POLISH POLAR RESEARCH	17	1–2	93-106	1996

Zbigniew KLIMOWICZ and Stanisław UZIAK

Department of Soil Science
Institute of Earth Sciences
Maria Curie-Skłodowska University
Akademicka 19
20-033 Lublin, POLAND

Soil and vegetation conditions in small valleys at southern coast of Bellsund, Spitsbergen

ABSTRACT: Soil-plant conditions in selected valleys typical for Bellsund Region are varying from hardly favourable (Skilvika), to favourable (Calypsostranda) and medium (Lyellstranda). Plant growth and development of a soil cover are favoured by grain size composition (loamy sands and light loams), quick warming-up of a soil, relative stability of a ground, location and shape of valleys, *etc.* Unfavourable soil-plant conditions result from too light or too heavy grain size composition, considerable dynamics of ground mechanical features and high compactness of a soil. Varying contents of carbonates and alkaline reaction (except for almost neutral reaction in organic horizons) were typical for the studied soils. Thickness of humus horizons as well as contents of organic C vary at the three studied sites. Significant is high concentration of easily available Ca and Mg, sometimes also of Na.

Key words: Arctic, Spitsbergen, valleys, soil and vegetation conditions.

Introduction

The present study continues research of soil covers in different microzones of Spitsbergen. Results of these studies indicate high relationship between soil properties and other components of natural environment, devoid of anthropogenic transformations.

Numerous authors studied arctic soils in Spitsbergen (among others Szerszeń 1974, Ugolini and Sletten 1988, Skiba and Kuczek 1993). Melke, Chodorowski and Uziak (1990), Uziak (1992), Klimowicz, Melke and Uziak (1993) examined properties of soils in the northwestern Wedel Jarlsberg Land. Some authors (*e.g.* Szerszeń 1974, Plichta and Luścińska 1988) underlined role of plant community in development of soils in a polar zone. Zabawski and Żurawska (1975) studied microflora in soils of the Hornsund Region. Intensity of metabolic processes in

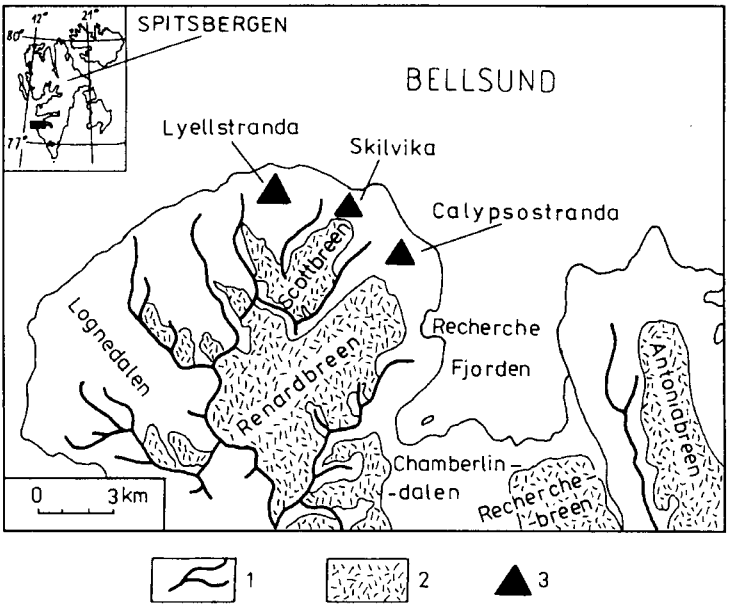

Fig. 1. Location of the study area in the Bellsund Region.
1 — mountain ridges, 2 — glaciers, 3 — study sites.

soils of Spitsbergen was also examined. Research of the Svalbard flora was carried out by Rønning (1964).

The aim of this paper is to present soil-plant conditions in various valleys at southern coast of Bellsund. These valleys are considerably varying and create characteristic element of the arctic tundra landscape.

Study area and methods

Three different valleys at Lyellstranda, Skilvika and Calypsostranda were selected. These sites are typical for the study area and they are all located at raised marine terraces. The latter form a coastal plain, gently inclinated towards the fiord (Szczęsny *et al.* 1989). Dolomites and phyllites of the Middle Proterozoic age predominate in Lyellstranda and Calypsostranda (Fig. 1). In Skilvika, located between the two afore-mentioned areas, phyllites (Upper Proterozoic) of an "uncertain stratigraphic pattern" may occur (Dallmann *et al.* 1990). These rock formations are covered with Tertiary sandstones and mudstones, and with Quaternary sediments. Thickness of the latter reaches a dozen of metres. They are usually composed of gravels and sands at the lower marine terraces whereas at higher altitudes there are mostly clays, sands and tills; at higher terraces gravel-sandy sediments are common (Pękala 1987).

Weakly consolidated younger marine deposits are usually modified by waters of glacial and naval rivers, and of streams, formed due to thawing of a ground (Repelewska-Pękalowa 1987). Dynamics of glacial rivers make any development of soils along their flowlines and any growth of vegetation impossible.

Selected valleys were formed by waters from snow ablation and thawing of permafrost. At Lyellstranda, they were also formed by waters from nival streams flowing down-slope.

