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SOILS OF THE TASERSIAQ AREA, GREENLAND

BY

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WITH 9 FIGURES AND 3 PLATES

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Frontispiece. Tasersiaq and marginal ice-free area. View to the south-west. Arrows mark the general location of text figures. 18 July 1948. Photo courtesy of the Geodetic Institute, Denmark. Copyright.

Abstract

Ten soil series are recognized for the ice-free area of Tasersiaq, Greenland. A profile description and pertinent chemical and physical data are presented for each series.

For the most part the soils have developed in sandy till and kame terrace deposits under drainage conditions ranging from standing water to those which can be termed excessively well drained.

It is believed that the soils of the Tasersiaq area represent only a few thousand years of development under a climate similar to the present. The combination of factors of rapid internal drainage, relative site stability and heath vegetation, have under present climatic conditions allowed the zonal process of podzolization to be weakly expressed. Where internal drainage is partly or completely restricted, and site instability occurs, a series of half-bog and tundra soils have developed.

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Description of Area

The Tasersiaq area is a portion of the ice-free foreland marginal to the Sukkertoppen Iskappe. Bounded by latitudes 66°24′ and 66°40′ north and longitudes 51°19′ and 51°30′ west, it is situated about 90 km south-southwest of Søndre Strømfjord airfield and is located in the Sukkertoppen Kommune. The total area investigated covers approximately 100 sq km.

Bedrock Geology

The bedrock geology of the area covered in this report has not been investigated in detail. TREVES (in LOEWE *et al.*, 1962; 1965) has done detailed geologic mapping at the east end of Tasersiaq.

The bedrock is composed of steep to vertically dipping Precambrian gneisses with variable amounts of included schist. The oldest gneiss at the east end of the lake is a grey biotite or hornblende gneiss. In places it is strongly contorted migmatite containing inclusions and schlieren of biotite schist, hornblende schist and amphibolite (TREVES, *in* LOEWE *et al.*, 1962). This statement also describes the rocks that make up the precipitous ridge which parallels Tasersiaq on the northeast.

Tasersiaq represents a structural discontinuity between the grey paragneiss (TREVES, *in* LOEWE *et al.*, 1962) and a similar grey paragneiss which makes up, at least in part, the dip-slope hills on the southwest, and which is extensively intruded by red granite and/or granite gneiss. The gneiss grades (?) across a structural depression into red granite and granite gneiss with minor inclusions of grey paragneiss. This last rock type is coincident with the more rugged topography up to the Sukkertoppen Iskappe.

The gneisses on both sides of Tasersiaq are intruded by large ultrabasic dikes of considerable lateral extent. Red feldspathic dikes are common, and intrude the paragneisses on the southwest side of Tasersiaq.

In many areas the original bedding is preserved and dips range between 20° and 65° to the northeast. At least one prominent set of joints characterizes extensive areas of this igneous-metamorphic complex, one set trending northeast-southwest and the other northwest-southeast. This joint set controls the major drainage network of the area to a large degree.

Surficial Geology

Details of the surficial geology of the Tasersiaq area have been outlined by Crowl and Goldthwait (1963) and will be given here in general terms as background.

Broadly classified the deposits are: (1) ground moraine or till and end moraine related to Wisconsin or earlier glaciation; (2) kame terraces and outwash representative of several minor glacial advances or stillstands during retreat; (3) recent end moraine and outwash close to and related to present glaciers.

Almost the entire ice-free area is blanketed by bouldery and sandy ground moraine and till, except where it has been removed from the steeper slopes by mass-wasting and running water. The slopes, particularly on the southwest side of Tasersiaq, are complicated by a series of discontinuous kame terraces up to 100 meters or more above the present lake level. Similar terraces on the opposing slope are less well preserved and do not occur as high up on the slope, either because they were never deposited or have been removed by mass-wasting subsequent to ice retreat. Many of these terraces have a veneer of ground moraine and may display rock rampart fronts.

Extensive areas of the valley bottom at the west end of Tasersiaq are occupied by flat-topped outwash and/or kame terraces to an elevation of 19 meters above present spring lake level. According to Crowl & Goldthwait (1963) these deposits are related to a late-phase ice tongue. The deposits are horizontally bedded or display a gentle dip toward the surrounding high ground. Most are sparsely covered with sedges and grasses and have a windstripped surface of lag gravel.

Moraines of uncertain age and affinities block the head of a dry valley and are bisected by Miligaersartoq (Plate I). Moraines and outwash associated with present-day glaciers cover only a small percentage of the ice-free area. The moraines are ice-cored and topographically impressive. However, they are of little importance to this study except to show that the original materials are coarse textured with a large content of stones and boulders and that the fines are slightly calcareous (see Table III).

Topography

The foreland area just east of the Sukkertoppen Iskappe is characterized by long asymmetrical valleys bounded by precipitous escarpments on the northeast and dip-slope hills on the southwest. Most are occupied by underfit streams and/or paternoster lakes.

Highland elevations range from about 500 meters near the head of Søndre Strømfjord to about 1100 meters in the Tasersiaq area.

The most pronounced topographic feature of the area, aside from Tasersiaq itself, is the fjord Qingua avangnardleq along which is displayed some of the most impressive scenery of the area, particularly on the south side where outlet glaciers of the inland ice pass around imposing half-domed peaks as they flow into the fjord. The fjord and its westward extension, Evighedsfjord, follow the northeast-southwest joint set.

Tasersiaq is approximately 60 km in length, empties to the northwest through a deep, narrow gorge into the Sarfartôq river, which, in turn, empties into the Søndre Strømfjord.

Repeated Pleistocene glaciations have sent tongues of ice down the major drainage lines and the inland ice completely covered the area at least once and probably several times. Changes wrought by the ice are not as pronounced as might be expected. The glaciers worked on a landscape with a well-established drainage pattern, a pattern most likely sculptured by streams long before the Pleistocene. Glaciations have modified the landscape and have widened, and in some cases deepened, valleys, oversteepened escarpments, and in the lower reaches of Tasersiaq, sculptured gneissic outliers into roches moutonnées. Moraine deposition in one case blocked and diverted Miligaersartoq. Kame deposition on the lower portions of the hillsides has imparted a benched appearance to the slope profile.

The uplands appear to be little modified by glaciation. Till cover is thin or absent. These surfaces must have undergone scour by a thinner, slower-moving ice sheet. According to Crowl & Goldthwait (1963) the last ice advance of major significance, at least in the lowlands, was approximately 9000 years B.P.

Climate

According to observations made in 1963 (Brecher & Kryger, 1963) the general climate of Tasersiaq area is characterized by a cold, wet spring and autumn and a short, dry summer. Wind speeds of more than 9 meters/sec. were common while the highest velocity recorded was 18.5 meters/sec. The prevailing winds are in the southeast quadrant, with strongest winds from the south and southeast.

A total precipitation of 47 mm was recorded in 1963. Of this, 32 mm fell between 26 June and 18 July and 9 mm between 24 August and 1 September. No precipitation was recorded from 19 July to 2 August. Snow flurries occurred in all months. Judging from snowbank accumulations winter snowfall appears to be moderate to light. The strong southerly wind forms large drifts on the north- and northwest-facing slopes, many remaining throughout the summer. These strong winds keep the terraces relatively clear of snow.

Observations of temperatures made during the months of July and August have been summarized by KOSIBA and LOEWE (1964). As shown in Table I, the temperatures are low but show appreciable fluctuations. These observations also indicate that the temperatures near the Tasersiaq Gletscher at an elevation of 1040 meters are noticeably lower than those recorded at the Base Camp having an elevation of about 680 meters.

Table I. *Mean and mean maximum and minimum temperatures in °C, July and August 1963, recorded at Base Camp and at Tasersiaq Gletscher.*

Station	Month	Mean	Mean Max.	Mean Min.
Base	July	6.5	10.4	2.4
Glacier	0	3.8	6.8	0.4
Base	August	7.4	11.7	3.6
Glacier	0	4.5	7.8	1.3

Soil temperatures observed during the summer of 1963 show appreciable variability, the soils of the well-drained sites being noticeably warmer than those that are wet or very poorly drained. Insulation due to the surficial layer of organic matter and the probably lower temperatures of the waters emanating from the melting snowbanks appear to be the contributing factors. Observations made at two sites at the end of July are recorded in Table II as examples of these differences in soil temperatures.

Table II. *Comparison of soil temperatures recorded on 29 and 30 July at a well-drained and a very-poorly-drained site.*

Site	Temperature (°C) 5 cm	15 cm	30 cm
Well-drained	13.1	8.5	6.5
Very-poorly-drained	6.5	5.5	4.7

The substrate of all soils is permanently frozen. In well-drained soils the depth to this permanently frozen zone in the latter part of the summer is about 2 meters. It is appreciably less in the soils of the wetter sites.

Vegetation

MCCORMICK (in LOEWE *et al.*, 1962) described the vegetation of the region as "a mosaic of Arctic steppe, shrub tundra, and wet meadow tundra, and lichen encrusted rock fields".

The south-facing slopes have an Arctic steppe vegetation composed of the following dominants: *Calamagrostis*, *Kobresia*, *Poa*, *Hierochloe*, and *Carex*. This flora alternates and is interspersed with dense stands of *Betula nana-Empetrum nigrum* association, *Salix glauca*, or *Vaccinium uliginosum*. The *Betula-Empetrum* association is common in the drier boulder fields. *Vaccinium* outlines the shallow, moderately to poorly drained areas. *Salix* is common as isolated shrubs in boulder fields and and on well-drained hillsides.

The north-facing slopes are, according to McCormick, occupied by mixed stands of *Luzula*, *Carex*, and, in the moist places, *Vaccinium*. *Cassiope*, the largest component of the vegetation, excluding *Carex*, can be found on all areas of the slope except the very wettest and occurs in almost pure stands on the north-facing outwash slopes. A relatively minor constituent in the total vegetation, but none the less ubiquitous, is *Lycopodium selago*.

The flat areas, particularly the valley bottom kame or outwash terraces, are covered with communities similar to those of the north-facing slope with the addition of grasses, principally *Agropyron geradi*.

Carex aquatilis and mosses are the predominant constituents of the vegetation prevailing in wet and very-poorly-drained sites.

Soils

A variety of soils intermingled with patches of rockland, especially around the periphery, occupy the land area investigated (Plate II). The rockland ranges from nearly level to mountainous in relief and it may be nearly bare or it may be strewn with rocks of various sizes, many being large boulders. Fines occurring on the rockland are thin and patchy and are usually of a coarse sandy texture. The differences among the several kinds of soil result primarily from differences in composition and stability of parent materials and in soil moisture environments. The latter factors are related to such features of topography as length, gradient, and shape or form of the slopes, the direction of exposure to insolation and to winds, and the microrelief of the surface. Vegetative cover, especially its composition, is likewise an important factor, but it too appears to be related closely to the moisture environments of the soil.

The generalized soils map (Plate II) reflects the dominance of a specific soil series. Plate III is included to illustrate the complexity and interrelationship of the different series in a small area.

