5/6), silt-silty clay loam, massive-weak, coarse platy structure. Permafrost 20cm.

T Polygon center: Carex sp., Salix sp., mosses, lichens. Average microrelief 8cm.

- 0-3cm Dark grayish brown (10YR4/4), loamy very fine sand, moderate amount of organic matter, weak, fine subangular blocky to granular structure; lower boundary clear to gradual, interrupted.
- 3-10 Finely mottled yellowish brown (10YR5/4), gray (10YR5/1) grayish brown (10YR5/2) silty clay loam; peaty structure; lower boundary gradual.
- 10-22 As above; weak, moderate subangular blocky structure; lower boundary gradual.
- 22-38 Mottled, yellowish brown (10YR5/4), dark gray (10YR4/1-4/2), smears of dark brown (7.5YR3/2), silt loam; moderate subangular blocky structure. Permafrost.

T_1 Slightly better drained than T, small desiccation cracks; hummocky microrelief aligned normal to slope; Carex sp., moss, Salix sp., lichens 90% coverage.

- 1-0cm Organic mat.
- 0-12 Very weak, fine mottling, dark gray (10YR4/1), dark grayish brown (10YR4/2), silty clay loam, massive to very weak platyness; lower boundary gradual.
- 12-38 Very dark grayish brown (10YR3/2, silt loam, some very fine weak mottling; massive. Permafrost.

U Hummocky Carex sp., Salix sp., moss 100% cover; microrelief 10-15cm.

- 0-2cm Very dark brown (10YR2/2) fine sandy loam; high in organic matter; massive, lower boundary clear, uneven.
- 2-3 Dark yellowish brown (10YR4/4) silty clay loam, lower boundary clear to gradual, interrupted.
- 3-14 Fine to medium mottles; yellowish red (10YR5/8-5YR4/8), dark gray (10YR4/1) silty clay loam; massive, coarse peaty structure; lower boundary gradual.
- 14-31 Fine weak gleying gray (10YR5/1), dark brown (10YR4/3) silt loam; massive. Permafrost.

V Large, poorly defined soil polygons, few low hummocks; microrelief averages 7cm: Carex sp., Salix sp., moss, Dryas octopetala grasses; coverage 95%.

- 4-0cm Organic mat.
- 0-3 Very dark grayish brown (10YR3/2-3/3)], dark brown (7.5YR3/2), silt loam, very high in organic matter; loose; lower boundary clear, uneven.
- 3-13 Dark grayish brown (10YR4/2), very dark grayish brown (10YR3/2), very fine sandy loam; massive, lower boundary gradual.
- 13-30 Yellowish brown (10YR5/6), very dark grayish brown (10YR3/2), dark yellowish brown (10YR4/4), silt loam; massive; skeleton 5%.

W Pronounced large-diameter soil polygons, surface very uneven, small high-relief desiccation polygons average microrelief 12cm: Rhacomitrium sp., lichens, scattered Carex sp., coverage 90%; scattered rocks.

- 0-11cm Dark grayish brown (10YR4/2), fine sandy silt loam; massive, breaks to weak, moderate granular structure, moderate amount of in-mixed organic matter; lower boundary gradual.
- 11-27 Dark grayish brown (10YR4/2) silt loam or silty clay loam; massive skeleton < 5%. Permafrost.

W_1 Surface character about as above: Carex sp. and Rhacomitrium co-dominant, coverage 99%; microrelief 6cm.

