POLISH POLAR RESEARCH	9	1	61—71	1988

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Soil-forming processes and soil properties in Calypsostranda, Spitsbergen

ABSTRACT: Results of field investigations in 1986 in Calypsostranda, southern coast of Bellsund, are presented. Soils of dry, wet and very wet tundra were studied. Strong skeleton, presence of carbonates, neutral or alkaline reaction, low content of available phosphorus and potassium, high content of organic carbon (in mineral soils) are the most characteristic properties of investigated soils. Regularities in vertical distribution of some components were distinguished.

Key words: Arctic, Spitsbergen, soils.

Introduction

Little has been written on soils of the arctic areas (Jahn 1946, Rieger 1974, Stäblein 1977, Andreiev 1980, Låg 1981, Linell and Tedrow 1981), Spitsbergen included (Szerszeń 1965, 1968, 1974; Boratyński *et al.* 1968; Baranowski and Szerszeń 1968; Plichta 1977, Szerszeń and Chodak 1983; Låg 1980, 1983; Klimowicz and Uziak 1987). Detailed and almost complete description of some soil types from Hornsund region was presented by Szerszeń (1965, 1968, 1974). Soils from the southern coast of Bellsund have not been fully described yet. In this paper results of investigations carried out in 1986 during the Scientific Expedition of the Institute of Earth Sciences, Maria Curie-Skłodowska University of Lublin, are presented.

Area and methods

The studied area forms a part of coastal plain of southern Bellsund shore. It is constituted of several raised marine beaches that slope northeastwards.

Geologic structure of this area is described by Stäblein (1969), Hauser (*unpubl.*), Harasimiuk (1987), Repelewska-Pękalowa (1987) and Pękala (1987). Climatic conditions are presented by Rodzik and Stepko (1985) as well as by Rodzik and Ryżyk (1987).

Soil profiles were studied in places characteristic for dry tundra (which predominates in Calypsostranda: Fig. 1; Pl. 1, Fig. 1), and also for wet and very wet tundra. Samples were collected from locations with dense vegetation and for a comparison also with tussock vegetation. In dry tundra moss and vascular plants as *Salix polaris*, *Poligonum viviparum*, *Cerastium arcticum*, *Silene acaulis*, *Saxifraga oppositifolia* and *Saxifraga caespitosa* prevail.

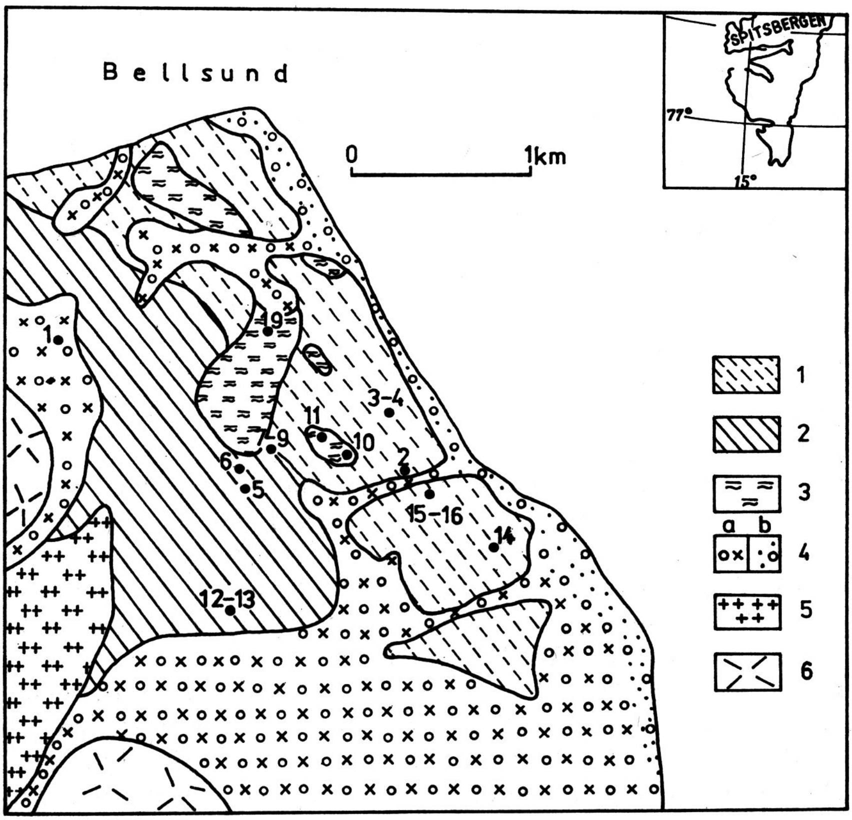

Fig. 1. Scheme of soil distribution in Calypsostranda (with locations and numbers of analyzed soil profiles): 1 — complex of poorly developed and brown soils formed from slightly loamy and loamy sands, 2 — gley and poorly gley soils formed from light and medium loam, and locally lithosols, 3 — gley soils formed from medium, heavy loam and clay, locally peat and shallow peaty soils, 4 — areas devoid of soils: a — stones and gravels, b — gravels and sands, and locally regosols; 5 — mountains, 6 — glaciers

