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Andrzej MIZGAJSKI

Institute of Physycal Geography
Adam Mickiewicz University
Fredry 10
61-701 Poznań, POLAND

Diversity of the valley natural environment in the Arctic region, Ebbadalen in Olav V Land, central Spitsbergen

ABSTRACT: The present article provides information on the method of distinguishing between spatial natural units within a valley microregion in the Arctic zone. Geocomplexes fall into 20 types and are grouped under four categories of high order units, i.e. glacial, fluvial, slope and polygenetic geocomplexes. The lithomorphogenetic criterion is useful in differentiating other natural characteristics.

Key words: Arctic, Spitsbergen, environment, landscape.

Introduction

Nature of the Arctic regions is predominantly affected by physical processes conditioned by two principal factors, i.e. climate and lithology-tectonics. The climatic factor determines chiefly the intensity of glaciation, whereas the litological-tectonic factor affects the main features of surface morphology. Characteristics of a given geocomplex are the products of direct or indirect influence of these factors.

The objective of this study is to differentiate natural features and present structural relationships within the studied spatial unit of microchore (microregion) rank. This article is an extension of the present author's publication on the spatial distribution of Ebbadalen geocomplexes (Mizgajski 1987).

Study area, research scope and methods

Fieled studies were carried out during '87 summer season. Ebbadalen is a latitudinal-oriented linking valley between the Lomonosov fonna and the

Petuniabukta which is the northeasternmost part of Isfjorden. The eastern part of Ebbadalen is occupied by the Ebbabreen tongue flowing from the Lomonosov fonna. The study area covers an ice- free valley reach about 5 km long. An area of about 17 sq km between the crests of Wordiekammen and Løvehovden that limit the valley to the south and north, respectively, was subjected to investigation.

The applied research procedure involves the following major stages:

1 — a preliminary field reconnaissance survey of nature variation in the study area,

2 — adoption of criteria of distinguishing between spatial units and classification of their types, i.e. geocomplexes,

3 — field interpretation of a 1:50.000-scale air photo in conjunction with the delimitation of geocomplexes,

4 — field identification of natural features within geocomplexes,

5 — verification of the delimited geocomplexes by the use of a Carl-Zeiss--Jena interpretoscope.

The air photo that showed clearly the surface distribution of spatial unit types proved to be of importance for this procedure. A small area which was easy of access and detailed studies were the grounds for field air-photo interpretation. However, the usefulness of a much more efficient office-work method of studying large areas which are most often difficult of access should not be denied (Jania and Szczypek 1987).

Particularly significant for the research and its results has been the choice of criteria of the delimitation of relatively uniform geocomplexes. In a study on structure of the geographical environment in northwestern Sörkappland, the authors (Czeppe and Ziaja 1985) pointed out eight principal criteria of geocomplex delimitation. However, the natural environment of that landscape zone reflects a hierarchy and it appears unnecessary to distinguish between so many criteria. This procedure must have caused a lot of methodological difficulties in determining the limits. Only the most important characteristics should be taken into account. Others may serve as tools, by means of which the delimited geocomplexes are described.

Physical processes affecting substrate characteristics in this area prevail in the Arctic regions. Because of insignificant human involvement in geo-complex qualities and a concurrent close relationship of scarce vegetation with features of non-living nature the litho-morphogenetic criterion can be adopted in delimiting spatial units. The most important processes controlling the kind of material and surface morphology of the study area include glacier action, fluvial processes, slope processes and sea action. Following this variety of processes, specific periglacial processes take place Their intensity is the result of variations of the climatic and litology-tectonic factors.

Present-day climatic fluctuations are marked by changing positions of the glacier snout. Ebbabreen is now retreating, which is characteristic of most Spitsbergen glaciers. A comparison between the extent of the northern snout part detectable in the air photo of 1961 and a position occupied after 26 years indicates recession by about 400 m. This implies that the mean annual rate of deglaciation approximated then 15 m. A record of Late Holocene movements of the Earth's crust is preserved in this area by raised marine beaches. The uppermost beaches are located at an altitude of about 50 m above present-day water level in the bay (*see* Stankowski, *this volume*).