Applied was the method of crossing soil-levelling sections that covered relatively small areas (about 5000 m^2 each). The latter are considered later as objects that represent different microzones. Along these sections altitude as well as soil morphology with evaluation of approximate size and type of vegetation cover were studied. Samples for laboratory analyses were collected from selected soils.

Basic soil properties were evaluated by methods commonly applied in the Polish laboratories. Contents of soluble components (easily available for plants) as Ca, Mg, K, Na, and P in 0.03M CH_3COOH, were also determined. Calorimetric method was used for examination of P and atomic absorption spectrometry (with use of the Perkin-Elmer 3300 apparatus) — of the other elements. Soil colours were determined at dry samples, according to the revised Standard Soil Colour Charts (Oyama and Takehara 1967).

Results and discussion

Description of study objects, soil morphology and plant cover Lyellstranda, the westernmost site (Figs 1 and 2), represents a fragment of a braided river and is located at 25 m a.s.l., about 350 m from the fiord.

The first 10 m of the cross-section A–B form a relatively flat area (Fig. 2), composed of light silty loam at land surface and heavy silty loam beneath (Table 1). Soils are initial brown ones, with poorly visible mud boils at the surface. Plant cover occupies generally about 30% of the area and is mainly composed of *Cetraria delisei* and *C. hiascens, Saxifraga oppositifolia, Salix polaris, Stereocaulon* sp., *Silene acaulis* (the order represents decreasing size of the occupied area). Towards the river, there is a clearly visible and considerably inclined valley slope, mainly composed of light loam in the bed and of striped soils. Plant cover is more widespread there (65%) than on the top — the flattened part of a terrace, and among the species there is also *Equisetum variegatum*.

Valley bottom is mainly filled with stones and gravels, containing small admixture of soil particles (< 1 mm). Such poor substrate made soil development difficult and therefore, the latter has no plant cover.

Slightly inclined and poorly marked opposite slope of the valley and its top plateau, are formed mainly of light silty loams with locally increased water

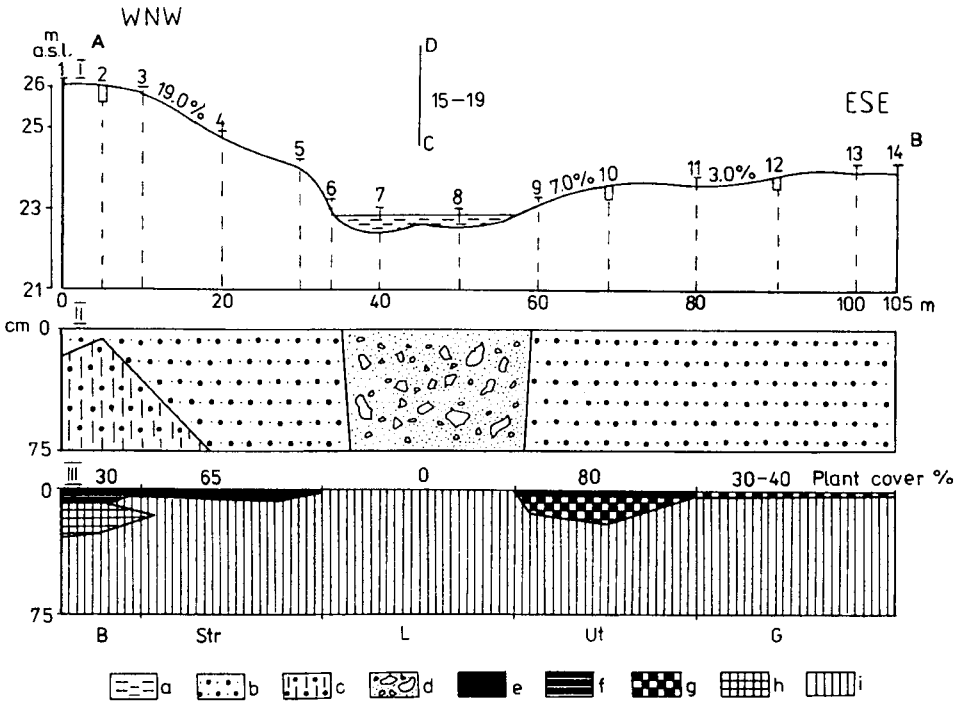

Fig. 2. Cross-section A–B (Lyellstranda).
I — topographic section, II — geological section, III — pedological section and plant cover, 1–14-soil pits, a — water, b — light or medium loam, c — heavy loam, d — stone-gravel material, e — humus horizon (A), f — transitional horizon (AB), g — transitional horizon (AC), h — brown horizon (B), i — parent rock (C), B — brown soil (Arctic Brown Soil), Str. — striped soil, G — gley soil (Gelic Gleysol — FAO), Ut — soil of indeterminate typology, L — lack of soil cover. CD — cross-section with soil pits (15–19).

content. Soils in this area are first of all morphologically close to gley ones, developed in stone rings, and with poorly developed typological features — undifferentiated at the surface. These soils are covered with quite compact plant cover (80%) with *Cetraria delisei* and *C. hiascens, Saxifraga oppositifolia, Stereocaulon* sp., *Saxifraga caespitosa, Draba corymbosa.* Plant cover is less compact on gley soils and concentrates mainly in-between stone rings and in their close neighbourhood. Predominating species are *Cetraria hiascens, Salix polaris,* moss, *Saxifraga oppositifolia, Polygonum viviparum.* There is also a lot of algae in wetter places.