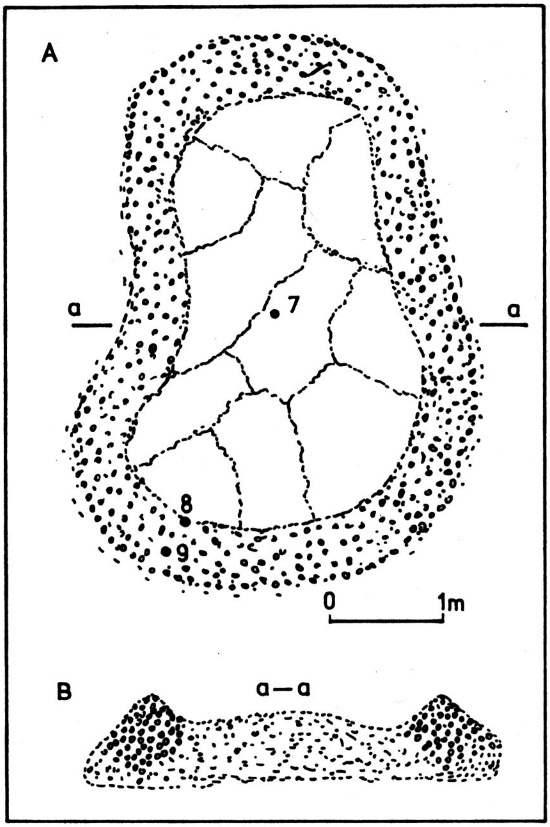

Fig. 2. Stone polygon with locations and numbers of profiles A — general view, B — cross--section (a—a)

In wet and very wet areas there are grass-moss communities with grass species as *Phippsia algida*, *Deshampsia alpina* and *Arctophila fulvia* (Rzętkowska 1987). During field works an additional section was prepared across a stony polygon surrounded by a stone circle (Fig. 2; Pl. 1, Fig. 2). Samples of soils accompanied by loamy outflows were also collected, as well as from centers and along fissures of fissure polygonal soils (Pl. 2).

The other profiles represent organic-mineral soil accompanied by characteristic turf hillocks, fossil soil, soil formed on roche moutonnée, mountain soil (outside the described area) and also soils formed on a pingo (in Chamberlindalen, several kilometers to the south from Calypsostranda). Several additional samples with undisturbed structure were collected to define physical properties of soils.

The first investigations included: grain size composition of soils by Bouyoucos' aerometric method, bulk density with a use of steel barrels of 100 cm^3, total porosity as well as capillary and noncapillary porosity with Leobell's apparatus, calcium carbonate content with Scheibler's apparatus, pH by electrometric method, contents of organic mater by ignition, humus by Tiurin's method, total nitrogen after Kjeldahl and easily available phosphorus and potassium by Egner's method modified by Riehm (for organic soils the method of the Institute of Reclamation and Grasslands, Warsaw, was applied.

Distribution of soils and their morphology

Field and laboratory studies of soils from Calypsostranda enabled to distinguish the following soil types:
1 — initial rocky soils (lithosols after FAO), 2 — initial loose soils (regosols after FAO), 3 — slightly developed soils, 4 — slightly developed brownish soils, 5 — slightly developed brown soils, 6 — brown soils (gelic cambisols after FAO), 7 — slightly gley soils, 8 — gley soils (gelic gleysols after FAO), 9 — shallow peaty soils, 10 — peat soils (histosols after FAO). These soils occur either on nondifferentiated or on polygonal surfaces. Genetic taxonomy of discussed soils is very similar to proposals of Plichta (1977). Some typical soils in the studied area are presented by the following profiles.

Profile 3 — slightly developed soil formed from silty loamy sands. Marine beach 29 m a.s.l., dry moss tundra, scarce vegetation (moss and cup-moss tufts, *Salix polaris*, *Saxifraga oppositifolia*, *Silene acaulis*, *Oxyria dygina*).

A_1 0—6 cm — humus horizon, dark-grey almost black brownish (7.5 YR 4/2) heavy loamy sand with gravels and stones, bottom boundary unclear.

A_1/C 6—20 cm — humus horizon with feature of parent rock, grey to dark-grey (5 YR 4/2) heavy loamy sand, more compact than A_1, few plant roots, bottom boundary unclear.

C 20 cm — parent rock horizon, grey-dark yellowish (10 YR 5/2), heavy loamy sand with numerous stones, below 20 cm reaction with HCl.