Litho-morphologic characteristics are correlated with the hydrological cycle and vegetation. Of special importance in the geosystem under investigation is water which is a factor controlling other natural features. The hydrological cycle is most dependent on lithomorphologic characteristics. Although the active role of water is only marked during the short Arctic summer, its effects are detectable in morphology and segregation of the denuded material. The hydrological cycle is markedly linked in terms of space to substrate qualities, including particle-size distributions and surface morphology. Scarce vegetation remains passive and adapts itself to a pattern of other components. However, examples may be quoted to indicate that vegetation can have a marked effect on physical properties of the surface substrate layer under extreme conditions. Over slope parts with dips of 2—4°, occur transverse movement ridges. Intermittent surface water flow takes place here and there. On meeting obstacles the water deposits sandy material in hollows between the ridges. At the mature stage microrelief occurs as terraces of several centimetres. Because of altered habitat conditions, moss is overgrown with other plants such as *Equisetum orvense*, *Polygonum viviparum*, *Salix polaris* and *Saxifraga* sp. They have been identified according to Rønning (1964).

With reference to the main processes affecting litho-morphologic characteristics of the study area, types under which geocomplexes fall are as follows (Fig. 1):

(1) glacial geocomplexes: (1.1) glacier ice devoid of morainic mantles, (1.2) medial moraine, (1.3) marginal zone over dead ice,

(2) fluvial geocomplexes: (2.1) outwash plains, (2.2) braided river valley floor, (2.3) accumulation plain, (2.4) gap section of valley floor, (2.5) mouth section of valley floor,

(3) geocomplexes associated with slope processes: (3.1) outcrops of solid rocks and weathered mantles, (3.2) gravity cones, (3.3) alluvial fans, including (3.3.1) area of contact with valley floor, (3.3.2) area of most frequent water flow, (3.3.3) area of sporadic water flow, (3.4) slopes liable to intense periglacial remodelling,

(4) polygenetic geocomplexes at valley outlets: (4.1) glacial accumulation landforms scoured at the surface, (4.2) parts of marine beaches over periglacially remodelled slopes, (4.3) valley and subslope peatbogs, (4.4) present-day beach, (4.5) bay part.