The second study object was located in the Skilvika Region at 33–35 m a.s.l. (Figs 1 and 3). It occurs in the area, slightly inclined towards the bay and at distance of about 300 m from it. The studied valley is relatively shallow and asymmetric, and only occasionally occupied by flowing water. Surface sediments in the Skilvika Region are mainly composed of heavy formations.

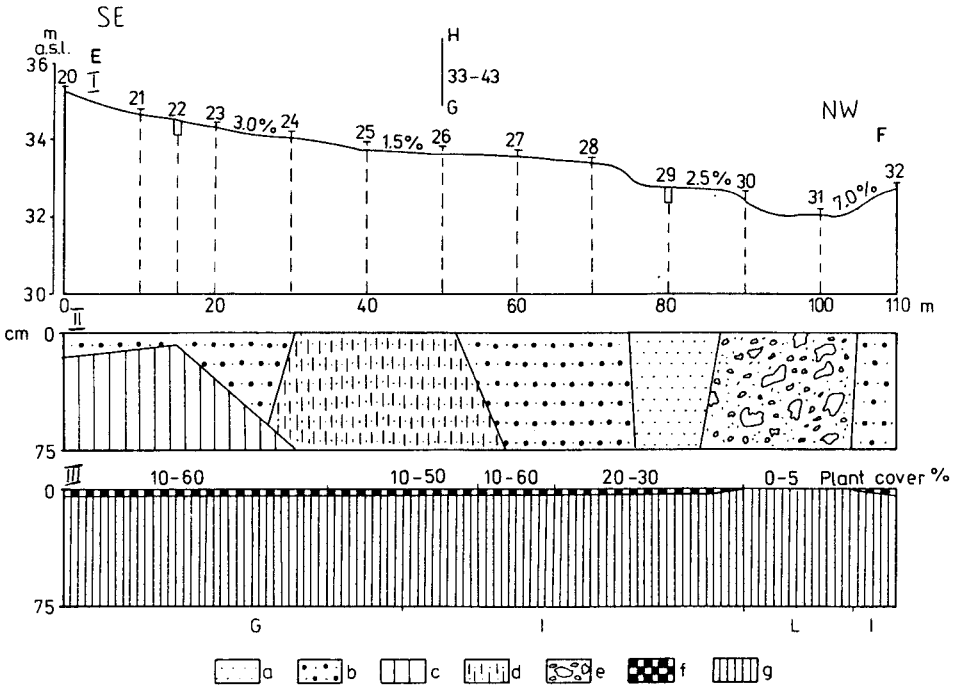

Fig. 3. Cross-section E–F (Skilvika).
I — topographic section, II — geological section, III — pedological section and plant cover, 20–32 — soil pits, a — slightly loamy sand, b — medium loam, c — clayey silt, d — silty clay, e — stone-gravel material, f — transitional horizon (AC), g — parent rock (C), G — gley soil (Gelic Gleysol — FAO), I — initial soil (Gelic Regosol — FAO), L — lack of soil cover. GH — cross-section with soil pits (33–43).

Most of the section E–F (Fig. 3) is slightly inclined towards the valley. This inclination does not exceed 3% but nevertheless, lithology is quite varied — from medium silty loam, through loamy silt to coarse silty clay (Table 1). Gley and initial soils were formed on this relatively heavy material. Both these soils are differentiated at the surface. Gley soils are mainly accompanied by stone rings, initial soils that are located at slightly lower altitudes, are accompanied by cell forms (polygons with 4–6 sides and diameter of 0.5–1 m). These soils have a simple structure with a relatively shallow transitionary level AC and slightly gleyey substrate underneath (Cg). Plant cover is differentiated — from 10% (inside rings) to about 50% (in the vicinity of single rings). More dense plant cover occurs occasionally in-between rings. This plant cover is mainly composed of lichens and mosses, as well as *Salix polaris* and *Saxifraga oppositifolia*. Initial cell soils are overgrown mainly along fissures (mosses, and also *Salix polaris, Saxifraga oppositifolia, Polygonum viviparum*). Inside cell forms, brown-black algae predominate.

Table 1

Granulometric composition of the soils studied (sites 1, 2).

Site, Profile No.	Horizon	depth cm	Colour (dry)	Skeleton >1mm	Fraction content %			
					1-0.1	0.1-0.02	<0.02	<0.002
Site 1 Lyellstranda								
2	A	1-5	10 YR 3/2	60	37	34	29	1
	Bv	10-20	7.5 YR 4/6	30	16	30	54	5
	C	25-35	7.5 YR 5/6	40	15	31	54	8
10	AC	10-20	2.5 YR 6/3	70	39	30	31	3
12	AC	0-1	10 YR 6/4	30	25	40	35	5
	Cg1	10-20	10 YR 6/3	50	30	37	33	5
	Cg2	25-35	10 YR 6/3	50	32	35	33	7
Site 2 Skilvika								
22	AC	0-3	5 Y 5/2	40	24	38	38	10
	Cg	15-25	5 Y 7/2	30	18	41	41	12
29	C	3-10	2.5 Y 6/2	70	74	19	7	3
37	C	5-15	2.5 Y 6/4	30	24	39	37	11
41	A	3-12	5 Y 5/3	40	11	41	48	11
	C1	15-22	5 Y 6/3	40	7	39	54	19
	C2	25-35	5 Y 6/2	50	0	35	65	24
42	AC	0-2	5 Y 5/2	30	7	37	56	19
	C1	10-20	5 Y 6/3	20	6	38	56	21
	C2	35-45	5 Y 6/1	40	0	33	67	27