Profile 6 — gley soil formed from silty medium loam. Marine beach 42 m a.s.l., humid tundra, rare vegetation (mainly moss, small grass tufts and *Saxifraga caespitosa*, *Saxifraga cernua*, *Cochlearia officinalis*).

A_1 0—3 cm humus horizon, greenish-grey (2.5 GY 6/1) heavy silty loam with small amount of skeleton, bottom boundary unclear.

G 3—19 cm — gley horizon, greenish (5 GY 6/1) medium silty loam with small amount of skeleton, gradual transition into CG, beneath 12 cm reacts with HCl.

CG 19 cm parent rock horizon with gley features, greenish (5 GY 6/1) light loam with considerable admixture of gravels and stones.

Profile 16 — brown polygonal soil formed from low loamy sand, center of fissure polygon at 15 m a.s.l., covered in half by vegetation (moss, cup-moss, *Salix polaris*, *Silene acaulis*, *Poligonum viviparum*, *Saxifraga hirculus*).

Table 1

Soil texture (nd — not determined)

profile no. and soil name	location and altitude (a.s.l.)	horizon	depth (cm)	skeleton	grain size content in %: 1—0.1	0.1—0.05	0.05—0.02	0.02—0.005	0.005 0.002	Σ <0.002	Σ <0.02
1	2	3	4	5	6	7	8	9	10	11	12
3. poorly developed soil, heavy	marine terrace 25—30 m dry	A_1	0—6	45	45	18	19	11	3	4	18
silty loamy sand, medium — deep	tundra, rare vegetation, 29 m	A_1/C	10—15	35	48	19	14	14	4	1	19
		C	20—25	55	55	17	11	11	3	3	17
4. poorly developed brownish	marine tarrace 25—30 m dry	A_1	0—10	50	nd	nd	nd	nd	nd	nd	—
soil, light silty loamy sand,	tundra, dense vegetation, 28 m	(B)C	10—20	65	58	16	13	9	3	1	13
medium-deep		D	20—30	75	30	21	25	16	4	4	24
6. gley soil, medium silty loam	marine terrace 40—60 m humid	A_1	0—3	5	28	13	17	18	13	11	42
	tundra, rare vegetation, 42 m	G	7—15	10	30	14	16	20	10	10	40
		CG	20—30	50	48	10	12	14	10	6	30
5. gley soil, medium silty loam	marine terrace 40—60 m humid	A_1	0—4	45	25	15	18	17	16	9	42
medium-deep	tundra, dense vegetation, 43 m	C_1G	8—15	20	28	15	13	15	16	13	44
		C_2G	20—30	70	40	14	17	13	8	8	29
19. gley soil, clay medium-deep	ancient bay, bottom, very wet	A_1G	0—5	40	28	39	15	11	4	3	18
	tundra, 17 m	G_1	10—20	15	10	7	17	19	13	24	56
		G_2	27—32	30	10	18	16	19	14	23	56
7. gley polygonal soil light loam,	center of stone polygon, 34 m	A_1	0—4	55	45	12	10	15	9	9	33
deep		G_1	7—14	40	48	11	10	14	10	7	31
		CG_2	18—25	25	40	17	11	18	9	5	32
		CG_2	45—55	35	43	14	11	19	9	4	32
8. gley polygonal soil, heavy silty	periphery of stone polygon,	A_1	0—5	75	58	14	11	12	4	1	17
loamy sand, deep	34 m	G	10—20	25	38	19	13	18	8	4	30
		CG	35—45	30	38	17	13	18	9	5	32