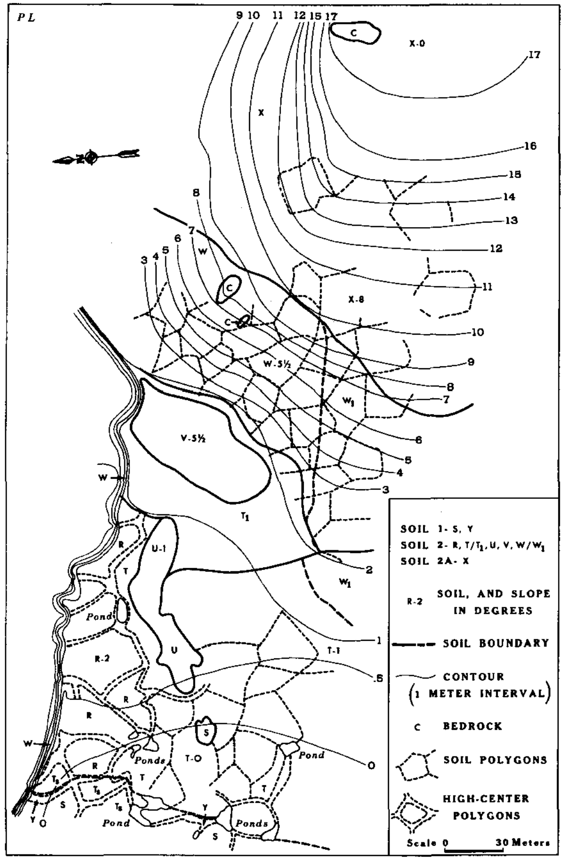
- 0-2cm Very dark grayish brown (10YR4/2), very fine sandy loam; scattered skeleton < 5%; lower boundary clear, interrupted.
- 2-9 Dark grayish brown (10YR4/2), silt loam, massive breaks to weak, moderate granular to subangular blocky structure, lower boundary gradual.
- 9-33 Dark grayish brown (10YR4/2), silt or silty clay loam, massive with tendency to weak platy structure. Permafrost.

X Small polygonal desiccation cracks, lag gravel, Carex sp., Papaver radicatum, Saxifraga oppositifolia, coverage 5%.

- 0-15cm Slightly mottled, light olive brown (2.5Y5/4), silt loam with scattered granules; very dark grayish brown (2.5Y3/2), silty clay loam; mixed; yellowish red (5YR4/8), reddish yellow (7.5YR6/8), very fine loamy sand, pale brown (10YR6/3) sand; tendency to crumble to weak, coarse subangular blocky structure, lower boundary gradual.
- 15-40 Highly mottled; general color, very dark grayish brown (2.5Y3/2), silty clay or clay loam; crumbles to coarse, weak to moderate subangular blocky structure; mottled colors as in previous horizon. Permafrost.

Y Polygon border depression, intermittent standing water: microrelief consists of slight hummocks averaging 13cm: mosses and Carex sp. Coverage 100%.

- 9-2cm Vegetation mat.
- 2-0 Dark reddish brown (5YR2/2) wet, dark reddish brown (5YR3/4) squeezed, coarse, fibrous, little decomposed organic matter, rubs with considerable difficulty. Lower boundary clear, somewhat uneven.
- 0-5 Strong, coarse mottling: reddish yellow (5YR6/8), yellowish red (5YR5/8), yellowish red (5YR4/8), gray (10YR5/1) silty clay; massive; inclusions of very dark gray (7.5YR3/0) clay and organic matter. Lower boundary clear, uneven.
- 5-15 Weakly mottled; dark gray (5Y4/1) silt and clay with flecks of yellowish red (5YR4/8) near roots. Permafrost.



DETAILED SOILS MAP

MOULD BAY (AREA I)

REPRESENTATIVE SOIL TEMPERATURE PROFILES

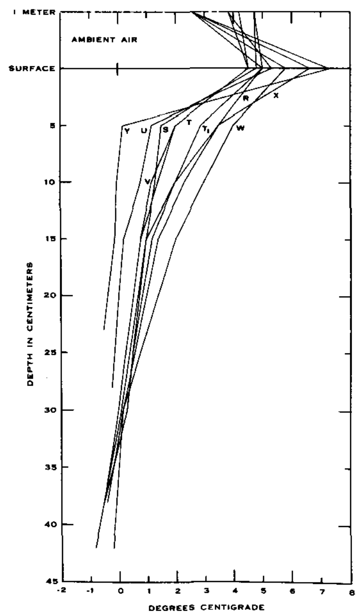


Plate II

A_1 Weak stripe pattern, small hummocks oriented along the contour: microrelief averages 12 cm: Carex sp., Rhacomitrium sp., moss. Coverage 98%.