The next fragment of the section (from about 75 to 90 m) is a small, occasionally flooded terrace with slightly loamy sand in subsoil. Soil formed in such conditions possess a very shallow initial level AC, directly underlain by a substrate. Plant cover is very scarce, usually 20–30% (clumps of moss, moreover *Salix polaris, Saxifraga oppositifolia, Polygonum viviparum, Silene acaulis*).

The next several metres of the section form a bottom of a periodically dry valley with predominant stony-gravel-sandy sediments. There is no soil in practical terms, and sporadic plants contain very dried-out dark grey algae only.

The third studied object is located in the Calypsostranda Region (Figs 1 and 4), at the same distance from the fiord as the two other objects but at the lowest altitude. The whole studied valley occurs at the lower marine terrace where no outcrops of older rocks are present (Szczęsny *et al.* 1989). This valley, contrary to the two others, is symmetric and cut most deeply into its bed.

The section I–J (Fig. 4) is an almost flat surface of loamy sands, in the segment of about 30 m long. There are well developed brown soils with a thick humus layer. They were formed, similarly to all other soils in this part of

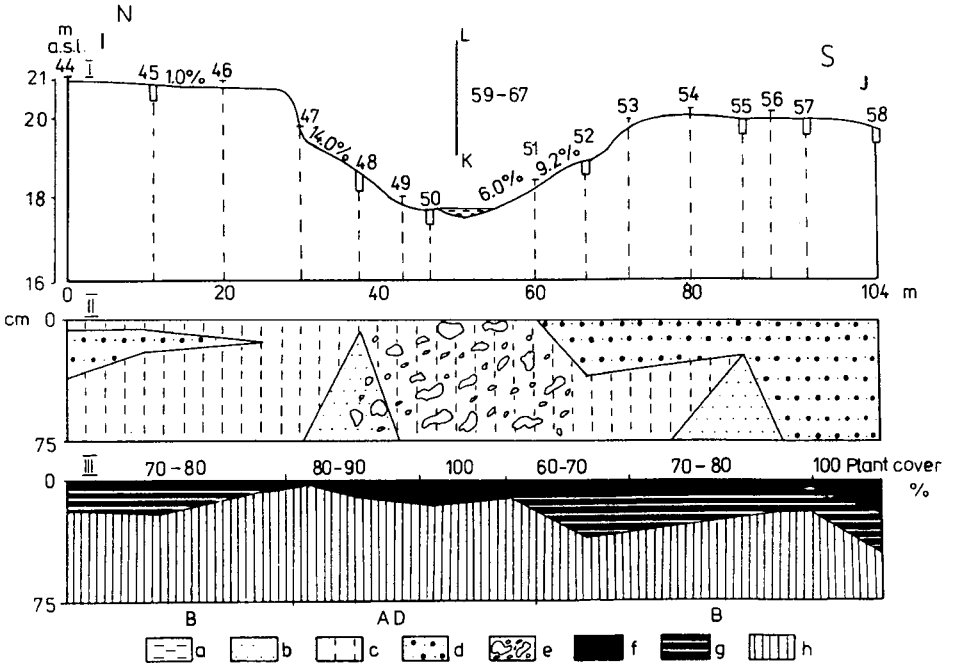

Fig. 4. Cross-section I–J (Calypsostranda).
I — topographic section, II — geological section, III — pedological section and plant cover, 44–58 — soil pits, a — water, b — slightly loamy sand, c — heavy loamy sand, d — light loam, e — stone-gravel material, f — humus horizon (A), g — transitional horizon (AB), h — parent rock (C), B — brown soil (Arctic Brown Soil), AD — alluvial-deluvial soil. KL — cross-section with soil pits (59–67).

Calypsostranda, within polygons limited by very visible frost fissures. Vegetation cover is quite compact. and occupies on the average 70–80% of the whole surface. Full vegetation cover is found mainly close to fissures and their ends. The predominating species are in turn: mosses, *Cetraria delisei* and *C. hiascens, Salix polaris, Silene acaulis* and grasses. Inside polygons there are mainly lichens as *Cetraria hiascens* and *Stereocaulon* sp. Moreover, there are also *Salix polaris, Silene acaulis, Polygonum viviparum* and various grass species.

Bottom of the valley and its slopes are about 70 m wide. They are of landslip-solifluction type. Material is both transferred and deposited at least-inclined areas. The valley is carpeted with sands: mainly heavy loamy sands and to a smaller degree — also slightly loamy sands (Table 2). At the very bottom of the valley there are numerous gravel-stony series with boulders, over 20 cm in diameter. There are alluvial-deluvial soils with a relatively thicker humus horizon. Plant cover is generally compact and rich in various species. Some plants as *Polygonum viviparum*, are far larger than in an open space. The very bottom of the valley is covered with dense clumps, composed of a thick layer

Table 2

Granulometric composition of the soils studied (site 3).