9. gley polygonal soil heavy	beneath stone circle, 34 m	A_1	0—5	85	65	9	10	12	3	1	16
loamy sand, medium-deep		G	7—13	35	53	14	11	15	4	3	22
		CG									
12. poorly gley polygonal soil,	marine terrace, center of loamy	A_1	0—10	20	43	14	17	19	6	1	26
light	outflow, 68 m	G	14—20	40	43	16	13	18	6	4	28
silty loam, medium-deep		CG	25—30	50	53	4	8	16	11	8	35
13. poorly gley polygonal soil,	marine terrace, beneath vegetation	A_1	0—8	20	nd	nd	nd	nd	nd	nd	—
silty clay, medium-deep	circle, 68 m	G	13—19	15	23	19	21	23	19	5	37
		DG	22—28	45	50	12	11	15	7	5	27
16. brown soil, slightly loamy	center of fissure polygon, 15 m	A_1	0—8	20	53	31	8	8	0	0	8
silty sand, medium deep		(B)	15—25	10	63	18	7	9	2	1	12
		C	30—40	55	70	12	7	9	1	1	11
15. poorly developed soil,	along frost fissure 15 m	A_1	0—10	5	nd	nd	nd	nd	nd	nd	—
slightly loamy sand, deep		A_1/C	15—25	10	nd	nd	nd	nd	nd	nd	—
		C	45—50	45	83	5	4	6	1	1	8
14. peat soil, medium deep	along frost fissure 18 m	AdT	0—12	0	nd	nd	nd	nd	nd	nd	—
		T_1	20—30	10	nd	nd	nd	nd	nd	nd	—
		D	36—42	25	nd	nd	nd	nd	nd	nd	—
		D	44—47	40	nd	nd	nd	nd	nd	nd	—
2. Brown soil, silty loamy sand,	center of fissure polygon, 22 m	A_1	0—3	40	30	50	13	5	1	2	8
medium deep		$A_1/(B_1)$	8—14	45	43	22	15	13	5	2	20
		(B_2)	16—19	35	65	13	9	8	2	3	13
		D	25—35	25	90	0	7	1	1	1	3
10. shallow peaty soil on loamy	turf hillock in solifluction kettle,	AdT	0—10	0	nd	nd	nd	nd	nd	nd	—
sand	33 m	D	15—25	40	65	14	8	11	2	0	13
11. peat soil on silty loamy	turf hillock in solifluction kettle,	AdT	0—10	0	nd	nd	nd	nd	nd	nd	—
sand	34 m	T_1	15—25	0	nd	nd	nd	nd	nd	nd	—
		D	25—35	55	48	22	14	10	4	2	16
1. fossil brown soil on light	Beneath terminal moraine of	A_1	0—5	55	40	24	1	16	0	3	22
silty loam, shallow	Scott Glacier, 66 m	$A_1/(B)$	15—20	55	38	19	16	16	6	5	27
		D_1	30—40	60	80	3	7	6	2	2	10
		D_2	60—70	60	90	5	1	2	0	2	4
17. brown silty soil, very shallow	roche moutonnée between	A_1	0—3	20	40	25	17	15	2	1	18
	terminal and nival moraine of	(B)	4—8	5	28	26	19	18	7	2	27
	Scott Glacier, 85 m	C	9—12	40	23	26	21	20	7	3	30
18. initial loamy soil	bench at foot of Wijkanderberget,	(A_1)	0—1	20	28	21	16	19	8	8	35
	500 m	C	8—15	20	31	20	13	17	9	10	36
20. slightly developed brown	crest of pingo (Chamberlindalen)	(A_1)	0—2	20	nd	nd	nd	nd	nd	nd	—
silty soil, very shallow		(B)	2—5	20	35	35	21	7	2	0	9
		D	7—12	35	48	28	11	9	2	2	13
21. slightly developed silty	slope of pingo	A_1	0—4	5	nd	nd	nd	nd	nd	nd	—
soil on clay, very shallow	(Chamberlindalen)	A_1/C	5—8	15	36	32	18	9	2	3	14
		D	10—15	10	9	12	21	30	16	12	58