Soil Parent Materials

Very stony or bouldery sandy till provided the original source of parent materials in the area and it constitutes the materials from which most of the well- or excessively well-drained soils have been derived. This till exhibits considerable uniformity throughout the area although it has been deposited by glaciers entering the area from several directions. The fines of the till are olive grey (5 Y 5/2) loamy sand or sandy loam. They are slightly calcareous with the calcareous fraction being predominantly dolomitic.

The materials of the outwash and/or kame terraces are composed of sands and gravel, the latter component being rounded or subrounded pebbles or cobbles of the rocks common to the area. The fines apparently have been subjected to considerable sorting because their mechanical composition is almost entirely sand and they are not calcareous.

Appreciable sorting of upland till material has been noted along sections of the upland slopes which serve as passageways for runoff or

Table III. *Mechanical composition and some chemical properties of the fines*[1] *of parent materials.*

Sample No.	Depth of sample (cm)	Sand[2] (%)	Silt[3] (%)	Clay[4] (%)	pH	$CaCO_3$ Equiv. (%)	Calcite (%)	Dolomite (%)	Free Fe_2O_3 (%)
				Till					
16394.........	–	77.5	21.5	1.3	8.5	0.6	0.3	0.3	0.6
16396.........	–	80.1	19.4	0.5	7.9	1.0	0.3	0.6	0.6
16399.........	–	69.7	26.4	3.9	8.1	1.3	0.5	0.7	0.7
16346.........	117–125	70.5	24.8	4.7	8.3	1.1	–	–	0.4
			Outwash and/or kame terraces						
16237.........	68–92	93.0	6.2	0.8	6.0	–	–	–	0.3
16248.........	38–75	96.7	3.3	T	5.2	–	–	–	–
16359.........	138–150	93.6	6.4	T	6.5	–	–	–	–
			Water-sorted upland slopes						
16224.........	16–32	69.6	28.8	1.6	–	–	–	–	–
16364.........	25–55	61.4	37.4	1.2	–	–	–	–	–
16367.........	20–55	63.4	35.7	0.9	–	–	–	–	–

[1] *Fines* include mineral material in which the individual particles have a diameter of 2 mm or less.
[2] *Sand*—Mineral particles having diameters between 2 and 0.05 mm.
[3] *Silt*—Mineral particles having diameters between 0.05 and 0.002 mm.
[4] *Clay*—Mineral particles having diameters of less than 0.002 mm.

water from the melting snowbanks. Such materials contain appreciable quantities of silt.

Data pertaining to the mechanical composition and some chemical properties of the fines are given in Table III for selected samples of these materials. Numbers 16394, 16396, 16399, and 16346 are samples of till or soil parent materials taken respectively from Quantum, Sarfartôq, and Tasersiaq glaciers and from a deep sampling of an upland soil profile about 1 km south of the Base Camp (Plate I). Samples 16237, 16248, and 16359 are examples of the outwash and/or kame terraces, while numbers 16224, 16364, and 16367 represent the water-sorted materials of the slopes.

It was noted at several locations that in the case of the well-drained upland soils of the lower elevations, the upper parts of the soil profiles were more silty to an appreciable degree. This suggests that there may have been some loess deposition on the surface of the till.

Very limited areas of medium- or fine-textured materials, apparently of lacustrine origin, were noted at several locations. Because of their very limited extent, soils derived from such material have not been separated.

Soil Moisture Environments

Soil moisture environment refers to the kind of moisture regime that prevails in a soil during the warm season, *i.e.*, during the time when the temperature of the entire soil is above freezing. Some soils are saturated or even submerged while others may be subject to excessive moisture conditions only intermittently. Still others may be relatively free from such conditions and in some there may be a scarcity of moisture-holding capacity. Excessive desiccation by wind may also contribute to a scarcity of soil moisture at some sites.

Soil moisture environments are reflected in such morphological features as color and the quantity of organic matter accumulations. Water-logged conditions, because of inadequate aeration, produce grey colors and may favor considerable accumulation of organic matter. Intermittent periods of excessive moisture lead to mottled colors in which grey is generally intermingled with various shades of brown. The brown colors alone are associated with good aeration and oxidation such as occur under adequate but yet not excessive moisture conditions. Scarcity of adequate moisture is indicated by absence or only weak development of soil colors.

Seven categories of soil moisture environments were recognized in the area on the basis of color and organic matter accumulations. Each of these categories is defined below and is referred to as a soil drainage class, following in general the concepts outlined in the Soil Survey Manual (SOIL SURVEY STAFF, 1951).

Category I: Wet

This soil drainage class includes a soil moisture environment that is 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 grey or dark grey color.

Category II: Very poorly drained

The 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 predominantly grey or dark grey colors of the subsoil.

Category 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 free from excessive moisture periodically. The subsoil has mottled colors in which grey or dark grey is a common component.

Category IV: Somewhat poorly drained

Soils of this class are subject to conditions of excessive water during the first part of the summer; during the latter part, these conditions are less prevalent. Mottled colors in which dark greyish brown, instead of grey or dark grey, is intermingled with dark brown or dark reddish brown, are common to these soils.

Category V: Moderately well drained

This drainage class refers to conditions where the solum is subject to short intermittent periods of excessive moisture. There are localized areas of mottled colors in such soils in which greyish brown, grey, yellowish brown, and/or dark brown components are present.

Category VI: Well drained

Conditions of excessive moisture are absent, or, if they do occur, they are infrequent and of short duration in these soils. Mottled colors due to gleying are not present.

Category VII: Excessively drained or dry

Deficiency or scarcity of moisture are characteristic of this drainage class. Rapid runoff, highly porous materials or excessive desiccation are the factors that contribute to such conditions.

Ten kinds of soil were identified in the area. A description, together with some laboratory data, are given for each. The Soil Survey Manual (Soil Survey Staff, 1951; 1960) is used as the basis for the terminology in the descriptions. A tentative series name has been assigned to each of these soils as shown.

Miligaersartoq A Series

This wet soil is characterized by a histic surface horizon having a thickness of over 30 cm. The brown, fibrous, acid organic matter, derived from sedges and mosses, appears to have undergone some physical disintegration and limited humification. Considerable inwashed sandy material is admixed in this soil as a rule. This soil occurs in nearly level or slightly depressed areas subject to continuous wet conditions (Fig. 1).

Profile TAQ 129, described and sampled about 0.8 km south-southeast of Base Camp, is an example of this soil (Fig. 2 look at the end of the book). The area adjoins a shallow pond and free water was present at the soil surface. *Carex aquatilis*, *Eriophorum angustifolium*, and moss constitute the vegetation cover. Only occasional small hummocks interrupt the otherwise smooth microrelief. Data for this profile are presented in Table IV.

Table IV. *Organic carbon content, ignition loss, chemical properties, and mechanical composition of Miligaersartoq A soil profile TAQ 129.*

Horizon	Depth (cm)	Ignition wt loss (%)	Organic C (%)	pH	Exchangeable based meq/100g Ca	Mg	K	Na	Σ Exch cations meq/100g	Base sat (%)	Free Fe_2O_3 (%)
012	33–27	57.9	24.7	4.6	11.7	4.4	0.82	16.2	106.0	16	2.0
013	33–27	60.2	23.3	4.9	9.8	4.2	0.86	14.5	87.4	17	0.9
02	3–0	71.9	31.8	5.5	16.2	9.0	1.32	26.0	103.6	26	3.6
Bg	0–3	1.2	0.7	4.5	0.6	0.5	0.05	1.3	4.5	27	0.3

Horizon	Depth (cm)		Very Coarse sand 2–1	Coarse sand 1–0.5	Medium sand 0.5–0.25	Fine sand 0.25–0.1	Very fine sand 0.1–0.05	Total sands	Silt 0.05–0.002	Clay < 0.002	Textural class
		Particle size (mm)									
Bg	0–3	Distribution (percent)	0.7	1.0	1.5	15.1	23.6	41.9	57.5	0.6	sil

TAQ 129 Profile Description.

011	37 to 33 cm	Mixed living and dead remains of roots and stems.
012	33 to 27 cm	Dark brown (7.5 YR 3/2 wet), brown (7.5 YR 5/4 squeezed) partially disintegrated fibrous organic material derived from sedges and mosses; numerous roots and stems; lower boundary clear; continuous.
013	27 to 3 cm	Dark brown (10 YR 3/3 wet), yellowish brown (10 YR 5/6 squeezed) partially disintegrated, finely fibrous organic material derived from mosses and sedges; strongly resistant to disintegration by rubbing; lower boundary clear, wavy; continuous.
02	3 to 0 cm	Very dark brown (10 YR 2/2–3/2 wet), dark brown (10 YR 3/3 squeezed) disintegrated finely fibrous organic material; rubs apart easily; lower boundary clear to abrupt; continuous.
Bg	0 to 3 cm	Greenish grey (5 GY 5/1) loamy very fine sand with inclusions and stringers of organic material; frozen below; continuous.

Miligaersartoq B Series

Soil of the Miligaersartoq B series is characterized by a moderately thick (10 to 30 cm) histic surface horizon which is underlain by a grey or dark grey strongly gleyed subsoil. It is associated with the very poorly drained soil moisture environments of the areas often bordering Miligaersartoq A soil, or on gentle slopes having a gradient of about 6 percent or less (Fig. 1).

Table V. *Organic carbon content, ignition loss, chemical properties, and mechanical composition of Miligaersartoq B soil profile TAQ 130.*

Horizon	Depth (cm)	Ignition wt loss (%)	Organic C (%)	pH	Exchangeable based meq/100g Ca	Mg	K	Na	Σ Exch cations meq/100g	Base sat (%)	Free Fe_2O_3 (%)
011	19–17	71.4	33.9	5.7	NOT DETERMINED						
012ir	17–13	57.5	23.1	5.3	15.2	6.7	2.40	24.9	100.9	24	24.9
013	13–4	30.0	11.5	4.6	3.8	1.2	0.61	2.2	42.9	13	2.2
014	4–0	57.4	21.6	4.5	3.0	1.4	0.70	2.1	80.2	6	2.1
Bg	0–16	0.8	0.4	4.7	T	0.2	0.03	0.2	1.6	14	0.2

Horizon	Depth (cm)		Very coarse sand	Coarse sand	Medium sand	Fine sand	Very fine sand	Total sands	Silt	Clay	Textural class
		Particle size (mm)	2–1	1–0.5	0.5–0.25	0.25–0.1	0.1–0.05		0.05–0.002	< 0.002	
Bg	0–16	Distribution (percent)	4.3	11.6	14.0	48.9	13.6	92.4	7.1	0.5	s

Some small hummocks and stones or boulders are often present. A generalized profile description of this soil follows:

Profile Description

0 Dark brown or very dark brown when wet and yellowish brown when squeezed, partially disintegrated fibrous organic matter, commonly with an intermingling of some dark reddish brown iron-oxide-rich material near the surface; lower boundary clear or abrupt; acid; continuous; 10 to 30 cm thick.