Site, Profile No.	Horizon	depth cm	Colour (dry)	Skeleton >1mm	Fraction content %			
					1-0.1	0.1-0.02	<0.02	<0.002
Calypsostranda								
45	A	1-5	10 YR 4/2	30	56	27	17	1
	ABv	8-15	7.5 YR 3/4	50	41	33	26	2
	C	25-35	10 YR 4/4	60	58	22	20	6
48	A	2-6	10 YR 4/3	40	59	22	19	2
	C1	15-25	2.5 Y 4/2	50	86	6	8	2
	C2	40-50	2.5 Y 4/3	70	85	7	8	2
50	A	7-13	10 YR 4/2	60	67	17	16	2
52	A	1-5	7.5 YR 4/3	40	51	27	22	1
	ABv	20-30	7.5 YR 3/4	50	52	26	22	1
	C	35-45	10 YR 4/6	50	65	16	19	3
55	A	2-8	10 YR 2/2	*	*	*	*	*
	ABv	12-20	10 YR 4/3	60	50	25	25	1
	C	30-40	10 YR 4/2	70	81	9	10	3
57	A	0-3	10 YR 4/2	40	46	26	28	3
	ABv	5-15	10 YR 4/3	30	37	33	30	3
58	A	5-15	10 YR 3/3	*	*	*	*	*
	ABv1	20-30	10 YR 4/2	40	42	29	29	3
	ABv2	36-42	10 YR 3/2	40	44	25	31	3
	C	45-55	10 YR 3/4	60	53	22	25	5
59	A	5-15	2.5 Y 4/2	50	62	19	19	4
67	A	5-15	10 YR 4/1	50	46	36	18	2

* — organic matter

of moss. There are also black-brown algae that resemble short and voluted root-stocks. Participation of other plant species is not significant.

Lichens *Cetraria hiascens* and *Stereocaulon* sp. prevail on the slope with southern exposure. Moreover, there are also *Polygonum viviparum, Silene acaulis,* mosses, *Equisetum variegatum, Saxifraga oppositifolia, Oxyria digyna, Saxifraga cernua, Cerastium arcticum* and *Salix polaris*. Northerly exposed slope is covered with a less dense plant cover. There are also more mosses and grasses.

Permafrost occurs at small depths (70–90 cm) at valley bottom and also on a northerly exposed slope. It is probably, among others, the effect of a high content of organic matter and its thickness that protects from heat penetration into a soil. A similar opinion was expressed by Repelewska-Pękalowa *et al.* (1987).

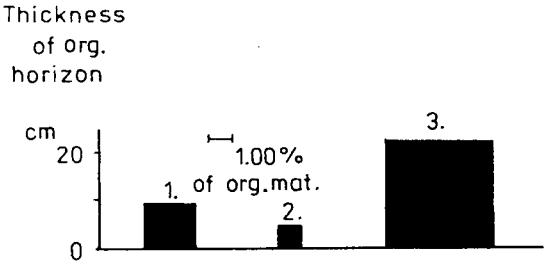

Fig. 5. Average thickness of organic horizon and content of organic matter in soils in: 1 — Lyellstranda, 2 — Skilvika, and 3 — Calypsostranda.

The next fragment of the section I–J (Fig. 4) covers a terrace flattening and is similar to the initial part of the section (0–30 m) as far as vegetation and soil are concerned. Brown soils have considerably thick horizons A and AB, and contain much organic matter. It is especially true for soils with frost fissures and their copings.

Vegetation-soil conditions of the studied object resemble the ones in the region of the Malbukta Gulf on the Reinsletta plain — with relatively thick sandy deposits and high contribution of slightly loamy sands (Klimowicz, Melke and Uziak 1993).

Selected chemical properties of soils

The studied soils have a varied content of carbonates from 0% to 50% (Tables 3 and 4). Reaction with 1N KCl is generally alkaline, except for organic horizons where it is close to neutral (pH 6.5).

Content of organic C is very varied in the studied objects (Fig. 5). The object of Lyellstranda seems to be the most representative of the three ones. High content of organic matter is to be underlined in soils of Calypsostranda.

Contents of compounds of Ca, Mg, K, Na and P, soluble in 0.03M CH_3COOH is very varied in the studied soils. High concentration of Ca and Mg, and in the case of the objects 1 and 3 — also of Na, is significant. Short interpretation of considerable contents of Ca and Mg are presented by Klimowicz and Uziak (*in press*).

In the case of Na, its contents in Na-Ca feldspars *i.e.* in subsoil, can be relatively high. Some influence of marine aerosoles, especially during strong storms, cannot be excluded as distances from a sea are small. Considerably smaller content of Na was noted in the region of the sea bay Skilvika (object 2). This area is located about 10 m higher than the other objects, and its high cliff contacts with a sea. High and steep coast is a clear obstacle for sea water and protects it from entering a land. However, such interpretation is not the only one.