Table 3

Some chemical properties of soils

profile no. and soil name	horizon	depth (cm)	$CaCO_3$ (%)	pH 1 N KCl	organic matter (%)	C (%)	N (%)	C:N	available mg/100 g P_2O_5	available mg/100 g K_2O
1	2	3	4	5	6	7	8	9	10	11
3. poorly developed soil, heavy silty loamy sand,	A_1	0—6	0	7,3		3,84	0,32	12	2,4	4,9
medium deep	A_1/C	10—15	0	7,1		2,17	0,21	10	1,7	2,6
	C	20—25	10,5	7,1		0,99	0,09	11	4,1	4,1
4. poorly developed brownish soil, light silty	A_1	0—10	0	6,6	22,24		0,95		44,0	21,6
loamy sand medium deep	(B)/C	10—20	0	6,7		2,45	0,23	11	2,4	3,9
	D	20—30	0	7,1		2,36	0,21	11	2,2	2,9
6. gley soil, medium silty loam, medium deep	A_1	0—3	0	6,9		1,26	0,15	8	0,5	3,6
	G	7—15	0,7	7,0		0,99	0,10	10	1,6	3,9
	CG	20—30	15,2	7,2		0,72	0,07	10	1,7	4,9
5. poorly gley soil, medium silty loam,	A_1	0—4	0	6,7		1,48	0,18	8	2,1	3,2
medium deep	C_1G	8—15	0	6,9		0,96	0,10	10	2,1	4,5
	C_2G	20—30	4,2	7,0		0,66	0,07	9	1,7	2,4
19. gley soil, clay medium deep	A_1G	0—5	5,5	7,5		2,07	0,22	9	2,1	2,4
	G_1	10—20	13,5	7,6		0,66	0,07	9	1,7	6,5
	G_2	27—32	13,5	7,5		0,74	0,08	9	3,5	6,5
7. gley polygonal soil, light loam, deep	A_1	0—4	37,3	7,5		0,30	0,02	15	0,6	2,4
	G_1	7—14	28,4	7,4		0,23	0,02	11	3,4	0,8
	CG_2	18—25	27,9	7,6		0,43	0,04	11	1,0	0,8
	CG_2	45—55	29,6	7,5		0,40	0,04	10	1,4	0,8
8. gley polygonal soil, heavy silty loamy sand,	A_1	0—5	25,5	7,6		2,38	0,19	13	2,9	4,9
deep	G	10—20	30,7	7,7		0,34	0,04	8	2,1	0,8
	CG	35—45	29,6	7,6		0,35	0,05	7	1,7	1,6
9. gley polygonal soil, heavy loamy sand,	A_1	0—5	23,6	7,5		1,33	0,14	9	1,7	3,2
medium deep	G	7—13	15,1	7,5		0,77	0,08	10	1,0	1,6
	CG									
12. slightly gley polygonal loam, medium deep	A_1	0—10	0	7,1		1,30	0,13	10	1,0	1,0
	G	14—20	27,1	7,3		0,53	0,06	9	1,7	0
	CG	25—30	35,8	7,5		0,24	0,04	6	1,4	0
13. slightly gley polygonal soil, silty clay,	A_1	0—8	0	7,3	14,06		0,50		24,0	7,6
medium deep	G	13—19	2,9	7,1		1,14	0,11	10	1,0	0,8
	DG	22—28	34,9	7,2		0,31	0,05	6	1,7	0,8
16. brown soil, slightly loamy silty sand,	A_1	0—8	3,2	7,2		2,77	0,25	11	0,6	1,6
medium deep	(B)	15—25	0	7,2		0,78	0,08	10	0,6	0,8
	C	30—40	17,4	7,1		0,48	0,04	12	1,9	0,8
15. poorly developed soil, slightly loamy sand,	A_1	0—10	0	6,6	15,97		0,45		44,0	27,0
deep	A_1/C	15—25	0	6,7	10,73		0,40		36,0	14,3
	C	45—50	24,6	7,2		0,59	0,11	5	2,2	0,8
14. peat soil, medium deep	AdT	0—12	0	5,9	42,80		1,51		60,0	14,2
	T_1	20—30	0	6,3	42,02		1,67		1700,0	9,6
	D	36—42	0	7,2	12,71		0,59		2000,0	6,5
	D	44—47	0	7,1	12,26		0,56		1600,0	6,5
2. brown soil, silty loamy sand, medium deep	A_1	0—3	0	7,5		2,17	0,15	14	0,5	2,9
	$A_1(B_1)$	8—14	0	7,4		2,15	0,17	13	0,7	1,3
	(B_2)	16—19	10,6	7,3		1,08	0,08	13	2,1	0,8
	D	25—35	14,7	7,4		0,34	0,03	11	4,1	2,4
10. shallow peaty soil on loamy sand	AdT	0—10	0	6,4	53,13		2,22		30,0	25,7
	D	15—25	0	7,3		1,31	0,12	11	1,4	1,6
11. peat soil on loamy sand	AdT	0—10	0	5,3	60,02		1,85		53,0	16,3
	T_1	15—25	0	5,6	61,81		1,68		36,0	28,2
	D	25—35	22,2	7,3		1,44	0,11	5	1,0	1,6
1. fossil brown soil, light silty loam, shallow	A_1	0—5	44,2	7,6		0,21	0,04	5	2,9	6,5
	$A_1/(B)$	15—20	28,4	7,4		0,81	0,07	12	2,1	3,2
	D_1	30—40	45,5	7,2		0,20	0,03	7	1,7	3,2
	D_2	60—70	46,3	7,5		0,18	0,01	18	1,4	10,6
17. brown silty soil, very shallow	A_1	0—3	0	7,3		2,06	0,20	10	1,2	2,6
	(B)	4—8	0	7,1		1,91	0,19	10	1,0	1,6
	C	9—12	0	7,0		1,91	0,18	11	0,3	1,6
18. initial loamy soil	(A_1)	0—1	14,8	7,2		0,49	0,05	10	1,4	2,4
	C	8—15	11,1	7,5		0,45	0,06	8	4,8	1,6
20. poorly developed brown silty soil,	(A_1)	0—2	0	6,6	13,97		0,53		108,0	26,0
very shallow	(B)	2—5	0	7,2		3,53	0,30	12	0,5	1,9
	D	7—12	0	7,1		2,00	0,15	13	1,0	1,6
21. poorly developed silty soil on clay,	A_1	0—4	0	7,0	9,85		0,39		266,0	23,9
very shallow	A_1/C	5—8	0	6,8		3,78	0,31	12	1,0	3,9
	D	10—15	1,0	6,8		1,06	0,12	9	2,7	4,2

A_1 0—10 cm humus horizon, grey to dark grey (5 YR 4/2) low loamy silty sand with gravel and stones, bottom boundary clear, reacts with HCl.