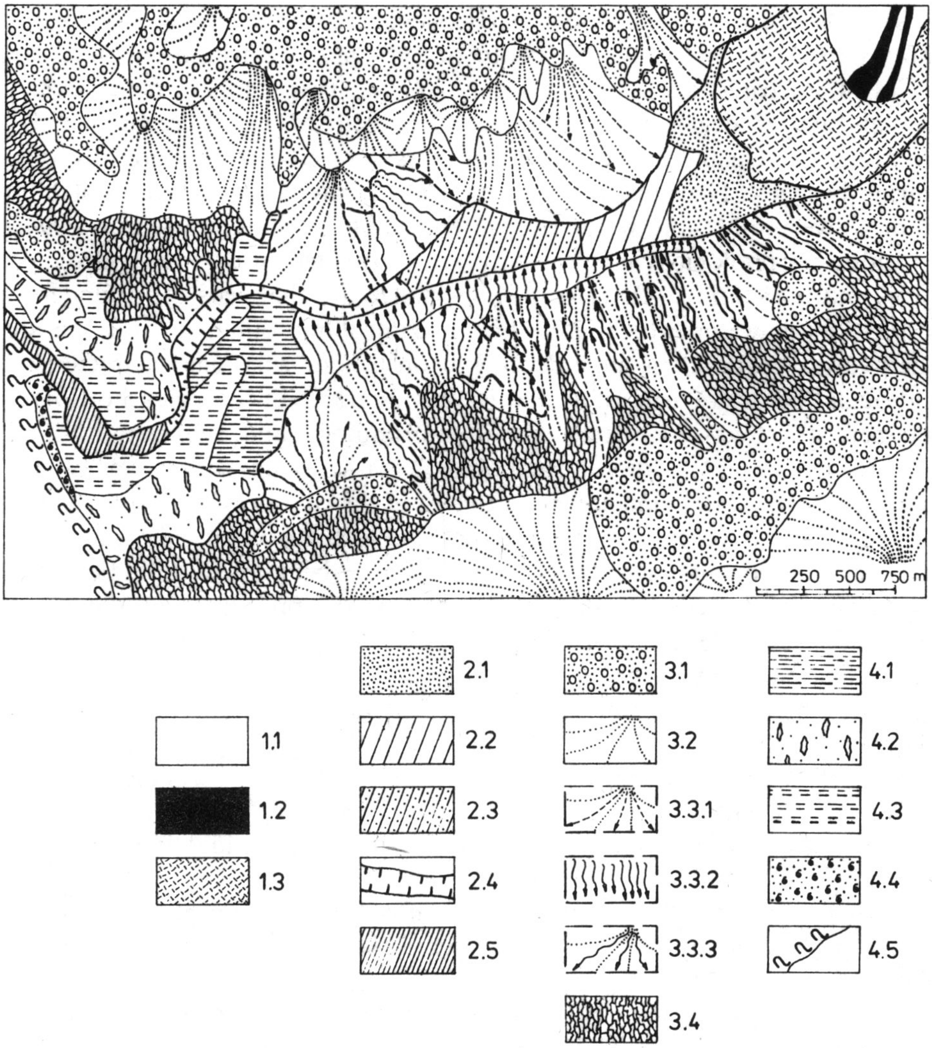

Fig. 1. Spatial distribution of geocomplex types recognized in Ebbadalen (*see* the text for explanation)

Sets of glacial landforms occurring in Ebbadalen have been described by Kłysz (1985) and Kłysz *et al.* 1989 (*this volume*). The latter authors have also published a 1:20.000-scale map of glacial landforms found in this region.

Although this study is, to a certain extent, consistent with the quoted sources, an attempt has been made here to differentiate spatial units of different origin. Considerations are not confined to glacial landforms. There is considerable discrepancy between the spatial units under consideration and the belts of lateral moraines lying on the Wordiekammen slopes near the valley outlet (Kłysz *et al.* 1989 *this volume*). These conspicuous landforms of the slope relief prove to be rock outcrops running across the slopes.

Natural characteristics of geocomplexes

1. Glacial geocomplexes

(1.1) Glacier ice devoid of morainic mantles

The glacier surface is densely dissected by transverse cracks, which is the result of overriding ofarock threshold in bedrock. Therefore there exist no favourable conditions for the occurrence of supraglacial streams. This makes Ebbabreen different from many other glaciers occurring in this region.

(1.2) Medial moraine

It extends as a strip from the nunatak Bastionfjellet and develops into two parallel crests composed of boulders and stones in its final section in front of the snout. Because of the absence of fine fractions, even single plant specimens, e.g. mosses which are found in medial moraines left behind by other glaciers, are not encountered there.

(1.3) Marginal zone containing landforms which overlie dead ice

This area is bipartite. The southern portion consists of many ridges being several metres in relative height. An air photo shows it as a fan-shaped form which spreads out from medial moraines towards the glacier foreland. This is markedly indicative of the origin of the main part of material of which the supraglacial layers of landforms are built up there. The material consists of rock blocks and stones, as is the case for the medial moraine. Traces of fine fractions are not detectable at the surface. Because of the thickness of debris, it is, as a rule, not possible for water to remain at the surface. The kind of a substrate and the associated hydrological cycle restrict considerably plant growth. Only single specimens of *Saxifraga* sp., *Melandrium affine* and *Draba oblongata* are encountered there. They occur at the margins of ice-morainic ridges and a lateral moraine.

The northern portion has a quite different nature. It has developed after the glacier retreated during the last decades. Bedrock morphology features result in a heavily fractured glacier. As a consequence, there exist no favourable conditions for the accumulation of large amounts of morainic material. Therefore, landforms are markedly lower. The substrate of which they are built up displays a high degree of variability. Another characteristic is strong hydration. The headwaters of a proglacial river cause a waterfall on a rock threshold in front of the glacier snout and develop into a network of streams forcing their way towards the farther foreland. Water-saturated till begins to flow downslope. Even single plant specimens are absent from this portion.

2. Fluvial geocomplexes

(2.1) Outwash plains

An outwash plain beyond Ebbabreen is bipartite. It consists of adjacent cones of which the proximal parts are associated with the northern and southern extremities of the marginal glacier zone at the foot of the valley slopes. As can be seen in an air photo, there is a marked difference in phototone between both cones, which is due to different material of which they are built up. In the southern portion debris released from light sedimentary rocks assumes dominance, whereas there is a large proportion of debris from dark metamorphic in the northern portion. The stone-sized fraction dominates the composition of the outwash surface. Finer particles are carried by water and washed inwards.