Bg Grey or dark grey sand, loamy sand, or sandy loam occasionally with some olive brown, yellowish brown, or reddish brown mottling; massive; may have some inclusions and thin streaks of partially altered organic material; acid; frozen below.

An example of Miligaersartoq B series is profile TAQ 130 located in an extensive gently sloping area about 0.7 km south-southeast of Base Camp (Fig. 2). The site is on a long (about 300 meters) gentle slope having a gradient of 4 to 5 percent. Some hummocks 10 to 20 cm high are present. Free water was present at or within 10 cm of the surface. *Carex aquatilis*, moss and some *Salix* sp. constitute the vegetation cover. Table V includes some data on this profile.

TAQ 130 Profile Description.

011 19 to 17 cm Mat of living and dead stems, roots and leaves.

012ir 17 to 13 cm Dark reddish brown (2.5 YR 2/4 wet), dark red (2.5 YR 3/6 squeezed) fibrous organic matter with some soft amorphous

Fig. 1. View 0.8 km south-southeast of Base Camp showing topographic and drainage environment of soil series. Frontispiece designation 1. A. Miligaersartoq A series, drainage category 1, TAQ 129; B. Miligaersartoq B series, drainage category 2, TAQ 130; C. Miligaersartoq C series, drainage category 2, TAQ 113; D. Sarfartôq C series, drainage category 6, TAQ 157; E. Tasersiaq A series, drainage category 3, TAQ 161. Photo July 1964.

		material; lower boundary clear, wavy; acid; horizon is erratic in occurrence and may often be discontinuous.
013	13 to 4 cm	Dark brown (10 YR 3/3 wet), yellowish brown (10 YR 5/4 squeezed), fibrous organic matter; strongly resistant to disintegration by rubbing; considerable admixture of sandy mineral material; lower boundary clear; acid; continuous; organic matter appears to have been derived largely from sedges.
014	4 to 0 cm	Very dark greyish brown (10 YR 3/2–2/2 wet), yellowish brown (10 YR 5/6 squeezed) appreciably disintegrated fibrous organic matter; moderately resistant to disintegration by rubbing; lower boundary abrupt, somewhat wavy; acid; continuous.
Bg	0 to 16 cm	Grey (5 Y 5/1 moist, 10 YR 6/1–6/2 dry) fine sandy loam with lenses of grit and coarse sand; massive; few roots; acid; frozen below.
Cf	16 to 54 cm	Frozen, grey loamy fine sand with some thin lenses of very coarse sand and grit and occasional layers of very dark brown disintegrated fibrous organic material.

Miligaersartoq C Series

This very-poorly-drained soil occurs on somewhat steeper slopes than does the soil of the Miligaersartoq B series. The surface organic horizon is thinner, usually less than 10 cm thick, and more frequently about 4 to 6 cm. Microrelief is usually hummocky (up to 40 cm high), and stones and boulders on the surface are common. In general the morphology of this soil is as follows:

Profile Description.

0 Dark brown, very dark brown or very dark grey, partially altered, fibrous organic matter occasionally intermingled with some dark reddish brown, especially in the hummocks; lower boundary clear to abrupt; acid; continuous.

Bg Grey or dark grey loamy fine sand or sandy loam often with some yellowish brown, dark brown, or olive brown mottling; massive or weakly subangular structure; streaks of organic matter may be present; acid; continuous.

Profile TAQ 113, described and sampled about 1.5 km south of Base Camp, is an example of the Miligaersartoq C series (Fig. 2). It is situated on a long (about 150 meters) moderate slope having a gradient of 8 percent, with a hummocky microrelief of up to 40 cm (Fig. 1). Stones and boulders are numerous and in many cases form the cores of the hummocks. *Carex* sp. and moss make up the vegetation. Free water was encountered at 22 cm depth. Laboratory data for this profile are given in Table VI.

Table VI. *Organic carbon content, ignition loss, chemical properties, and mechanical composition of Miligaersartoq C soil profile TAQ 113.*

Horizon	Depth (cm)	Ignition wt loss (%)	Organic C (%)	pH	Exchangeable based meq/100g Ca	Mg	K	Na	Σ Exch cations meq/100g	Base sat (%)	Free Fe_2O_3 (%)
012	4–0	47.4	21.1	5.1	6.9	6.4	1.00	13.6	69.7	21	3.1
B21g	0–16	1.9	1.0	4.9	1.2	0.7	0.05	1.2	5.3	38	0.2
B22g	16–32	4.4	2.2	4.8	0.8	0.6	0.05	1.6	9.4	19	0.7

Horizon	Depth (cm)		Very coarse sand 2–1	Coarse sand 1–0.5	Medium sand 0.5–0.25	Fine sand 0.25–0.1	Very fine sand 0.1–0.05	Total sands	Silt 0.05–0.002	Clay < 0.002	Textural class
		Particle size (mm)									
B21g	0–16	Distribution (percent)	2.3	5.8	8.7	28.4	22.7	67.9	30.9	1.2	fsl
B22g	16–32		2.7	10.0	11.2	28.0	17.7	69.6	28.8	1.6	fsl

TAQ 113 Profile Description.

011	5 to 4 cm	Mat of roots and stems, living and dead.
012	4 to 0 cm	Very dark brown (10 YR 2/2 wet), dark brown (10 YR 3/3 squeezed), finely fibrous organic material; strongly resistant to disintegration by rubbing; lower boundary abrupt, wavy; acid; continuous.
B21g	0 to 16 cm	Grey to dark grey (5 Y 5/1–4/1 moist, 10 YR 6/1 dry) fine sandy loam with few fine, dark yellowish brown (10 YR 4/4) mottles along some roots; massive with tendency to break up into weak fine subangular units; roots plentiful; acid; lower boundary gradual; continuous.
B22g	16 to 32 cm	Grey (5 Y 5/1–4/1 moist, 10 YR 6/1 dry) fine sandy loam with inclusions of thin streaks of dark brown (7.5 YR 3/2) organic material; massive; acid; continuous; frozen below.

Tasersiaq A Series

This poorly-drained soil frequently occupies moderately to strongly sloping benched tracts of the long valley slopes (Fig. 1). There is considerable skeletal material in this soil as a rule and numerous stones and boulders appear frequently at the surface. Hummocks of low relief are common in areas where this soil occurs. The following is a generalized description:

Profile Description.

0	Dark brown, very dark brown, or black, fibrous organic matter which may be intermingled with some dark reddish brown organic matter; lower boundary clear or abrupt, wavy; acid; continuous; thickness is less than 10 cm and most commonly is about 5 cm.
Bg	Greyish brown, light olive brown or dark greyish brown, fine sandy loam or loamy fine or very fine sand; distinctly mottled in which grey, dark brown, or reddish brown are common component colors; massive with some indication of weak platiness; contorted streaks of organic matter indicate appreciable disturbance; acid; continuous.

An example of the Tasersiaq A series is profile TAQ 161, which was described and sampled about 4 km south of Base Camp. The site examined is on a moderately sloping (10 percent gradient) tract about 75 meters long. The general gradient of the valley slope in the area is about 15 percent. Hummocky microrelief of about 20 cm is prevalent in the vicinity of the site and there are numerous stones and boulders. *Carex* sp. and moss dominate the vegetation. Free water was encountered at a depth of 15 cm. Pertinent data for this profile are given in Table VII.

TAQ 161 Profile Description.

01	7 to 4 cm	Mat of roots and stems.
02	4 to 0 cm	Black (5 YR 2/1 wet), dark brown (7.5 YR 3/2 squeezed), moderately fibrous organic matter; moderately resistant to

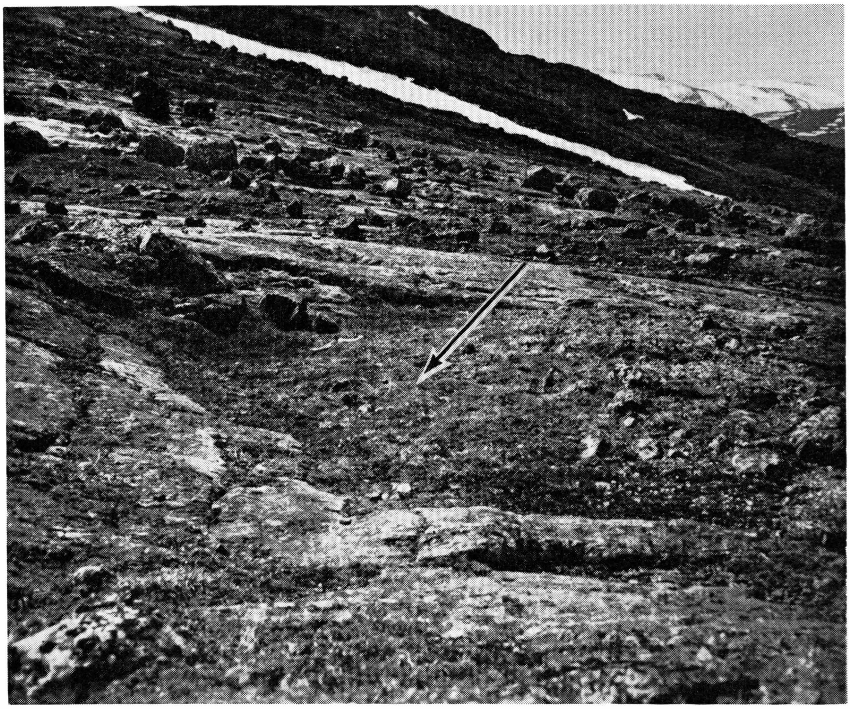

Fig. 3. Soil and rockland association, usually Tasersiaq B and Sarfartôq A series Frontispiece designation 6. Photo August 1964.

Table VII. *Organic carbon content, ignition loss, chemical properties and mechanical composition of Tasersiaq A soil profile TAQ 161.*

Horizon	Depth (cm)	Ignition wt loss (%)	Organic C (%)	pH	Exchangeable bases meq/100g Ca	Mg	K	Na	Σ Exch cations meq/100g	Base sat (%)	Free Fe_2O_3 (%)
02	4–0	27.6	15.0	5.4	17.7	4.8	0.56	23.4	50.8	45	0.8
B2g	0–20	1.0	0.6	5.4	0.8	0.5	0.05	1.6	4.5	31	0.2
B3	20–55	0.8	0.4	5.4	0.4	0.4	0.05	1.2	3.2	28	0.5

Horizon	Depth (cm)	Particle size (mm) / Distribution (percent)	Very coarse sand 2–1	Coarse sand 1–0.5	Medium sand 0.5–0.25	Fine sand 0.25–0.1	Very fine sand 0.1–0.05	Total sands	Silt 0.05–0.002	Clay < 0.002	Textural class
B2g	0–20		4.3	10.2	9.2	22.0	19.4	65.1	33.6	1.3	fsl
B3	20–55		2.8	10.3	9.1	22.0	19.2	63.4	35.7	0.9	fsl

		disintegration by rubbing; lower boundary clear or abrupt, very wavy; acid; continuous; thickness ranges from 2 to 7 cm at the site.
B2g	0 to 20 cm	Light olive brown (2.5 Y 5/4) fine sandy loam with coarse olive brown (2.5 Y 4/4), olive grey (5 Y 5/2) and dark brown (7.5 YR 4/4) mottling common; massive with some indication of very weak, thick platiness; roots plentiful in upper part and sparse in lower; lower boundary gradual; acid; continuous.
B3	20 to 55 cm	Light olive brown (2.5 Y 5/4) fine sandy loam with coarse olive brown mottling common; massive; frozen below.