5-0cm	Vegetation mat.
0-4	Very dark brown (10YR2/2) organic matter with some very fine sand. Lower boundary clear, uneven.
4-29	Very dark grayish brown (10YR4/2) loamy very fine sand, generally massive; skeleton 15%; smears of dark brown (10YR3/4) silt loam, high in organic matter. Permafrost.

B_1 Small soil polygons, minor surface cracking: microrelief averages 16cm: Carex sp., in depressions, Rhacomitrium sp. and Saxifraga oppositifolia on polygon surfaces, coverage 98%; few small rocks on surface.

2-0cm	Vegetation mat.
0-3	Very dark brown (10YR2/2) organic matter and very fine sand; lower boundary clear, uneven, interrupted.
3-6	Very dark grayish brown (10YR3/2) very fine sandy loam high in organic matter; friable; breaks to weak granular structure; lower boundary clear, uneven, interrupted.
6-13	Dark brown (10YR4/3) fine to medium loamy sand; massive; skeleton 30 to 40%; lower boundary clear.
13-24	Dark grayish brown (10YR4/2) fine to medium loamy sand; massive; skeleton 50%. Permafrost.

B_2 Well developed soil stripes: microrelief averages 12 cm: scattered Carex sp., Salix sp., Dryas octopetala and Saxifraga oppositifolia, mosses; coverage 20 to 30%, lag gravel 50%.

1-0cm	Vegetation mat.
0-3	Dark brown (10YR4/3) silt loam; friable, with weak aggregation; skeleton 5%. Lower boundary clear, uneven, interrupted.
3-13	Mixed; light olive brown (2.5Y5/4) fine loamy sand, dark brown (10YR3/3-3/4) loamy very fine sand, high in organic matter. Skeleton 10%; iron stain on underside, silt coatings on top. Lower boundary clear, uneven.
13-41	Dark grayish brown (2.5Y4/2) silty, very fine sandy loam; massive; broken to weak, very coarse subangular blocky structure; vesicular; skeleton 30 to 40%; no iron stain; non-calcareous. Permafrost.

B_3 Crest, large extended nets; 70% rock covered; microrelief averages 12 cm; Salix sp., Saxifraga oppositifolia, Dryas octopetala, Rhacomitrium sp. Coverage 20 to 30%.

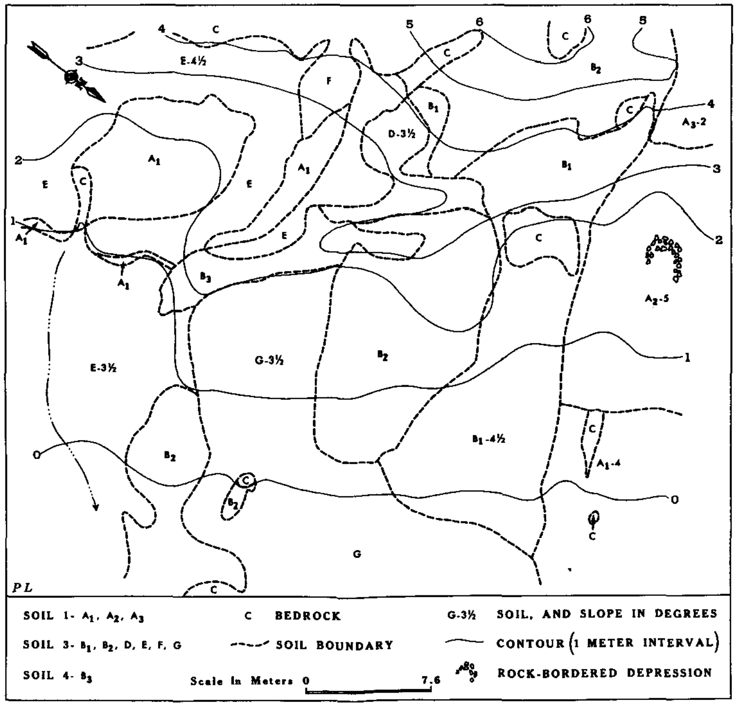
0-9cm	Dark grayish brown (10YR4/2) loamy fine to medium sand. Minor calcium carbonate encrustation on underside of large rocks. Lower boundary clear, uneven.
9-33	Dark grayish brown (2.5Y4/2) fine to medium loamy sand; massive. Skeleton 50 to 70%; minor iron stain on lower side of pebbles.
33-53	Mixed colors; general color, light olive brown (2.5Y5/4), yellowish brown (10YR5/8) fine loamy sand, dark grayish brown (2.5Y4/2) silt loam; massive; skeleton 5 to 10%. Lower boundary gradual.
53-70	Yellowish brown (10YR5/4) very fine loamy sand; massive; skeleton 5%. Permafrost.