(B) 10—26 cm — browning horizon, brown-grey (7.5 YR 4/4), light silty loamy sand, sometimes with flora roots, bottom boundary unclear.

C 26—45 cm — parent rock horizon, grey brownish (10 YR 5/3) light silty loamy sand with large amount of gravels and stones, strongly reacts with HCl.

Development of soils and their properties considerably depend on lithology of bedrock as well as frost segregation, ground swelling and cracking, solifluction, which are all typical processes in arctic areas. Many authors indicated that development of arctic soils depends more on cryogenic processes than on soil-forming processes. Local water conditions, microclimate and vegetation are also very important.

A considerable part of Calypsostranda does not possess any but occasionally initial soil cover (Fig. 1). Its higher marine beaches are composed of rock outcrops or debris with primitive soils and very rare vegetation (locally there are lithosols).

A lower part of the coastal plain and wide river valleys have sandy gravel trains with stone admixture (locally there are regosols).

Physical and chemical properties of soils

Soils of Calypsostranda are composed of light, medium and heavy formations (Table 1). But light and medium, often silty loams significantly prevail. They are mainly gley and poorly gley soils, usually connected with wet tundra, stone polygons and loamy outflows. Poorly developed brown or brownish soils have usually a lighter grain-size composition (silty sands with gravel) Such soils are most common in dry tundra and coastal plain, from the present beach up to the marine terrace at 25—30 m a.s.l. (Fig. 1). Polygons, sometimes very large, and surrounded by frost fissures prevail there. The heaviest grain-size composition (clays and silty clay) has been found in gley soils of very wet tundra, and in a poorly developed soil at lateral part of a pingo.

Section across a stone polygonal soil shows that the heaviest granulometric composition is connected with the center of the polygon. A lighter composition was observed at its border and the lightest beneath a stone circle.

Grain size distribution in described soils contains relatively more coarse silt than colloidal clay (particles below 0.002 mm). It probably results in a low resistance of soils to crushing. Insignificant predominance of the fraction smaller than 0.02 mm was observed in some horizons (B) only.

Most investigated soils show a strong skeleton (to about 85%). But in a vertical distribution of gravels and stones distinct regularities are only occasionally visible.

Bulk density of studied soils changes from 1.3 g/cm^3 in light sandy soil with much organic matter, to 2.2 g/cm^3 in gley loamy soil in center

Table 2

Physical properties of soils

profile no.	soil horizon	depth (cm)	bulk density (%)	total porosity (%)	bulk-capillary porosity (%)	noncapillary porosity
4	A_1	3—10	1,3	60	50	10
	(B)	12—18	1,5	53	44	9
7	A_1	0—4	1,9	39	29	10
	G_1	7—14	2,0	34	29	5
	CG_2	18—25	2,2	26	23	3
	CG_2	47—53	2,1	27	26	1
12	A_1	4—10	1,7	45	42	3
	G	14—20	1,9	39	35	4
16	A_1	4—10	1,4	57	51	6
	(B)	15—21	1,5	54	45	9

of a stone polygon (Table 2). Total porosity of these soils is widely varied. In general the total porosity decreases whereas bulk density increases with depth. Highest and lowest non-capillary porosities were observed in the same profile at different horizons of gley and stony polygonal soils (profile 7). This soil indicated strong swelling properties.

Calcium carbonate occurs in most soils (Table 3) and its content increases with depth, reaching 46% in a brown fossil soil. No carbonates were found in brown and similar soils formed on roche moutonnée and pingo, and also in peat and shallow peaty soils. Carbonate reaction with 10% HCl was often weak and slow. It indicates that in described soils calcium carbonate is accompanied by magnesium carbonate.

Reaction of studied soils does not indicate a great differentiation (Table 3) and is usually neutral or basic. Only upper horizons of organic (peat and shallow peaty) soils are slightly acidic. In some profiles a small increase of pH with depth was noted. Soils under dense vegetation cover in dry and wet tundra have a slightly lower pH than under scarce vegetation. Similarly in fissure polygonal soil lower pH values are noted along fissure where more organic matter occurs. Such regularities were neither found in stone polygonal soils nor in soils of loamy outflows. Alkaline reaction of most soils on Calypsostranda is due to occurrence of carbonates in parent rocks, poor leaching and intensive frost processes which generate permanent vertical movements of soil material.

Highest content of organic matter (max. 61.8%) was found in peat and shallow peaty soils formed in turf hummocks and polygonal soils around fissures (Table 3). Organic horizons are also the thickest in these soils. In poorly developed brownish soils in dry tundra but only under dense floristic cover, a considerable content of organic matter was noted as well.

In dry and wet tundra more organic carbon was found under dense than under thin vegetation cover. A small content of carbon was recorded in soils connected with stone polygons (especially with their centers). They are gley and poorly developed gley soils. A little bit more carbon occurs in brown soils (except brown fossil soil). Organic carbon is present in all soil profiles, but most of it occurs in their upper horizons.