Tasersiaq B Series

Commonly occupying the benched tracts of the middle and upper portions of the valley slope, this somewhat poorly-drained soil occurs on surfaces that may range from moderately sloping to very steep gradients of 12 to 40 percent. It has been derived from materials resulting from partial alteration or reworking of till by surface and subsurface flow of water originating as precipitation runoff or from the melting of snowbanks (Figs. 3, 4, and 5). These materials generally have a higher content of silt, and fine and very fine sand than do the other surficial materials of the area. Hummocks of low relief and numerous stones and boulders are common to the areas occupied by this soil. In general, the morphology of the soil is as follows:

Profile Description

0	Dark brown, very dark brown, or dark reddish brown fibrous organic matter; clear to abrupt wavy boundary; acid; continuous, thickness is less than 10 cm and most commonly is in the 2 to 5 cm range.
C1	Dark greyish brown fine or very fine sandy loam, loamy very fine sand or loamy fine sand with faint to distinct dark brown, dark reddish brown, olive brown or dark yellowish brown mottling; massive with some indications of weak platiness; contorted zones of colors and streaks of organic matter inclusions are indicative of considerable mixing and disturbance that apparently occur in such materials.

An example of the Tasersiaq B series is profile TAQ 160 which was examined about 4 km south-southeast of Base Camp. The benched tract on which the site cocurs has a gradient af 14 percent while the general slope was about 18 percent. Hummocky microrelief of about 20 cm and stones and boulders are common to the area. The vegetation consisted of *Carex* sp. and *Vaccinium* sp., mosses and lichens. Laboratory data for this profile are given in Table VIII.

TAQ 160 Profile Description.

01	7 to 5 cm	Mat of living and dead roots, stems, and leaves.
02	5 to 0 cm	Dark brown (10 YR 3/3) finely disintegrated somewhat fibrous organic material; soft, rubs down easily; lower boundary clear, wavy; acid; continuous; thickness at site ranges from 2 to 5 cm.

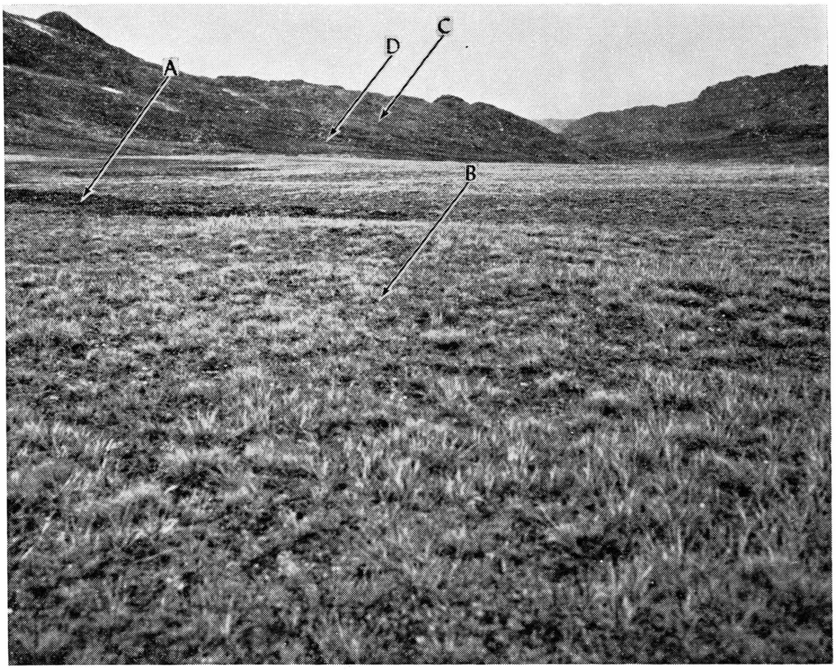

Fig. 4. View 0.4 km north-northwest of Base Camp showing topography and drainage environment of soil series. Frontispiece designation 2. A. Quantum Sø A series, drainage category 5, TAQ 139; B. Sarfartôq B series, drainage category 6, TAQ 158; C. Tasersiaq B series, drainage category 4, TAQ 160; D. Sarfartôq A series, drainage category 4, TAQ 124. Photo July 1964.

Table VIII. *Organic matter content, ignition loss, chemical properties, and mechanical composition of Tasersiaq B soil profile TAQ 160.*

Horizon	Depth (cm)	Ignition wt loss (%)	Organic C (%)	pH	Exchangeable bases meq/100g Ca	Mg	K	Na	Σ Exch cations meq/100g	Base sat (%)	Free Fe_2O_3 (%)
C1	0–25	3.3	1.7	5.1	0.8	0.4	0.08	1.2	9.2	14	0.6
C2	25–55	1.8	0.9	5.1	0.4	0.6	0.05	1.4	5.5	20	0.3

Horizon	Depth (cm)	Particle size (mm)	Very coarse sand 2–1	Coarse sand 1–0.5	Medium sand 0.5–0.25	Fine sand 0.25–0.1	Very fine sand 0.1–0.05	Total sands	Silt 0.05–0.002	Clay < 0.002	Textural class
C1	0–25	Distribution (percent)	1.1	4.1	7.1	29.3	25.5	67.1	31.6	1.3	fsl
C2	25–55		0.8	3.8	5.9	23.1	27.8	61.4	37.4	1.2	vfsl

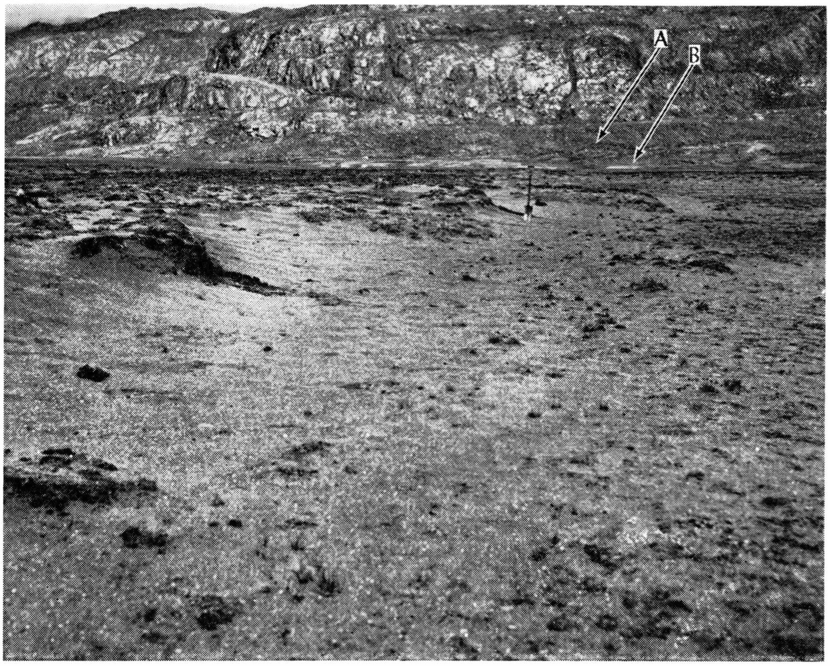

Fig. 5. Wind erosion of outwash terrace on which Sarfartôq B series is best developed. Erosion due to wind channeling and katabatic winds from Sarfartôq Gletscher. Regenerating vegetation is dominated by *Papaver radicatum* and *Saline acalus*. Arrows A and B indicate area where Tasersiaq B and Quantum Sø B series are typically developed. Lake is between terrace and arrow designations. Photo July 1964.

C1	0 to 25 cm	Dark greyish brown (2.5 Y 4/2) very fine sandy loam with coarse diffuse dark reddish brown (5 YR 3/3), olive brown (2.5 Y 4/4), and dark yellowish brown mottling; massive or somewhat weak, thick platy structure; roots plentiful; pebbles and stones make up about a third of the volume; acid; lower boundary gradual.
C2	25 to 55 cm	Dark greyish brown (2.5 Y 4/2) very fine sandy loam with few, large olive brown (2.5 Y 4/4) mottles; massive or somewhat weak platy structure; roots very few; frozen below; some free water above the frozen zone.

Quantum Sø A Series

This moderately well-drained soil has been derived from sandy materials of the outwash and/or kame terraces and hence is coarse textured throughout. An example of this soil is profile TAQ 139, which was examined about 150 meters north of Base Camp (Fig. 4). It occurs in a slightly depressed area on the extensive terrace. *Vaccinium* and some *Carex* sp. are the predominant constituents of the vegetation. Weakly expressed nonsorted nets about 2 meters across from the ground pattern

Table IX. *Organic carbon content, ignition loss, chemical properties, and mechanical composition of Quantum Sø A soil profile TAQ 139.*

Horizon	Depth (cm)	Ignition wt loss (%)	Organic C (%)	pH	Exchangeable bases meq/100g Ca	Mg	K	Na	Σ Exch cations meq/100g	Base sat (%)	Free Fe_2O_3 (%)
01	2–0	70.4	30.4	4.7	11.4	9.5	2.71	21.8	65.3	36	ND
A1	0–6	8.8	4.2	5.0	1.8	2.3	0.13	3.8	17.0	26	0.4
B & A2	6–17	1.3	0.7	5.5	0.5	0.6	0.05	1.3	3.8	32	0.4
B	17–41	0.9	0.4	5.8	0.4	0.6	0.04	1.0	2.6	38	0.4
C	41–67	0.4	ND	5.9	0.6	0.5	0.05	1.2	2.6	46	0.2

Horizon	Depth (cm)	Particle size (mm) / Distribution (percent)	Very coarse sand 2–1	Coarse sand 1–0.5	Medium sand 0.5–0.25	Fine sand 0.25–0.1	Very fine sand 0.1–0.05	Total sands	Silt 0.05–0.002	Clay < 0.002	Textural class
A1	0–6		4.1	22.7	21.8	33.0	6.1	87.7	11.8	0.5	cs
B & A2	6–17		2.2	15.7	20.9	41.1	12.6	92.5	7.1	0.4	s
B	17–41		3.1	19.3	19.7	38.6	11.9	92.6	7.1	0.3	s
C	41–67		8.5	54.8	20.1	11.5	3.2	98.1	1.8	0.1	cs

and a low microrelief of about 10 cm is present at the site. Some data for this profile are given in Table IX.

TAQ 139 Profile Description.

01 2 to 0 cm — Mat of stems, roots and leaves.