Table 3

Some chemical properties of the solils.

Profile No.	Horizon	Depth cm	$CaCO_3$ %	pH KCl	Org. C %	Content of soluble forms in the 0.03M CH_3COOH (mg/100g of soil)				
						Ca	Mg	K	Na	P
Site 1 (Lyellstranda)										
2	A	1-5	1.3	7.6	3.72	106.2	28.40	2.08	31.70	1.31
	Bv	10-20	4.1	7.8	2.12	124.5	36.14	0.64	45.80	1.41
	C	25-35	2.2	7.9	1.74	141.6	41.66	0.56	31.14	1.81
10	AC	10-20	42.9	7.8	2.04	207.3	32.50	2.21	62.48	1.81
12	AC	0-1	50.1	8.3	0.56	253.5	17.94	1.13	30.62	1.81
	Cg1	10-20	44.3	8.3	0.54	265.5	12.90	0.73	21.18	2.11
	Cg2	25-35	49.5	8.4	0.48	273.4	10.06	0.83	40.55	1.71
Site 2 (Skilvika)										
22	AC	0-3	44.0	8.2	0.72	251.0	19.10	1.01	3.23	1.09
	C	15-25	44.9	8.3	0.44	263.7	12.10	0.74	0.87	1.19
29	C	3-10	45.8	8.4	0.31	261.5	8.44	0.61	0.62	0.90
37	C	5-15	17.9	8.1	0.50	253.3	14.54	0.55	0.92	1.19
41	A	3-12	11.3	7.7	2.30	224.9	25.50	1.33	2.18	1.39
	C1	15-22	21.4	7.9	0.96	244.3	20.02	1.01	1.21	1.29
	C2	25-35	19.1	8.0	0.92	250.0	17.80	1.31	1.80	1.39
42	AC	0-2	21.2	7.9	1.12	249.1	13.94	1.32	2.73	1.19
	C1	10-20	12.6	7.9	0.84	256.1	16.70	1.02	1.30	1.19
	C2	35-45	30.3	7.9	0.54	250.6	14.46	1.44	1.16	1.39

Already Pociask-Karteczka (1987) pointed out a relatively far-distant air transport of aerosoles in the region of Palffyodden (southwestern Sörkappland, Spitsbergen).

Contents of compounds of P and K, soluble in acetic acid are relatively low in the studied soils.

Attempts of reference of a plant cover to various regions of a periglacial zone in the studied region have been undertaken recently only (Rzętkowska 1987, Karczmarz and Święs 1988, Święs 1988, Matuła and Święs 1989). Moreover, remarks on permafrost depth and its relation to vegetation cover, morphological formations and ground moisture are also valuable (Repelewska-Pękalowa, Gluza and Dąbrowski 1987), the same as observations of thermic differentiation in periglacial valleys (Łanczont and Rodzik 1989).

The fact that a habitat in Skilvika is poor for plants, is caused among others by grain size composition of its soils. Too heavy soils *i.e.* with predominating clay and loam, indicate high dynamics of mechanical properties. They influence differentiation of surface soils (stony rings, mud boils, cell forms). Soil cover

Table 4

Some chemical properties of the solils (site 3 — Calypsostranda).

Profile No.	Horizon	Depth cm	$CaCO_3$ %	pH KCl	Org. matter %	Org. C %	Content of soluble forms in the 0.03M CH_3COOH (mg/100g of soil)				
							Ca	Mg	K	Na	P
45	A	1-5	0.1	6.8		2.51	62.6	12.92	0.72	11.38	1.31
	ABv	8-15	0.2	7.3		1.59	61.3	12.06	0.38	14.30	0.70
	C	25-35	23.0	8.0		0.68	163.3	23.04	0.50	13.24	1.61
48	A	2-6	27.3	8.1		0.80	234.2	12.98	1.16	9.94	1.71
	C1	15-25	40.3	8.5		0.24	267.4	6.06	0.65	1.98	1.91
	C2	40-50	55.2	8.5		0.33	285.9	5.68	0.74	1.58	2.01
50	A	7-13	22.4	8.3		1.02	281.4	12.78	0.78	2.03	1.81
52	A	1-5	7.9	7.7		1.68	209.1	19.80	0.61	7.52	1.21
	ABv	20-30	0.4	7.7		1.56	124.9	14.74	0.42	11.75	1.10
	C	35-45	29.0	8.2		0.51	192.7	12.44	0.72	13.72	3.32
55	A	2-8	1.4	6.5	26.81		216.8	31.64	3.08	23.11	3.42
	ABv	12-20	6.9	7.5		2.10	189.9	28.00	0.52	14.73	1.51
	C	30-40	40.0	8.0		0.62	263.7	12.56	0.74	14.65	1.41
57	A	0-3	0.9	7.3		2.77	122.5	18.64	0.60	21.62	1.21
	ABv	5-15	0.6	6.5		3.42	88.1	14.78	0.62	16.93	0.80
58	A	5-15	1.0	6.5	19.00		190.1	24.50	0.84	21.41	2.82
	ABv1	20-30	2.1	7.1		3.03	131.3	15.60	0.44	14.86	1.41
	ABv2	36-42	0.4	7.4		3.60	132.2	17.92	0.38	20.65	1.31
	C	45-55	28.7	7.9		1.36	231.1	15.38	0.67	25.18	1.09
59	A	5-15	17.9	8.1		1.02	220.1	13.92	0.76	1.87	1.19
67	A	5-15	5.8	7.5		4.02	157.0	26.46	0.97	2.37	1.69

with poor stability does not favour stabilisation of a plant cover. Such formations are also too cold (high moisture content) and too compact for proper development of plants and therefore of soils (it is especially true for soils which are not influenced by avifauna). On the other hand, sandy series with high content of skeleton can warm-up quicker and are therefore dry.