Total nitrogen content is differentiated (from 2.22 to 0.01%) and depends largely on humus content. The lowest nitrogen content is noted in stone polygonal soils (in centers of polygons) and in fossil soils. More nitrogen occurs in mineral-organic and organic soils. Content of total nitrogen usually decreases with depth. C/N ratio varies widely (even in a single section) but usually it is narrow or sometimes very narrow.

Phosphorus and potassium contents are low in mineral soils. Only in organic soils with abundant bird and reindeer excrements, a considerable quantity of phosphorus was found. Potassium content is however very differentiated.

Soils in the described area as well as in the Hornsund region (Szerszeń 1968, 1974) are rich in organic carbon in contrast to available phosphorus and potassium in mineral soils. Noted pH was higher than in Hornsund area. The studied soils indicate regular patterns of carbonates, pH, organic carbon and total nitrogen in their profiles.

Conclusions

1. Cryogenic processes as well as gleization, peat-formation and browning are very important in soil-forming processes of the arctic periglacial zone. They influenced typology and properties of described soils.

2. Strong skeleton, general occurrence of carbonates, neutral or basic reaction, low content of available phosphorus and potassium, and high content of organic carbon are the characteristic features of the soils in Calypsostranda.

3. Despite of slightly distinct morphology of the studied soils, regularities in vertical distribution of some components have been distinguished.

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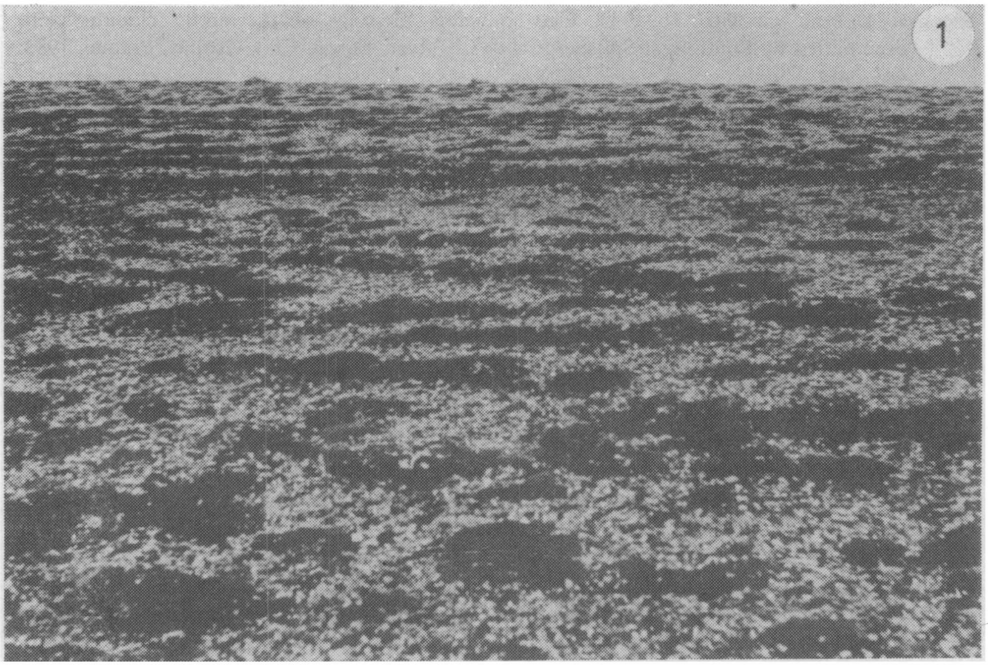
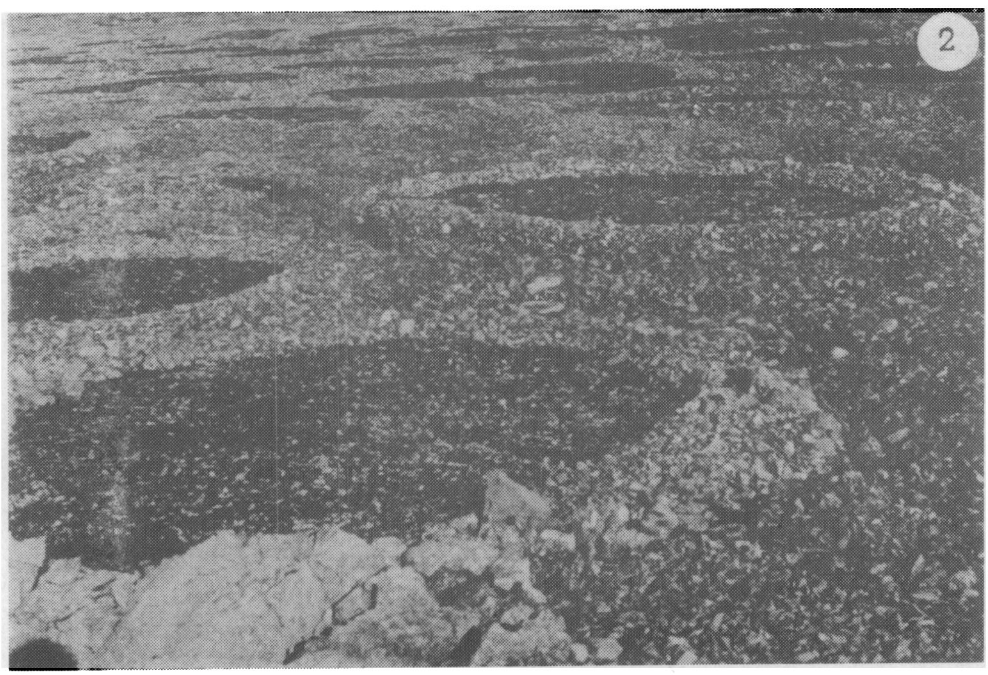
Received June 9, 1987
Revised and accepted October 21, 1987