A1 0 to 6 cm — Black (10 YR 2/1) sand with a high content of organic matter; weak coarse crumb structure; friable; roots plentiful; acid; lower boundary clear but irregular due to contortions; thickness at site ranged from 2 to 15 cm; continuous.

B & A2 6 to 17 cm — Intermingled light yellowish brown (10 YR 6/4) and grey (10 YR 6/1) sand with some greyish brown (2.5 Y 5/2) and some very dark greyish brown (10 YR 3/2) inclusions of A1 horizon material; considerably contorted; massive; friable; roots plentiful; acid; lower boundary clear to gradual.

B 17 to 41 cm — Dark greyish brown (2.5 Y–10 YR 4/2) sand with many fine, faint yellowish brown (10 YR 5/6) mottles; massive; soft; roots very few; acid; lower boundary clear, slightly wavy.

C 41 to 67 cm — Dark greyish brown (10 YR 4/2) coarse sand with occasional pebbles; loose; wet; acid; frozen below.

Quantum Sø B Series

Soil of the Quantum Sø B series occurs on nearly level or gentle sloping areas in the vicinity of Quantum Sø (Plate I). Although the soil shows weak profile development, it is considered to be moderately well drained because of intermingling of greyish brown and yellowish brown colors near the surface.

Profile TAQ 150 examined about 100 meters north of Quantum Sø is located on a long (about 300 meters) gentle slope having a gradient that ranges from 2 to 5 percent (Figs. 5 and 9). A stabilized ground pattern of nets 1 to 2 meters across with depressed borders about 15 cm deep imparts a slight microrelief to the area. About 10 percent of the surface is occupied by boulders. *Carex* sp. and *Draba* sp. and moss form the vegetation cover. The soil was described and sampled near the center of one of the nets. Data available for this soil are reported in Table X.

TAQ 150 Profile Description.

01 3 to 0 cm	Mat of roots and stems, some of which have been partially humified.
A1 0 to 5 cm	Dark greyish brown (2.5 Y 4/2) loamy fine sand intermingled or mottled with yellowish brown (10 YR 5/6); slightly acid; lower boundary clear, wavy; thickness ranges from 2 to 10 cm.
C 5 to 40 + cm	Olive grey (5 Y 5/2) loamy fine sand with considerable grit; massive, vesicular; firm; some inclusions of streaks of organic matter; slightly acid.

Table X. *Organic carbon content and pH of Quantum Sø B soil profile TAQ 150.*

Horizon	Depth (cm)	Organic C (%)	pH
A1	0–5	0.6	5.2
C	5–25	ND	6.2
C	25–40	ND	6.2

Sarfartôq B Series

This well-drained soil is one of the more extensive ones in the area, occupying most of the nearly level to moderately sloping portions of the outwash or kame terraces (Figs. 4 and 8). Having been derived from glaciofluvial deposits, it is coarse textured and readily permeable and shows a rather distinct morphology to a greater depth than do the other soils. Because of its coarse texture and the topographic positions it occupies, it is susceptible to serious wind erosion (see Fig. 5).

The following is a generalized description of this soil:

Profile Description.

A1 Dark greyish brown to black loamy sand; weak crumb structure; friable; roots abundant; acid; lower boundary clear, wavy to irregular, apparently due to contortions; continuous; thickness ranges from 4 to 15 cm.

A2 & B Intermingled grey, greyish brown or pale brown and yellowish brown, dark yellowish brown or very dark greyish brown sand or loamy sand; acid; considerable contorting evident; thickness ranges from 0 to about 20 cm.

B2 Yellowish brown or dark yellowish brown loamy sand or sand with some patches of strong brown color; weak crumb structure; some gravel may be present; acid; thickness ranges from 12 to 20 cm.

B3 Pale brown or light yellowish brown, loamy sand or sand with or without gravel; medium or slightly acid; lower boundary gradual.

C Sand or sand and gravel; frozen zone in late summer at a depth of about 1.5 to 2 meters.

Profile TAQ 158, described and sampled about 500 meters northeast of Base Camp, is representative of this soil (Fig. 4). The site is a nearly level area supporting a stand of vegetation consisting of *Carex*, *Agropyron*, *Silene* and *Rhacomitrium* sp. Data for this profile are given in Table XI.

Table XI. *Organic carbon content, ignition loss, chemical properties and mechanical composition of Sarfartoq B soil profile TAQ 158.*

Horizon	Depth (cm)	Ignition wt loss (%)	Organic C (%)	pH	Exchangeable bases meq/100g Ca	Mg	K	Na	Σ Exch cations meq/100g	Base sat (%)	Free Fe_2O_3 (%)
A1	0–9	2.6	1.2	5.8	2.2	1.2	0.13	3.4	7.0	50	0.4
A2	Patchy	2.0	0.7	5.8	1.7	1.0	0.05	3.0	5.5	51	0.3
B2	9–26	1.0	0.4	5.7	0.7	0.7	0.08	1.2	4.1	37	0.3
B31	26–38	0.7	0.2	6.0	0.7	0.8	0.08	1.8	2.6	46	0.4
B32	38–58	0.4	0.1	6.5	1.1	0.6	0.05	1.2	2.6	69	0.3
C	58–138	0.2	ND	7.0	0.3	0.3	0.05	1.8	0.8	88	0.2
Cf	138–150	0.1	ND	6.7	0.6	0.2	0.05	1.8	1.2	76	ND

Horizon	Depth (cm)		Very coarse sand	Coarse sand	Medium sand	Fine sand	Very fine sand	Total sands	Silt	Clay	Textural class
		Particle size (mm)	2–1	1–0.5	0.5–0.25	0.25–0.1	0.1–0.05		0.05–0.002	< 0.002	
A1	0–9	Distribution (percent)	3.4	19.2	18.3	30.3	13.4	84.6	15.1	0.3	ls
A2	Patchy		3.2	16.3	20.5	34.0	12.6	86.6	12.9	0.5	s
B2	9–26		1.1	9.0	15.2	37.7	17.0	80.0	19.6	0.4	ls
B31	26–38		9.7	27.2	14.5	22.9	12.0	86.3	13.3	0.4	lcs
B32	38–58		17.2	41.0	13.8	14.8	4.3	91.1	8.8	0.1	cs
C	58–138		5.7	31.8	31.0	26.8	3.1	98.6	1.4	0.1	cs
Cf	138–150		4.1	31.8	26.6	24.7	6.4	93.6	6.4	T	cs

TAQ 158 Profile Description.

A1	0 to 9 cm	Dark greyish brown (10 YR 4/2) loamy sand; weak fine granular structure; friable; roots abundant; lower boundary clear, very wavy due to contorting; continuous; thickness ranges from 9 to 15 cm.
A2		Erratic and patchy in distribution. Where present it occurs as a thin streak (about 1 cm thick) having a pale brown (10 YR 6/3) color (see Figs. 6 and 7).
B2	9 to 26 cm	Yellowish brown (10 YR 5/4) loamy sand with thin patches of dark yellowish brown (10 YR 4/4) along upper boundary; massive in place breaking into very weak very fine subangular blocky or crumb structure; roots plentiful; few pebbles present with dark reddish brown staining on lower surfaces; lower boundary gradual.
B31	26 to 38 cm	Light yellowish brown (10 YR 6/4–5/4) loamy coarse sand; about 50 percent of volume is made up of rounded pebbles and small cobbles with dark reddish brown (5 YR 3/3) staining on lower surfaces; roots plentiful, lower boundary clear.
B32	38 to 58 cm	Pale brown (10 YR 6/3) to light yellowish brown (10 YR 6/4) coarse sand; rounded pebbles and small cobbles make up about 60 to 70 percent of volume; roots plentiful; olive (5 Y 4/3) to light olive brown (2.5 Y 5/4) coatings of silty vesicular material on upper surfaces of pebbles, dark reddish brown (5 YR 4/4–3/3) staining and white calcareous coatings on lower surfaces.
C	58 to 138 cm	Sand and gravel of mixed colors and lithology; bedded.
C	138 to 150 cm	Frozen; greyish brown (2.5 Y 5/2) coarse sand.

Sarfartôq A Series

The well-drained Sarfartôq A soil is similar to that of the Sarfartôq B series in the sequence of horizons but is somewhat less coarse textured since it is derived from till (see Fig. 4). It occurs most commonly on the moderately to very steeply sloping terrain. As such, the materials are subject to appreciable mass movement downslope which is reflected in some disturbance of the soil profile. This in general has contributed to a weaker expression of the A2 and B horizons. A high content of skeletal material in the solum and stone- or boulder-littered surface is common to the areas occupied by this soil. Fine sandy loam and loamy fine sand are the textures most common to this soil.

Soil profile TAQ 124, examined about 0.6 km south-southwest of the Base Camp, is an example of this soil. The profile, however, does exhibit a somewhat stronger development of the B horizon than is usually found in the soil of this series. This site is on a 25 percent slope, of which about 25 percent of the surface is occupied by lichen-covered stones and boulders and about 15 percent is free of vegetation. The vegetation cover consists of *Dryas* sp. and *Carex* sp. and some grasses and lichens. Data for some chemical properties of this soil are shown in Table XII.

Fig. 8. Profile representative of Sarfartôq B series, TAQ 158, developed in fine sand and silt capping outwash sands and gravels. Frontispiece designation 1. See also Figure 4. Description on page 26. Photo August 1964.

Table XII. *Organic carbon content, ignition loss, chemical properties and mechanical composition of Sarfartôq A soil profile TAQ 124*

Horizon	Depth (cm)	Ignition wt loss (%)	Organic C (%)	pH	Exchangeable bases meq/100q Ca	Mg	K	Na	Σ Exch cations meq/100g	Base sat (%)	Free Fe_2O_3 (%)
A1	0–4	5.1	2.3	5.8	3.9	2.4	0.20	– –	13.7	47	0.7
B	4–10	2.6	1.0	5.8	1.2	1.1	0.08	9.7	9.8	24	1.0
C1	10–36	0.8	0.3	5.7	0.3	0.4	0.05	6.7	3.1	26	0.4
B	10–36	2.7	ND	5.6	1.0	0.7	0.05	2.6	10.4	17	1.0
C2	36–80	0.6	0.18	5.8	0.4	0.4	0.05	1.1	3.7	24	0.6

Horizon	Depth (cm)	Particle size (mm)	Very coarse sand 2–1	Coarse sand 1–0.5	Medium sand 0.5–0.25	Fine sand 0.25–0.1	Very fine sand 0.1–0.05	Total sands	Silt 0.05–0.002	Clay < 0.002	Textural class
A1	0–4	Distribution (percent)	5.2	10.8	8.8	19.8	17.4	62.0	32.6	5.4	fsl
B	4–10		4.4	8.9	8.4	19.2	15.7	56.6	35.8	7.6	fsl
C1	10–36		5.4	12.6	9.0	22.6	18.1	67.7	30.6	1.7	fsl
B	10–36		9.4	8.2	7.1	16.9	14.2	50.8	41.3	7.9	fsl
C	C2		4.2	10.7	8.4	22.1	19.6	65.0	34.2	0.8	fsl

TAQ 124 Profile Description.