A_2 Wet meadow, scattered hummocks: microrelief averages 8 cm; Carex sp., Rhacomitrium sp., mosses. Coverage 99%.

7-4cm	Vegetation mat.
4-0	Very dark brown (10YR2/2) coarsely fibrous organic matter, little decomposed; lower boundary clear, uneven.
0-4	Dark brown (7.5YR3/2) very fine sandy loam, high in organic matter; massive; lower boundary clear, even.
4-17	Finely mottled and mixed. Grayish brown (10YR5/2) silt, dark brown (7.5YR4/4) silt or silty clay loam, dark grayish brown (10YR4/2) very fine loamy sand; skeleton 5%. Permafrost.

DETAILED SOILS MAP

MOULD BAY (AREA II)



A_3 Wet meadow; relatively flat, scattered peat plateaus with maximum microrelief of 60 cm: Carex sp., moss, coverage 100%.

17-15cm	Vegetation mat.
15-13	Very dark brown (10YR2/2) coarse, fibrous peat; lower boundary clear.
13-12	Yellowish red (5YR4/6-4/8) silt loam and organic matter.
12-0	Dark brown (10YR4/3) raw, yellowish brown (10YR5/4), squeezed, fibrous peat and silt; little decomposed. Permafrost.

D Variable ground pattern; stripes, small hummocks and polygons: microrelief 10 to 12 cm: mosses in depressions, lichens on raised areas.

0-2cm	Very dark grayish brown (10YR3/2) very fine sandy loam. Lower boundary clear, uneven, interrupted.
2-22	Dark grayish brown (10YR4/2) fine sand or loamy fine sand; skeleton 15 to 25%, increasing with depth to 80%; wet. Permafrost.

E Subtle stripe pattern, somewhat hummocky: microrelief 5 cm, many large rocks on the surface: Carex sp., Rhacomitrium sp.

1-0cm	Vegetation mat.
0.3	Very dark brown (10YR2/2) silt loam and partly decomposed organic matter. Lower boundary clear, uneven, interrupted.
3.38	Dark grayish brown (10YR4/2) very fine sand and silt; skeleton 30%; wet. Permafrost.

F Small polygons: microrelief less than 5 cm, few scattered rocks: Carex sp., mosses. Coverage 25%.

0-20cm	Brown (10YR5/3) loamy very fine sand; massive; breaks to weak, coarse subangular blocky structure. Lower boundary clear.
20-38	Light olive brown (2.5Y5/4) silty clay loam; massive; breaks to very weak coarse subangular blocky structure; skeleton 30%. Permafrost.

G Uneven surface with poorly defined large polygons; few large rocks; wet: microrelief averages 7cm: Rhacomitrium sp., mosses. Coverage 99%.

0.1cm	Vegetation mat.
1-6	Dark brown (10YR4/3) silt loam; skeleton 20%; weak iron stain on lower side of large skeleton fragments. Lower boundary gradual.
6-22	Dark brown (10YR3/3) very fine sandy loam; intermixtures of very dark brown (10YR2/2) silt loam high in organic matter; skeleton 15 to 20%. Permafrost.