Plants can grow if there are some water-retaining fine particles in bedrock. Such conditions exist at beds of numerous outwash channels. However, these relatively favourable factors are accompanied by the intermittent destructive action of flowing water. Hence, only single specimens of best adaptable *Saxifraga oppositifolia* persist.

(2.2) Braided river valley floor

The zone of drainage is considerably narrower than outwash plains. The substrate surface is composed of stones embedded in sands and gravels. They are smaller than those found over outwash plains. Because of changing water stages and drainage channel diversion, plants, as a rule, cannot persist.

(2.3) Accumulation plain

The proglacial river begins to flow slower there and expands into a few more stable channels. Above then occurs a flat where flood facies are accumulated as fine sands and silts at high water stages. Aeolian processes are active there at low water stages. No plants inhabit this plain.

(2.4) Valley gap section

Beneath the plain the valley floor becomes highly narrowed. The river flows between alluvial fans in the north and glacial accumulation landforms in the south. In the channel there is abundant coarse rock material occurring as blocks and stones of metamorphic and sedimentary rocks. Along a several-metre-long section the river cuts into solid bedrock to which the debris is rooted. This reach terminates in rapids among glacier-transported boulders. Diversity of rocks and varying degrees of abrasion are indicative of this. In the valley floor gap section plants grow only beyond the zone of river action. Therefore, they are discussed under other geocomplex types.

(2.5) Valley mouth section

It is in the shape of a curved funnel which consists of three zones. The river bed containing numerous pools and bars is blanketed with material varying a lot in particle size (stones, gravels, sands). The bed width is about 15 m. There exist conditions adverse to colonization by plants.

Another zone is marked by the extent of flooding at high water stages. Sands and silts dominate the composition of the layer immediately beneath the surface. The stone-sized fraction is encountered in places only. Height differences approach 1 m. Lowerlying areas are most often water flow routes. Hence, they are not inhabited by plants. Higher-lying areas are covered with a variety of plants (0—30 per cent), including *Saxifraga oppositifolia, Polygonum viviparum* and *Melandrium affine.*

The third zone lying now outside a floodplain contains a peatbog separated from the higher-lying area by a 2-2.5-m-high erosional scarp. The hydrological cycle displays variability in accord with the rhythm of permafrost melting. A characteristic of this zone is the arrangement of moss ridges following the trend of frost cracks. During meltwater release water accumulates between them, thereby reducing the duration of the growing season in inundated areas. Thus, peatbog vegetation grows slowly. At dry sites there is a large proportion of *Carex rupestris.*

Hydrologic characteristics of this valley reach are described by Choiński (see his article in this volume).

3. Geocomplexes associated with slope processes

(3.1) Outcrops of solid rocks and weathered mantles

Weathering-resistant metamorphic rocks occur near the glacier snout in the interior of the valley. Their steep walls are nearly devoid of weathered material at the base. Because of great thermal capacity of metamorphic rocks, there exist relatively favourable thermal conditions for the growth of vegetation. Numerous specimens of *Dryas octopetala* are encountered on a smooth surface of a roche moutonnee. In wet places mosses and *Cassiope tetragona* make up a shallow high peatbog.

The top portions of the valley slopes are occupied by outcrops of slightly resistant sedimentary rocks, among which marls and sandstones assume dominance. Gypsum outcrops are detectable in some sections. The arrangement of rock layers is generally weakly disturbed. In terms of morphology the outcrops are up-to-about-50-m-high vertical rocks embedded in the weathered material. They are broken up into parts devoid of plants. The organic world is represented there by numerous birds inhabiting rock niches and ledges during the summer months.

At the northern valley outlet beneath the solifluction slope there is a weathered mantle composed of angular claystone chips 2—5 cm in diameter, among which large blocks can be found (20—30—50 cm). It is a very dry habitat where the imprints of periglacial processes are not visible. Shallow hollows are inhabited by clusters of *Dryas octopetala* and *Saxifraga* sp. which account for 0 to 50 per cent of the cover.

(3.2) Gravity cones

They are composed of rock chips, mostly below 10 cm in diameter. Topoclimatic and hydrologic conditions are unfavourable to the growth of vegetation. Merely clusters of *Dryas octopetala* remaih as strips along dip lines, which may be indicative of shallow subsurface runoff along these lines.