Soils with well developed sections (in polar conditions), rich in humus, with dense and rich in species plant cover are characteristic for Calypsostranda. In the authors' opinion, it is due to favourable grain size composition (slightly loamy sands and loamy sands, light silty loams). It results, among others in relatively quick warming-up of the above-mentioned formations, however without their drying out. They present a very slight cryoturbation only. It must be stressed that shape of this valley ensures good protection against cold winds and hence, a favourable microclimate.

All these factors of soil formation and plant growth are closely interrelated.

Conclusions

1. Soil and vegetation conditions in selected small valleys, typical for the Bellsund Region, are different: hardly favourable (Skilvika), favourable (Calypsostranda) and medium (Lyellstranda).

2. Plant growth and soil formation are favoured by the following direct and indirect factors: grain size composition of loamy sands and light loams, relatively quick warming-up of a soil (at its sufficient moisture), minute cryoturbations, valley location and shape.

3. Unfavourable soil and vegetation conditions in valleys of arctic tundra result from much light (quick drying) or heavy grain size compositon. The latter cause high dynamics of soil mechanical features and high compactness, together with slow and long-lasting warming-up of a soil.

References

ALEKSANDROVA V. D. 1977. Geobotaniceskoye rayonirowanie Arktiki i Antarktiki. — Kom. Ucet. Leningrad, 29.

DALLMANN W. K., HJELLE A., OHTA Y., SALVIGSEN O., BJØRNERUD M. G., HAUSER E. C., MAHER H. D. and CRADDOCK C. 1990. Geological Map of Svalbard 1:100,000, Sheet B1 1G Van Keulenfjorden. — Norsk Polarinst., Oslo.

DZIADOWIEC H. 1992. Decomposition of *Saxifraga oppositifolia* L. shoots and *Deschampsia alpina* R. et S. leaves under conditions of Spitsbergen tundra. — *In:* Landscape, Life World and Man in High Arctic: 177–183.

FISCHER Z. 1988. The intensity of soil metabolic processes in Spitsbergen tundra. — XV Symp. Polarne, Wrocław, Mat.: 271–275.

HARASIMIUK M. and KRÓL T. 1993. Development of fluvial system of the Dunder Basin (Western Spitsbergen). — XX Polar Symp., Lublin, Mat.: 341–348.

KARCZMARZ K. and ŚWIĘS F. 1988. Bryophyte flora of South Bellsund Bay coast, West Spitsbergen. — Wypr. Geogr. na Spitsbergen, UMCS, Lublin: 229–235.

KLIMOWICZ Z., MELKE J. and UZIAK S. 1993. The influence of relief and lithology on soil formation in West Spitsbergen. — Proc. VIth Intern. Conf. on Permafrost, 1, Beijing, China: 350–355.

KLIMOWICZ Z. and UZIAK S. 1995. Arctic soils formation in the area of lakes occurrence (West Spitsbergen). — Pol. J. Soil Sci., 28 (2): 139–148.

ŁANCZONT M. and RODZIK J. 1989. Thermic differentiation of periglacial valley slopes. — XVI Symp. Polarne, Toruń, Mat.: 173–175.

MATUŁA J. and ŚWIĘS F. 1989. Preliminary characteristics of algae in the southeastern coast of Bellsund, western Spitsbergen. — Wypr. Geogr. na Spitsbergen, UMCS, Lublin: 97–110.

MELKE J., CHODOROWSKI J. and UZIAK S. 1990. Soil formation and soil properties in the areas of Lyellstranda, Dyrstad and Logne in the region of Bellsund (West Spitsbergen). — Pol. J. Soil Sci., 23 (2): 213–222.

OYAMA M. and TAKEHARA H. 1967. Revised standard soil color charts.

PĘKALA K. 1987. Relief and Quaternary deposits on the Scott and Renard glaciers forefield, Spitsbergen. — XIV Symp. Polarne, Lublin, Mat.: 84–87.

PLICHTA W. and LUŚCIŃSKA M. 1988. Blue-green algae and their influence on development of tundra soils in Kaffiöyra, Oscar II Land, Spitsbergen. — Pol. Polar Res., 9 (4): 475–484.

POCIASK-KARTECZKA J. 1987. Marine aerosols influence on the chlorides content in the rainwater in the Palffyodden, SW Sörkapp Land Spitsbergen. — XIV Symp. Polarne, Lublin, Mat.: 162–165.

REPELEWSKA-PĘKALOWA J. 1987. Development of shore plain under the influence of the erosion processes on the example of Calypsostranda, Bellsund region, West Spitsbergen. — XIV Symp. Polarne, Lublin, Mat.: 103–105.