Plate III

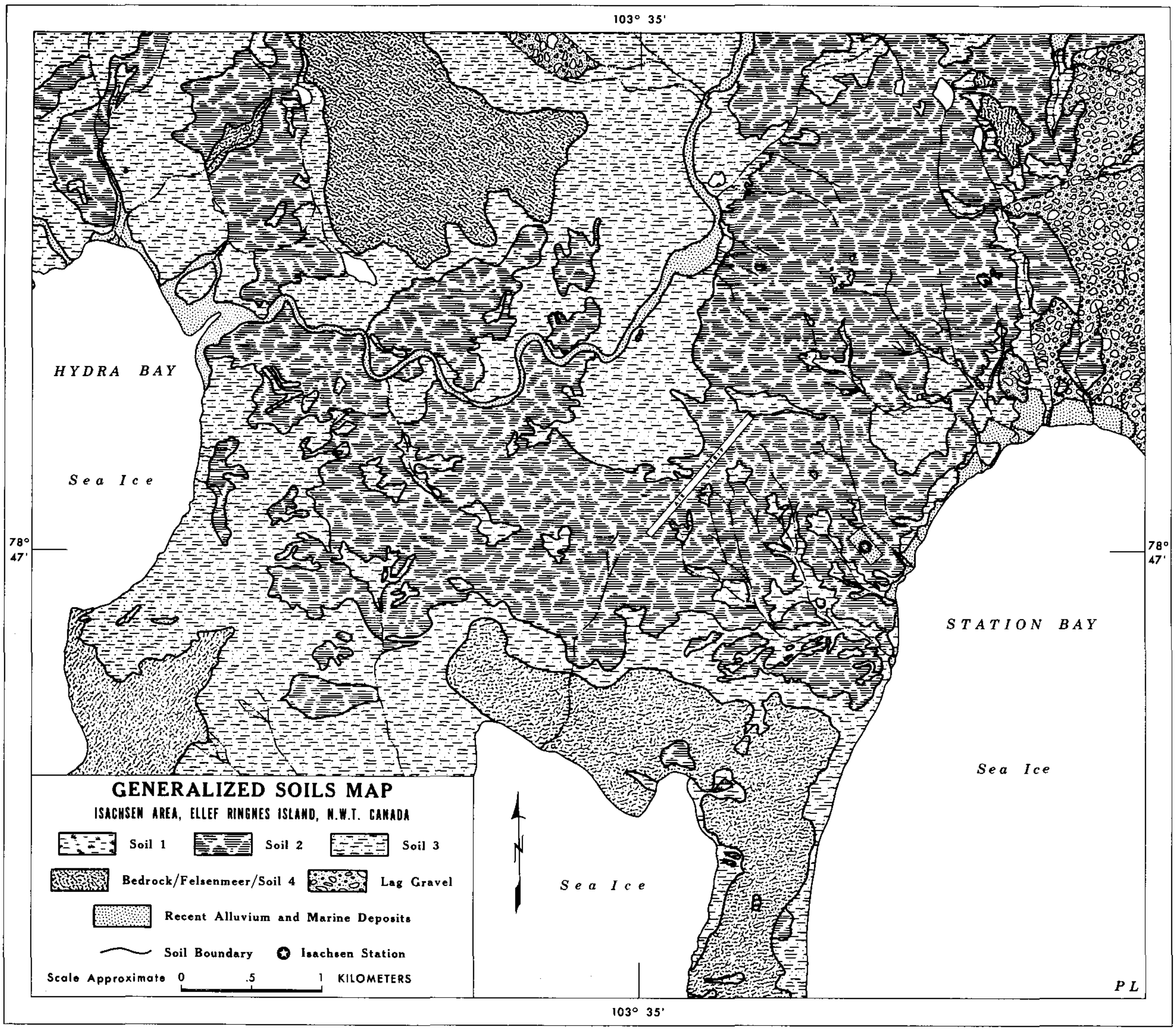

103° 35'
HYDRA BAY
Sea Ice
78° 47'
STATION BAY
Sea Ice
78° 47'
Sea Ice
GENERALIZED SOILS MAP
ISACHSEN AREA, ELLEF RINGNES ISLAND, N.W.T. CANADA
Soil 1
Soil 2
Soil 3
Bedrock/Felsenmeer/Soil 4
Lag Gravel
Recent Alluvium and Marine Deposits
Soil Boundary
Isachsen Station
Scale Approximate 0 .5 1 KILOMETERS
N
PL
103° 35'

Plate IV