Extremities of these landforms offer favourable moisture conditions. Small vegetation-covered patches occur in the upper part in the area of contact with solid rock. An extensive vegetation cover is also found in the lower part where a gravity cone becomes an alluvial cone. *Saxifraga* sp. remains dominant there. In highly hydrated places mosses form incipient slope peatbogs.

(3.3) Alluvial fans

They are extremely extensive landforms which prevail in the expression of the valley. Their characteristic profile is concave. Dips diminish gradually from about 15° in the upper part to below 2° in the area of contact with the valley floor. These landforms can be divided into three distinctive zones differing in water activity.

(3.3.1) The area of contact with the valley floor

Adjusted downslope flow of water ceases there. The water begins to move slowly and percolates through bedrock where the sand-sized fraction prevails. Single boulders being the remainder of scoured debris are embedded in the sand. The angle of dip does not exceed 2°. Among plants, *Polygonum viviparum* assumes dominance but the vegetation cover does not make up more than 10 per cent.

(3.3.2) The area of most frequent water flow

It consists of a network of cuts down to 1 m deep into slopes. A characteristic of its structure is particle size varying from rock chips several cm in diameter to the sand-sized fraction. Water flow reaches its maximum during snow and permafrost melting to become reduced afterwards and cease finally. Substrate variability affects variations in soil moisture, there by influencing the growth of plants, although the destructive action of flowing water appears to be the main factor.

The vegetation cover accounts for up to 5 per cent of the surface area. *Saxifraga oppositifolia, Dryas octopetala, Salix polaris*, as well as *Polygonum viviparum* are most often encountered.

(3.3.3) The area of sporadic water flow

Its surface carries an extensive vegetation cover which makes up even 90 per cent. Single cuts into cones are indicative of waning activity. They are generally exposed in the middle part of cones as a result of turf stripping-off and rock pavement exposure. This indicates the occurrence of subsurface flow. Underlying these cuts occurs sandy material through which plants project again. *Polygonum viviparum* is the first to turn up. It is followed by *Saxifraga* sp.

In different parts of the slopes there are variable proportions of plants. *Saxifraga* sp. *Dryas octopetala, Polygonum viviparum* and *Salix polaris* are mostly encountered but *Melandrium affine* and *Carex narchina* also occur at dry sites.

As a rule the vegetation cover tends to be more extensive upslope.

(3.4) Slopes liable to intense periglacial remodelling

They are affected by changing processes conditioned largely by a substrate, the hydrological cycle and land dip angle.

Shallow slope peatbogs form in the lower slope portions with dips of about 2—4° and sufficient moisture content. They are made up of moss clusters when the angle of dip is about 4°. Mosses remain as a network of strips perpendicular to the inclination at the lower angle of dip, i.e. 2°. Silts and fine sands often accumulate between these ridges. A network of contraction cracks filled to varying degrees with material is detectable at the surface of dry flats.

A rather extensive solifluction area occurs on a slope with the angle of dip of about 6° in the northern portion of the valley outlet. It overlies a weathered mantle in the form of an about-1-m-high scarp. The solifluction slope is composed of slimy till material in which angular stones are embedded. At full watersaturation levels water travels over the surface in trickles.

Polygonal structures which remain elongated downslope are easily traceable. Along crack lines a contribution from the stone-sized fraction is great and the ground is more stable. Grass clusters occur there. At intervals of about 0.5—1 m there are transverse ridges up to several metres high, following the trend of frost cracks. Because of plants, *i.e. Dryas octopetala* and *Saxifraga aizoides*, which colonize them, they are more pronounced.

Polygonal structures are also present on slope flats on the south side of the valley. The outlines of polygons are marked by clusters of *Dryas octopetala* inhabiting hollows along crack lines.

Slope parts affected by active sliding processes lie above alluvial fans in the middle portion of the valley. These processes become active in places with the angle of dip of about 20° where a continuous soil cover with high moisture content is present. The largest continuous area of this type occurs in the middle part of the south-facing valley slope between two deep cuts. Slides occurring in Ebbadalen are usually not of large size. Very often a niche together with a tongue is several metres in length and width. Slides remain at different developmental stages and display variable hydrologic characteristics. The bottoms of slide hollows have the highest moisture content but a soil cover is absent there. Thus, new landforms are either devoid of vegetation or colonized by mosses. Older slide hollows are covered with vegetation to a larger extent than the surrounding area.