01	2 to 0 cm	Mat of roots, stems, and lichens.
A1	0 to 4 cm	Very dark greyish brown (10 YR 3/2) fine sandy loam; weak fine crumb structure; friable; discontinuous; thickness ranges from 0 to 4 cm. Thin patches of grey fine sandy loam adjoin pebbles and stones indicating an incipient development of A2 horizon.
B	4 to 10 cm	Yellowish brown (10 YR 5/4) fine sandy loam; weak fine granular structure; friable; lower boundary clear to abrupt, wavy; continuous; thickness ranges from 2 to 10 cm.
C1 & B	10 to 36 cm	Grey (5 Y 5/1) fine sandy loam intermingled with masses of dark yellowish brown (10 YR 4/4) and light yellowish brown (10 YR 6/4) soil similar to that of the B horizon; grey soil is massive and vesicular while B horizon inclusions are weak fine granular; roots plentiful; lower boundary abrupt and irregular.
C2	36 to 80 cm	Olive grey (5 Y 5/2) fine sandy loam with occasional thin horizontal streaks of dark yellowish brown; massive, vesicular.

The intermingling of the grey and dark-yellowish brown material in the C1 horizon is indicative of appreciable mixing by downslope mass movement. These two kinds of material in the C1 & B horizon were sampled separately for analysis. About 30 percent of the soil volume is made up of rock fragments of various sizes.

Sarfartôq C Series

This well- to somewhat excessively-drained soil has been derived from till and usually occurs on the upper slopes as well as on the crests and shoulders of the upland terrain (Figs. 1 and 9). Morphologically it exhibits little development in color—usually the upper part of the profile is only slightly darker than the subsoil or parent material. Lower pH values and the absence of the calcareous fraction in the upper part of the solum, however, are indicative of some leaching.

Derived from till, this soil is coarse textured. Sandy loams and loamy fine sand are the common texture classes. A large proportion of the soil volume, an estimated 30 to 60 percent, is made up of skeletal material. Stones and boulders litter the surface and occupy a considerable portion of the surface.

Vegetation consisting of isolated mats of *Dryas* sp. and some *Carex* sp. and lichens is sparse, generally covering only a minor portion of the soil surface.

An example of the Sarfartôq C soil is profile TAQ 157 examined about 1 km south-southwest of Base Camp. It is located on the crest of the Miligaersartoq moraine.

Table XIII. *Organic carbon content, chemical properties and mechanical composition of Sarfartôq C soil profile TAQ 157.*

Horizon	Depth (cm)	Organic C (%)	pH	$CaCO_3$ Equiv (%)	Exchangeable bases meq/100g Ca	Mg	K	Na	Σ Exch cations meq/100g	Base sat (%)	Free Fe_2O_3 (%)
A1	0–2	0.7	6.6	–	1.3	1.4	0.28	2.6	3.9	77	0.4
B	2–15	0.2	7.2	–	0.7	0.8	0.08	1.8	2.5	64	0.3
C1	15–33	ND	7.4	T	–	–	–	–	–	–	0.3
C2	33–66	ND	7.4	T	–	–	–	–	–	–	0.4
C2	66–100	ND	7.5	T	–	–	–	–	–	–	0.4
C2	100–117	ND	7.8	0.05	–	–	–	–	–	–	0.4
C3	115–125	ND	8.3	1.10	–	–	–	–	–	–	0.4

Horizon	Depth (cm)	Particle size (mm) / Distribution (percent)	Very coarse sand 2–1	Coarse sand 1–0.5	Medium sand 0.5–0.25	Fine sand 0.25–0.1	Very fine sand 0.1–0.25	Total sands	Silt 0.05–0.002	Clay < 0.002	Textural class
A1	0–2		7.3	16.0	11.9	24.0	18.4	77.6	22.1	0.3	ls
B	2–15		7.2	12.2	10.3	24.2	19.3	73.2	26.6	0.2	ls
C1	15–33		4.0	10.7	10.4	24.7	18.2	68.0	30.8	1.2	fsl
C2	33–66		4.7	10.6	9.3	20.2	16.9	61.7	35.8	2.5	fsl
C2	66–100		3.9	10.0	9.1	21.5	18.0	62.5	34.5	3.0	fsl
C2	100–117		4.8	14.1	11.9	25.2	15.9	71.9	25.3	2.8	sl
C3	117–125		6.9	16.0	11.0	22.2	14.4	70.5	24.8	4.7	fsl

A description of this profile follows while some data regarding chemical properties are shown in Table XIII.

TAQ 157 Profile Description.

A1 0 to 2 cm	Pale brown (10 YR 6/3) loamy sand; loose; roots few; lower boundary clear; discontinuous.
B 2 to 15 cm	Greyish brown (2.5 Y 5/2) loamy sand with some patches of yellowish brown (10 YR 5/4) adjacent to rock fragments; somewhat massive in place; friable; roots plentiful; lower boundary wavy or irregular; discontinuous.
C1 15 to 33 cm	Olive grey (5 Y 5/2) fine sandy loam; massive in place; very few roots; lower boundary gradual.
C2 33 to 117 cm	Olive grey (5 Y 5/2) fine sandy loam with light olive grey (5 Y 6/2) around rock fragments; somewhat massive in place; loose when removed.
C3 117 to 125 + cm	Olive grey (5 Y 4/2) sandy loam with considerable grit; slightly calcareous.

Fig. 9. View 7 km south-southwest of Base Camp showing topographic and drainage environment of soil series. Frontispiece designation 3. A. Quantum Sø B series, drainage category 5, TAQ 150; B. Sarfartôq C series, drainage category 6, TAQ 157. Photo July 1964.

Clay Mineralogy

A profile representative of the well- to excessively-well-drained Sarfartôq A series (TAQ 124, page 28) was analyzed for clay minerals. Relative order of mineral abundance by horizon is presented below.

Horizon	Depth (cm)	Mineralogy
B	4–10	quartz > vermiculite > interstratified vermiculite and mica > illite or mica > hornblende ≈ K- and Na-feldspars.
C1	10–36	quartz > vermiculite > illite or mica > hornblende ≈ K- and Na-feldspars; trace amounts of Fe-chlorite.
B	10–36	quartz > vermiculite > interstratified vermiculite and mica > illite or mica > hornblende ≈ K- and Na-feldspars; trace amounts of Fe-chlorite.
C2	36–80	quartz > > vermiculite > illite > Na- and K-feldspars > hornblende; trace amounts of mica, vermiculite and Fe-chlorite.

The rather high proportion of interstratified vermiculite and illite in the 12 Å region (air dry) of both the 4- to 10-cm B horizon and the included 10- to 36-cm B horizon material and its virtual absence in either the C1 or C2 horizons attests to initial weathering of the micaceous minerals. No expansion was noted in response to glycolation in either the 12 or 14 Å areas and collapse to 10 Å upon heating to 550° C was complete.

The relative intensity of the vermiculite and quartz peaks was about equal in both B horizon samples. The quartz peak was clearly stronger in the C1 horizon and very much stronger relative to vermiculite in the C2 horizon. This again is suggestive of *in situ* weathering as well as clay translocation to the B horizon.

Soil Genesis

With few exceptions the soils of the Tasersiaq area have developed on rather uniform bouldery, sandy till or well- to moderately-well-sorted kame deposits. Many of these deposits have a thin capping of loess. All of the soils show indications of site instability. However, in most cases this has not been severe enough to alter significantly the soil-forming processes.

The coarse-textured character of the ground moraine, pre-recent moraines, and kame terrace deposits has allowed the process of podzolization to express itself. Soils of the Sarfartôq A and B series are the best representatives of the process.

Whether the A2 horizon, as described for these soils, is real from a genetic point of view is not clearly established by its chemistry or clay content. What is clear in both series is that there has been translocation of clays to the B horizon as well as movement and redeposition of organic material (humus) and iron. This is best shown by profile TAQ 124, Sarfartôq A series.

With the exception of one profile there is no indication that the bleached A2 horizon is a sedimentary layer and thus unrelated to the soil-forming process. In this exception, micro-crossbedding is evident and it is clear that an A1 horizon is beginning to develop in the sand. Further, the sand overlies a soil with a well-developed ortstein in the lower B and upper C horizons.

Hydrogen ion values are well within the range of podzolic soils (Muir, 1961). The absence of an increase in pH in the A1 horizon, a characteristic of many well-drained northern soils, suggests little if any upward movement of soil water. The depths to carbonate effervescence in both the terrace soils and those of the pre-recent moraines (117 cm for morainal soil) are similar and could not be used to separate these soils as to relative ages. The relatively deep leaching in these low moisture environments may indicate a rather long period of time.

X-ray analyses of profile TAQ 124 indicate that quartz, vermiculite, illite, and mica probably are the dominant clay size minerals in the soil. There does not appear to be any positive evidence of clay mineral synthesis in the B horizon; however, it is likely that some of the vermiculite has been derived from weathering of mica and that the illite may in part be derived from iron-rich chlorite. The absence of montmorillonite, and the presence of clay-size hornblendes attest to the incompleteness or weakness of the process of podzolization.

Soils with greater than 30 cm of organic material are restricted to areas of very shallow, standing, or slowly circulating water. pH values are low, but only in the wettest soil, the Miligaersartoq A, do they show an increase with depth. Other wet soils have a somewhat higher pH value in the surface horizon which is due to base cycling by vegetation, as indicated by the chemical analyses.

Exchangeable sodium values are very high in the Miligaersartoq A soils and in more highly humified O horizons of the better-drained soils of the area. The sodium values decrease sharply in the mineral horizons. Much of the sodium is derived from the atmosphere (rain and snow) and has been concentrated in low areas by runoff and water percolation through the surrounding soils where the hydrogen ion is replacing sodium and as simple solution of free sodium salts.

The higher exchange capacity associated with the organic complex provides sites for the sodium ion. The higher sodium values obtained in the O2 horizons of the better-drained soils reflect their increased exchange capacity. The pH of the Tasersiaq area soils is generally too low to allow hydrolization of the sodium (or magnesium) and movement of these humates lower in the profile, except perhaps in the Sarfartôq A and B series.

Free iron oxide values are generally high throughout all profiles examined and reach a maximum in the Miligaersartoq B series. These soils occupy somewhat better-drained hummocks and areas of protracted seasonal wetness in and adjacent to the Miligaersartoq A soils. During the brief summer dry periods considerable oxidation takes place in the upper horizons of these soils.

The thinness and rather advanced decomposition of much of the organic material suggest a rather low rate of accumulation and conditions unfavorable for humus formation. Soils of both the Miligaersartoq A and B series have some thin layers of silt within the organic matter which attest to short, aperiodic interruptions of organic accumulation. An organic layer below the permafrost table (horizon depth 76 cm) gave a radiocarbon date of 1090 ± 110 years B.P. (I-1527). It is not known whether the overlying mineral soil buried an organic soil or if the dated material is from a zone which represents fluctuating depositional environments. The date does indicate that present Miligaersartoq A soils are of relatively recent age.