Streszczenie

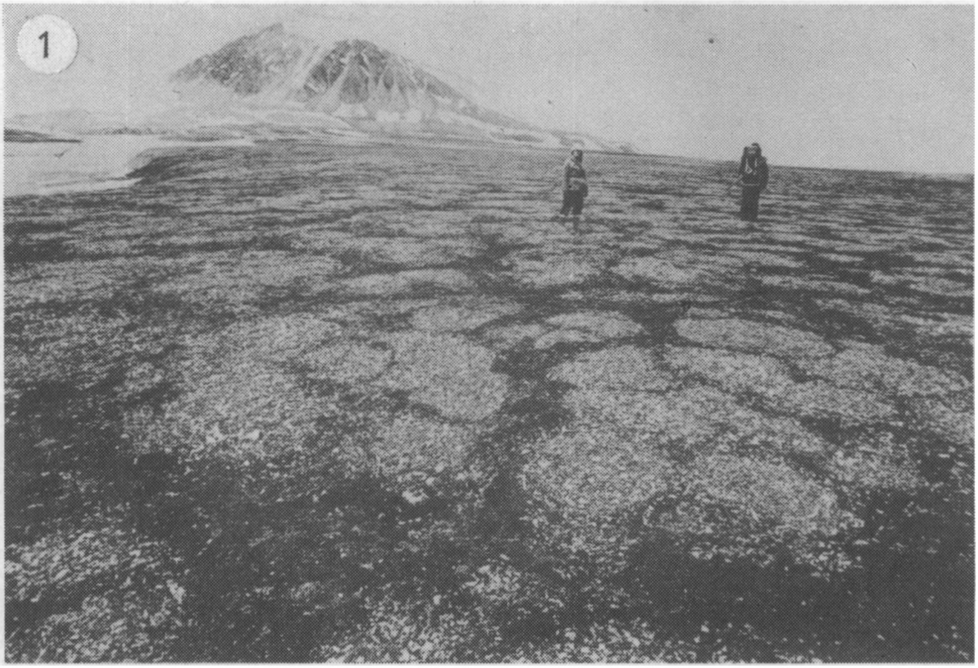
Badania gleb przeprowadzono w 1986 roku w miejscach charakterystycznych dla tundry arktycznej, to jest na tundrze suchej (pl. 1, fig. 1), tundrze wilgotnej oraz bardzo wilgotnej. Ponadto zbadano gleby poligonalne związane z poligonami kamienistymi (fig. 2; pl. 1, fig. 2), poligonami szczelinowymi (pl. 2, fig. 2) oraz wylewami gliniastymi (pl. 2, fig. 1). Wydzielono dziesięć jednostek glebowych (fig. 1).

W tworzeniu się gleb w arktycznej strefie peryglacjalnej obok procesów glebotwórczych (glejowych, torfotwórczych, brunatnienia), istotną rolę odgrywają procesy kriogeniczne. Te ostatnie wywierają duży wpływ na typologię a także na właściwości omawianych gleb. Dominującymi cechami gleb Calypsostrandy są: silna szkieletowość, dość powszechne występowanie węglanów, odczyn obojętny lub zasadowy, mała zawartość (w glebach mineralnych) przyswajalnych form fosforu i potasu oraz stosunkowo znaczna węgla organicznego (tab. 1—3). Pomimo mało wyraźnej (wizualnie) morfologii badanych gleb, zaznaczają się pewne prawidłowości w pionowym rozmieszczeniu niektórych składników.





1. Dry moss tundra (photo K. Pękala)
2. Stone polygons (photo Z. Klimowicz)



1. Loamy outflows (photo K. Pękala)
2. Fissure polygons (photo Z. Klimowicz)