4. Polygenetic geocomplexes at the valley outlet

(4.1) Glacial accumulation landforms scoured at the surface

An end morainic ridge remains as a barrier that crosses the valley at a distance of about 1.5 km from its outlet. The ridge is raised above the surrounding alluvial fans, thereby producing a northward-curved river bend. Because of rock outcrops visible beneath morainic deposits in the river gap section, it can be presumed that the morainic ridge has been formed on a rock threshold. It is a mound-shaped landform of which the long axis is inclined northwards at the angle of 3—4°. The blanketing surface is made up of rock pavement chips 2, 5 or 10 cm in diameter, embedded in the sand. Its characteristics are numerous boulders, especially on the west-facing slope. Because of the elevation and high permeability of the substrate, this area becomes dried out rapidly at the surface after the release of meltwater. The top portion itself and steep slope parts are nearly devoid of vegetation. The maximum vegetation cover does not exceed 20 per cent of the geocomplex area. Clusters of *Dryas octopetala* with a contribution from sparse *Polygonum viviparum* are prevalent.

(4.2) Parts of marine beaches over periglacially remodelled slopes

Morphologic characteristics of these geocomplexes are elongated flat ridges or thresholds located on gentle slopes inclined towards the valley outlet. The landforms are several to a few hundred metres in length but their width does not exceed a few metres. The sand-sized fraction with a great contribution from gravel and sand-gravel aggregates prevails at the substrate surface. Non-extensive aeolian mantles which are, as a rule, up to a few cm thick are often encountered at the sheltered base of terrace-like beaches.

As no water issuing from the surrounding area enters there and infiltration rates are fast, the beach surface becomes dried out rapidly. The vegetation cover is not extensive and does not exceed 5 per cent. *Dryas octopetala* and *Saxifraga* sp. occur in clusters. Single specimens of *Papaver dahlianum* are also found.

Nearly bare marine beaches are conspicuous for their light colour against the surrounding area inhabited by tundra that is the largest vegetated region in the entire study area. A vegetation cover accounts for 90 per cent of its surface area. Hollows at the base of beaches are occupied by peatbogs fed by water derived from permafrost thawing at upper terraces. Sites with high moisture contents at the peatbog margins are colonized by *Cassiope tetragona.*

Saxifraga sp. and *Dryas octopetala* are prevalent in the tundra. They are accompanied by *Carex narchina* and sparse specimens of *Pedicularis dasyanta* and *Melandrium affine* in dry tundra habitats.

Carex rupestris assumes dominance at wet sites. *Polygonum viviparum* is a plant encountered in a variety of habitats.

(4.3) Valley and subslope peatbogs

Only vast continuous peatbog areas are classified as a distinctive group of geocomplexes although some of their characteristics fall under other geocomplexes. Organic matter is not too thick there because of slight accretion. It rises to a maximum of about 30 cm in thickness. During the polar summer months peatbogs are increasingly dried out, irrespective of rising water stages on the periglacial river as a result of ablation. This implies that meltwaters and those due to permafrost thawing are of major importance in feeding these peatbogs.

Mosses are often mixed with *Eoqisetum orvense*. At less wet sites patches covered with *Carex rupestris* turn up. The peatbog margins are inhabited by *Cassiope tetragona*.

(4.4) Present-day beach

A strip of beach is about 15 m wide. In the vicinity of Skottehytta on vhe landward side it is closed by an about-2.5-m-high abrasion threshold sloping down northwards.

It is a stony beach composed of particles 2, 3 or 5 cm in diameter. A discontinuous vegetation cover occurs at the uppermost level beyond storm ridges and on a steep abrasion slope. Clusters of *Festuca supina vivipara* occupying 30—50 per cent of the surface area grow immediately above a beach platform at sites with high moisture content. There are single specimens of *Papaver radicatum*, *Saxifraga* sp. and *Draba oblongata* in the dry upper part of the slope.