Soils of the Miligaersartoq C, Tasersiaq A and B series are morphologically and chemically closely related. All show some indication of site instability such as cracking and distortion of horizons. Most show a thin organic-rich O horizon and a moderately to strongly gleyed B horizon. Their pH values fall between those of the well-drained and wet soils. In addition to a seasonal alternation of waterlogged and oxidizing states there is a net upward movement of salts during the dry period.

Soils comprising the Quantum Sø A and B series occupy a position intermediate between the wet meadow soils and the well-drained and excessively well-drained podzolized soils. They are representative of the Arctic Brown soils and similar to those described by UGOLINI (1966a) from the Mesters Vig District of East Greenland. The disturbed nature of the profiles makes the placing of an A2 horizon designation on the Quantum Sø A series tenuous and makes questionable any genetic significance which might be attached to it. Neither the chemistry nor the mechanical analyses offer support for its being genetic. The soils occupy slight depressions, and, therefore, the possibility exists that increments of bleached sands could have been added from deflation of the terrace and subsequently intermixed with A1 material by congeliturbation.

Quantum Sø B soils are closely related to those of the Quantum Sø A series and occur in conjunction with what appear to be stabilized polygons. It might be imagined that if the climatic environment of these series would remain stable over a sufficiently long time, both soils would become podzolized.

The most immature soils of the area belong to the Sarfartôq C series. Profile development is minimal. However, a slight organic matter accumulation is detectable in the A1 horizon. Decrease in pH values in the upper few centimeters of the profile as well as a slight depletion in the silt and clay particles indicate some leaching. These soils are subject to frost heave and deflation on areas only recently exhumed from permanent snow cover; some of these areas may still retain a semi-permanent cover.

Classification of Soils

A classification of the ten soil series occurring in the Tasersiaq area has been made according to TEDROW *et al.* (1958), TEDROW and CANTLON (1958), and SOIL SURVEY STAFF (1960). The classification shown in Table XIV is into Great Soil Groups and Great Group classes.

Table XIV. *Classification of soils of Tasersiaq area into Great Soil Groups according to* TEDROW *and* CANTLON *(1958) and* TEDROW *et al. (1958) and into Great Groups according to* SOIL SURVEY STAFF *(1960).*

Soil Series	Great Soil Group	Great Group
Miligaersartoq A	Half-bog	Histosols (order category)
Miligaersartoq B	Half-bog	Cryaquepts
Miligaersartoq C	Wet Meadow	Cryaquepts
Tasersiaq A	Wet Meadow	Cryaquepts
Tasersiaq B	Upland Tundra	Cryaquepts
Quantum Sø A	Arctic Brown	Cryopsamments
Quantum Sø B	Upland Tundra	Cryopsamments
Sarfartôq B	Arctic Brown	Cryopsamments
Sarfartôq A	Arctic Brown, Minimal	Cryochrepts
Sarfartôq C	Polar Desert	Cryorthents

Conclusions

The ten soil series recognized in the Tasersiaq area are similar in many respects to those from East Greenland recognized by UGOLINI (1966a, 1966b), and those on Baffin Island by EVERETT (unpublished data). All the above are on materials derived from crystalline terrain and at similar latitudes. The zonal, moist, temperate soil-forming process of podzolization is operative at much reduced intensity under conditions of low temperatures and low rainfall. Nevertheless, it has produced and is producing clearly recognizable podzolic soils in favorable situations. It is always a matter of concern whether the soils of a given region are in equilibrium with the present climate or are perhaps a relic reflecting a recent past climate. There is nothing in the chemistry or morphology of the Tasersiaq soils to suggest disequilibrium. Evidence based on leaching depth, clay mineralogy, and radiocarbon dates does not support any great antiquity for these soils. It is our opinion that the soils of the Tasersiaq area were formed in a time interval of only one or two thousand years under climatic conditions ranging not too widely from those of the present.

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Færdig fra trykkeriet den 31. december 1971.

FIGURES

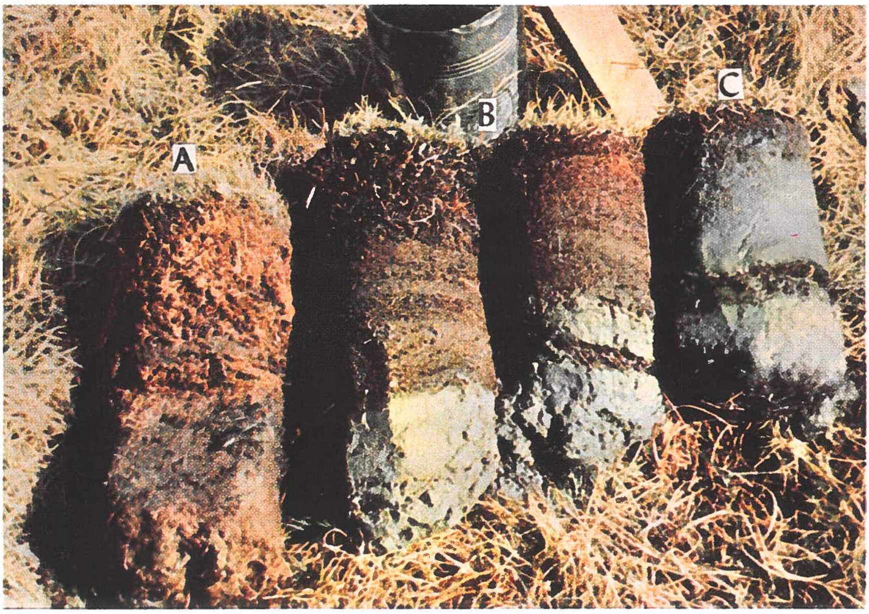


Fig. 2. Catenary sequence representing profiles which correspond to arrow designations A, B and C, Figure 1.

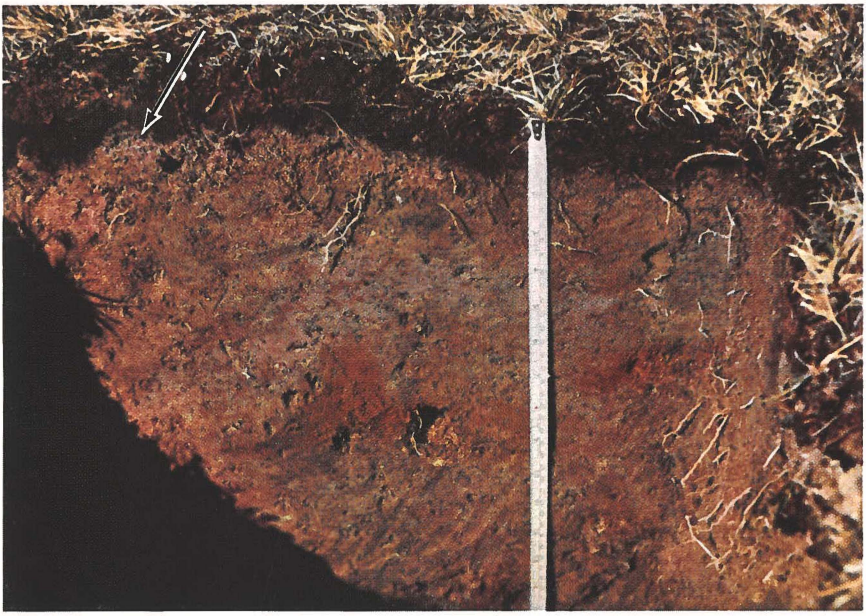
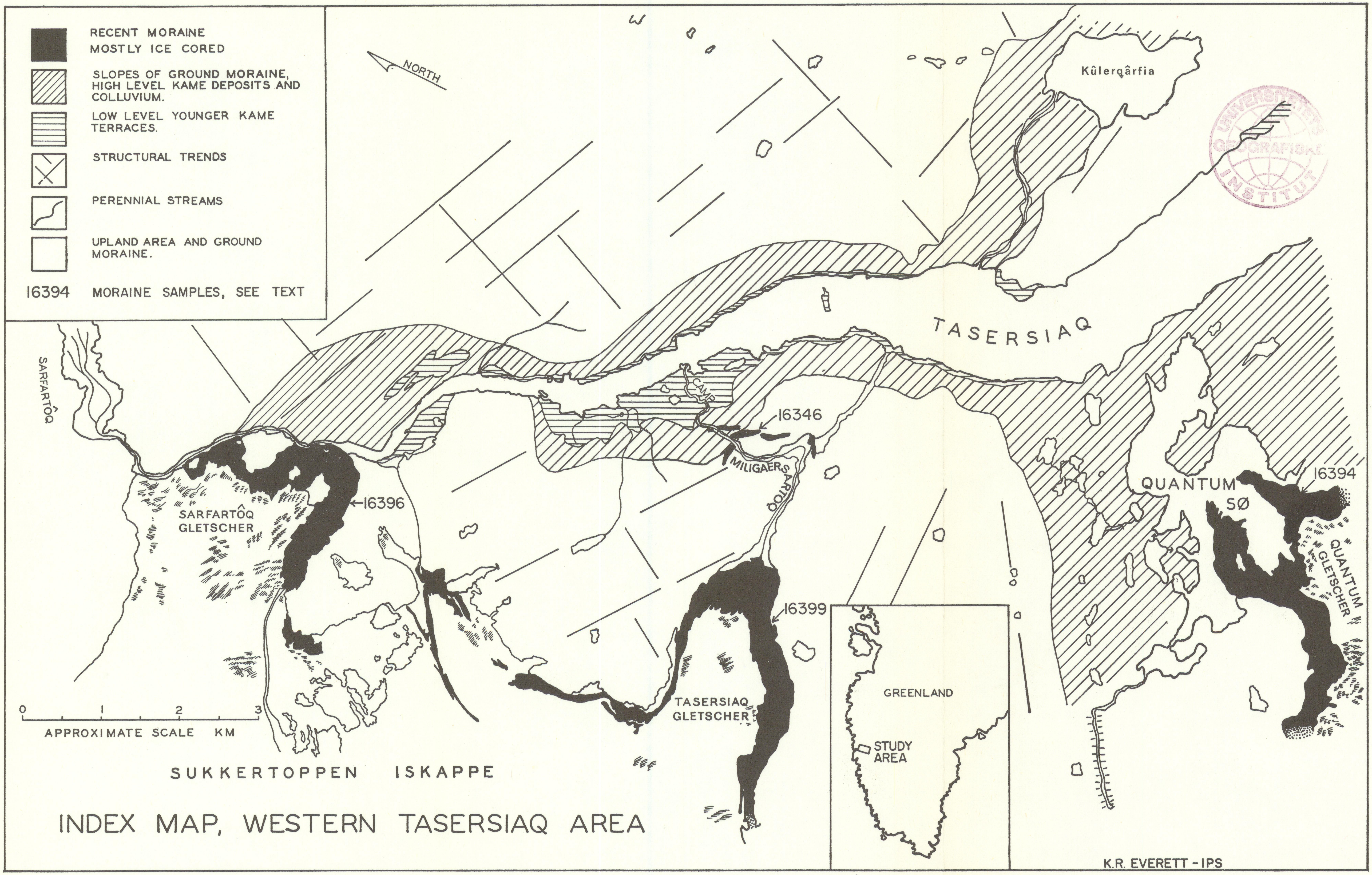
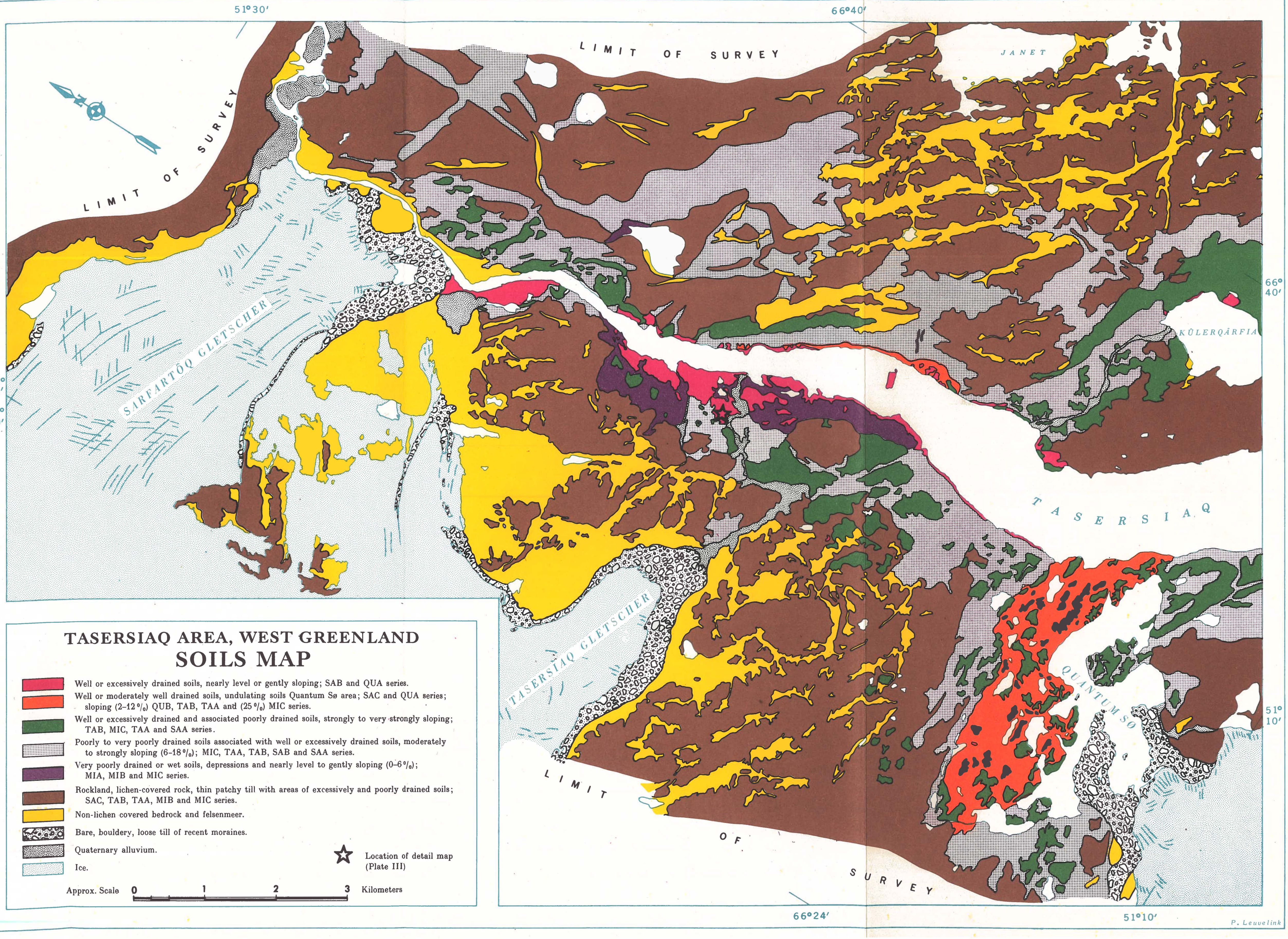