REPELEWSKA-PĘKALOWA J., GLUZA A. F. and DĄBROWSKI K. 1987. The thermic of the tundra and dynamics of the permafrost active layer in the forefield of Scott and Renard glaciers, Bellsund region, West Spitsbergen. — XIV Symp. Polarne, Lublin, Mat.: 108–115.

RØNNING O. I. 1964. Svalbards flora. — Polarhänbok, 1. Oslo.

RØNNING O. I. 1972. The distribution of the vascular cryptogams and monocotyledones in Svalbard. — Det Kong. N. Vidensk. Selskab. Skr., 24, Universit. Trondheim — Oslo — Bergen — Tromsö.

RZĘTKOWSKA A. 1987. Preliminary description of flora in Calypsostranda region, Wedel-Jarlsberg Land, Spitsbergen. — XIV Symp. Polarne, Lublin, Mat.: 218–220.

SKIBA S. and KUCZEK M. 1993. Preliminary studies of the soil cover in North-West Sörkapp Land, SW Spitsbergen. — Zesz. Nauk. UJ, Prace Geogr., 94: 93–103.

SZCZĘSNY R., DZIERŻEK J., HARASIMIUK M., NITYCHORUK J., PĘKALA K. and REPELEWSKA-PĘKALOWA J. 1989. Photogeological map of the Renardbreen, Scottbreen and Blomlibreen forefield (Wedel-Jarlsberg Land, Spitsbergen), 1:10,000. — Wyd. Geol., Warszawa.

SZERSZEŃ L. 1974. Effect of bioclimatic factors on processes occurring in soil of the Sudety Mountains and Spitsbergen. — Roczn. Glebozn., 25: 53–95.

ŚWIĘS F. 1988. Geobotanic differentiation of tundra on the southern coast of the Bellsund Bay, western Spitsbergen. — Wypr. Geogr. na Spitsbergen, UMCS, Lublin: 215–228.

TEDROV J. C. F. 1977. Soils of the Polar Landscapes. — Rutgers Univ. Press, New Brunswick — New Jersey.

UGOLINI F. C. and SLETTEN R. S. 1988. Genesis of Arctic brown soils (Pergelic Cryochrept) in Svalbard. — Proc. Vth Intern. Conf. on Permafrost, Trondheim, 1: 478–483.

UZIAK S. 1992. Polish pedological studies on Spitsbergen, a review. — Geogr. Polon., 60: 67–78.

ZABAWSKI J. and ŻURAWSKA M. 1975. The soil microflora in the Hornsund region (West Spitsbergen). — 7th Scient. Sess. of Soil Biology and Conservation of the Biosphere, Keszthely, Hung. Ass. of Agric. Sci.

Received March 10, 1995
Revised and accepted September 27, 1995

Streszczenie

Celem opracowania było poznanie warunków glebowo-roślinnych w różnych formach dolinnych na obszarze południowego Bellsundu. Do badań wybrano typowe dla badanego obszaru 3 różne doliny w rejonie Lyellstranda, Skilvika i Calypsostranda (fig. 1–4). Genezę tych form można wiązać z wodami pochodzącymi z ablacji pokrywy śnieżnej i zmarzliny oraz w przypadku obiektu na Lyellstranda — także z wodami rzek zasilania niwalnego z wyższych partii stoków. W badaniach wykorzystano metodę krzyżujących się przekrojów niwelacyjno-glebowych. W pobranych próbkach oznaczono skład granulometryczny (tab. 1–2) oraz podstawowe właściwości chemiczne, a także zawartość form rozpuszczalnych Ca, Mg, K, Na i P w 0,03M CH_3COOH (tab. 3–4).

Warunki glebowo-roślinne we wspomnianych formach dolinnych są zróżnicowane: mało korzystne (Skilvika), korzystne (Calypsostranda) i pośrednie (Lyellstranda). Czynnikami sprzyjają-

cymi kształtowaniu się pokrywy glebowej oraz wzrostowi roślin są: korzystne uziarnienie (tj. piaski gliniaste i gliny lekkie), szybkie ogrzewanie się gleby (przy zachowaniu wystarczającego uwilgotnienia), względna stabilność gruntu, usytuowanie i kształt doliny. Natomiast gorsze warunki glebowo-roślinne są wynikiem zbyt lekkiego lub zbyt ciężkiego składu granulometrycznego, wysokiej dynamiki cech mechanicznych gruntu, jego dużej zwięzłości, a ponadto powolnego i długotrwałego nagrzewania. Badane gleby cechują się zróżnicowaną zawartością węglanów, a odczyn w 1N KCl jest z reguły alkaliczny — poza poziomami organicznymi, gdzie jest zbliżony do obojętnego.

Miąższość poziomów próchnicznych, a także zawartość węgla organicznego znacznie różnią się w każdym z 3 badanych obiektów (fig. 5). Zawartość rozpuszczalnych w 0,03M CH_3COOH form Ca, Mg, K, Na, i P jest zróżnicowana. Na uwagę zasługuje wysoka koncentracja Ca i Mg, a niekiedy również Na. Zawartość rozpuszczalnych w kwasie octowym form P i K jest w badanych glebach stosunkowo niewielka.