(4.5) Bay part

Petuniabukta is a northern segment closing Billefjorden and the north-easternmost part of the superior unit *i.e.* Isfjorden. It is a basin extending over 4 km following the parallel and over about 6 km along the meridian line, including a tidal plain. Tide height is 1 to 1.5 m and the maximum depth exceeds 60 m after cartographic sources. Waters of the bay are generally rather calm. It is during the summer months that wave height rarely exceeds 1 m. The period of glaciation is long-term. For instance, it lasted till late June in 1987. Sometimes ice blocks derived from the nearby ice cliff of Nordenskiold drift towards Petuniabukta. A section shown on the map lies between the Ebba river mouth and the mouth of an intermittent stream to the south of Skottehytta. The two streams carry large amounts of suspended sediment load over some periods (*see* Kostrzewski *et al.*, *this volume*) and Choiński (*this volume*). This is indicated by changed colour of the water layer immediately below the surface in this part of the bay.

The quoted article written by Choiński provides more information on the hydrology of this basin.

Conclusions

A description of natural geographical characteristics of 20 geocomplex types occurring in Ebbadalen shows that the lithomorphogenetic criterion also allows differentiation of other natural characteristics of the Arctic regions. In general, the valley under investigation is markedly tripartite in nature. The upper part is affected by the glacier and slope processes that take place above the ice-lying line. The middle part of the valley is affected by slope and fluvial processes. The outlet is markedly polygenetic due to concurrent glacial accumulation erosional-accumulative sea action slope fluvial and periglacial processes, as well as organic matter accumulation.

How detailed the description of particular geocomplex types are depends on varying degrees of complexity of their structure on the one hand and a supply of fragmentary data due to relatively shortterm fieldwork and technical limitations on the other hand.

The study area should be subjected to thorough geobotanical study, thereby allowing convincing conclusions to be drawn as to functioning of the physical environmental part. It appears that the method of bioindication of environmental features may prove to be of particularly great value for such an area where physical processes remain prevalent and human activity effects are indiscernible. Although this study does not exhaust information on the natural environmental characteristics, it does provide a certain picture of the structure of natural characteristics of this area. It seems to represent a basis of detailed research programmes concerning Ebbadalen and regional comparative analyses for larger areas.

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Streszczenie

Przedmiotem prezentowanego artykułu jest przedstawienie zróżnicowania cech przyrodniczych oraz ukazanie powiązań strukturalnych w obrębie analizowanej jednostki w randze mikrochory. Procedura badawcza obejmowała następujące etapy:

— wstępne rozpoznanie terenowe zmienności przyrody na analizowanym obszarze;
— przyjęcie kryteriów wyróżnienia jednostek przestrzennych i zbudowanie klasyfikacji typów występujących jednostek (geokompleksów);
— terenową analizę zdjęcia lotniczego 1:50 000 połączoną z wyznaczeniem przebiegu granic geokompleksów;
— terenowe rozpoznanie cech przyrodniczych w obrębie wyróżnionych geokompleksów;
— weryfikację przebiegu granic jednostek z wykorzystaniem interpretoskopu.

Jednostki przestrzenne wyróżniono na podstawie kryterium lito-morfogenetycznego, co uzasadnione jest dominacją procesów fizycznych kształtujących własności substratu w tej strefie klimatycznej. Najważniejszymi procesami określającymi rodzaj materiału oraz ukształtowanie powierzchni na tym obszarze są: działalność lodowca, procesy fluwialne, procesy stokowe i działalność morza. Na te różnorodne procesy nakłada się specyficzny zespół procesów peryglacjalnych. W nawiązaniu do głównych procesów kształtujących cechy lito-morfologiczne obszaru badań wyróżniono 20 typów geokompleksów, których rozkład przestrzenny ukazano na rycinie 1. Dokumentuje on trójczłonowy charakter Ebbadalen. Górna część kształtowana jest przez lodowiec oraz procesy stokowe powyżej zalegania lodu. Charakter środkowej części determinują procesy fluwialne i stokowe, jej cechą są rozległe stożki napływowe. Natomiast odcinek wylotowy ma wyraźnie poligenetyczny charakter. Szczególny rys nadaje mu wał morenowy oraz różne generacje „półek" morskich sięgających 50 m ponad obecny poziom plaży.

W ramach charakterystyk poszczególnych geokompleksów uwzględniono własności substratu, stosunki wodne oraz pokrycie roślinnością i dominujące gatunki roślin. Nie pretendując do wyczerpania charakterystyki środowiska przyrodniczego praca daje skonkretyzowany obraz struktury cech przyrodniczych tej doliny.