Fig. 6. Sarfartôq B series. Profile taken 2 km southeast of Base Camp. Arrow indicates discontinuous A_2 horizon. Note mottling in B horizon.

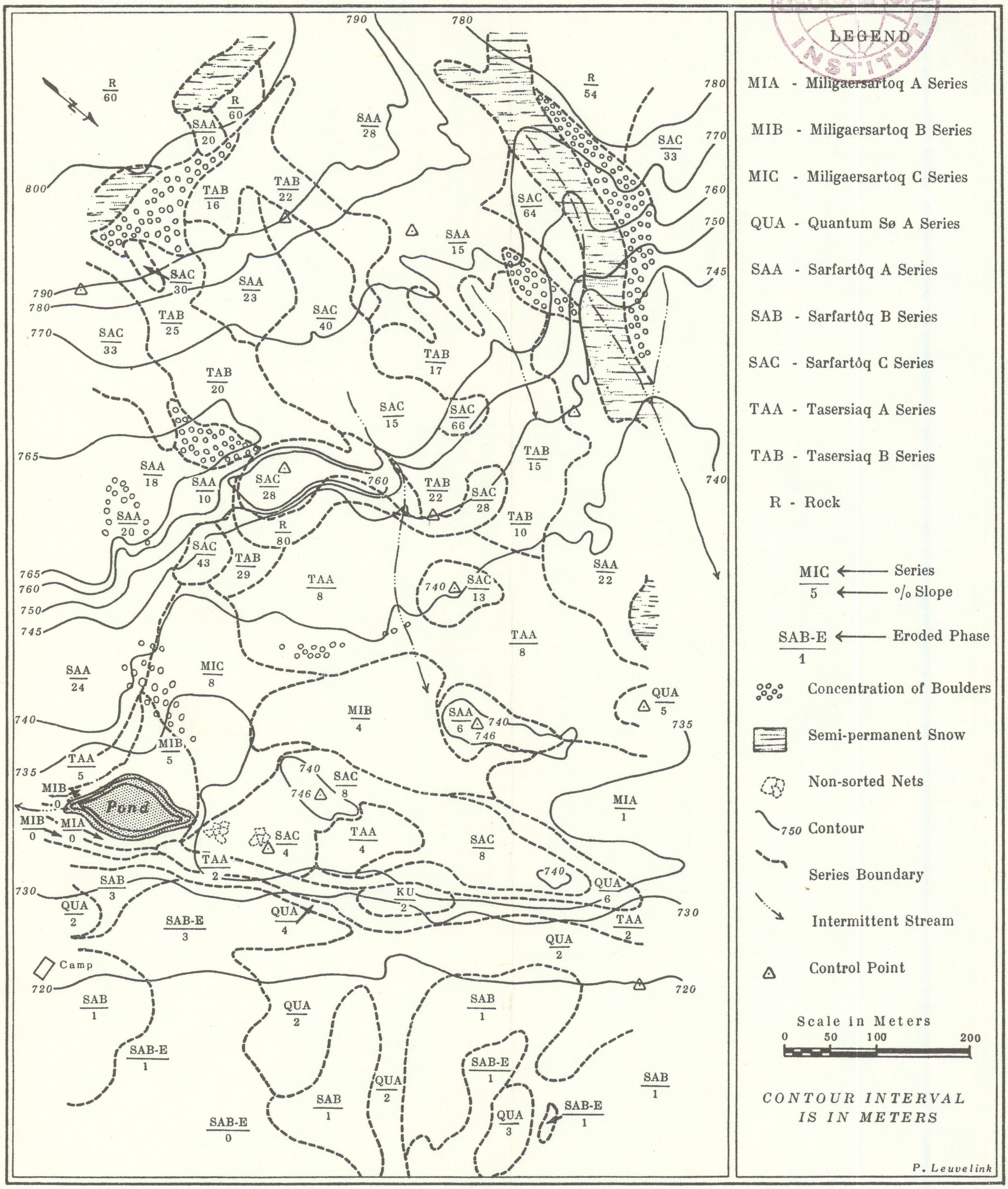
Fig. 7. Sarfartôq B series developed in loess cap over bedded kame sands. See Figure 4, arrow B, for location. Note pendants and inclusions of A_1 material. A discontinuous color A2 is present associated with A_1 pendants. Shovel rests on permafrost.



RECENT MORAINE MOSTLY ICE CORED
SLOPES OF GROUND MORAINE, HIGH LEVEL KAME DEPOSITS AND COLLUVIUM.
LOW LEVEL YOUNGER KAME TERRACES.
STRUCTURAL TRENDS
PERENNIAL STREAMS
UPLAND AREA AND GROUND MORAINE.
16394 MORAINE SAMPLES, SEE TEXT
NORTH
Kûlerqârfia
TASERSIAQ
SARFARTÔQ
CAMP
16346
MILIGAERSARTOQ
16396
SARFARTÔQ GLETSCHER
QUANTUM SØ
16394
QUANTUM GLETSCHER
16399
TASERSIAQ GLETSCHER
GREENLAND
STUDY AREA
0 1 2 3
APPROXIMATE SCALE KM
SUKKERTOPPEN ISKAPPE
INDEX MAP, WESTERN TASERSIAQ AREA
K.R. EVERETT - IPS



51° 30′
66° 40′
LIMIT OF SURVEY
JANET
66° 40′
KÜLERQÂRFIA
SARFARTÔQ GLETSCHER
TASERSIAQ
TASERSIAQ GLETSCHER
QUANTUM SØ
51° 10′
LIMIT OF SURVEY
66° 24′
51° 10′
TASERSIAQ AREA, WEST GREENLAND
SOILS MAP
Well or excessively drained soils, nearly level or gently sloping; SAB and QUA series.
Well or moderately well drained soils, undulating soils Quantum Sø area; SAC and QUA series; sloping (2–12 %) QUB, TAB, TAA and (25 %) MIC series.
Well or excessively drained and associated poorly drained soils, strongly to very strongly sloping; TAB, MIC, TAA and SAA series.
Poorly to very poorly drained soils associated with well or excessively drained soils, moderately to strongly sloping (6–18 %); MIC, TAA, TAB, SAB and SAA series.
Very poorly drained or wet soils, depressions and nearly level to gently sloping (0–6 %); MIA, MIB and MIC series.
Rockland, lichen-covered rock, thin patchy till with areas of excessively and poorly drained soils; SAC, TAB, TAA, MIB and MIC series.
Non-lichen covered bedrock and felsenmeer.
Bare, bouldery, loose till of recent moraines.
Quaternary alluvium.
Ice.
Location of detail map (Plate III)
Approx. Scale 0 1 2 3 Kilometers
P. Leuvelink



Interrelationship of soil series and topography adjacent to Base Camp.