

ENVIRONMENTAL CHANGES OF THE EASTERN SØRKAPP LAND, SPITSBERGEN, AFTER THE LITTLE ICE AGE

W. ZIAJA

Institute of Geography, Jagiellonian University, Grodzka 64, PL-31-044 Kraków, Poland

Received for publication: April 1994

SUMMARY

According to the data obtained from field investigations, old maps, satellite pictures and air photos the environmental changes determining the landscape development are described. The retreat of glaciers and the changes of the coast-line, influencing all components of environment, were analysed attentively.

KEY WORDS

environmental changes - landscape development - deglaciation

INTRODUCTION

The eastern Sørkapp Land has undergone quick changes since the Little Ice Age. They have been really intensive during the last 50-60 years. A young and dynamic landscape of the eastern, glaciated coast of Sørkapp Land, being an external indication of functioning of the environment, contrasts with the old and stable landscape of the north-western Sørkapp Land where a glaciation does not exist. That dynamics is conditioned by sensibility of glaciers to the last global climatic changes. The eastern Sørkapp Land is divided by Vasiliev Glacier into two parts described below. The ice cliff of that glacier on Isbukta has retreated 2-4 km since 1936.

The area has been precisely recognized by terrain mapping of basic geocomplexes in the scale 1:25 000 in 1991. Environmental changes during the 20th century are visible owing to the comparison of the contemporary landscape (according to: results of the mapping, infrared air photos 1:50 000 of 1990 and satellite "LANDSAT MSS" pictures of 1985 from Norsk Polarinstitut in Oslo) with the landscape from 1936 shown on the map 1:100 000 (Norge Topografisk kart over Svalbard) and from 1961 and 1971 shown in the standard air photos from Norwegian Polar Institute too.

ENVIRONMENTAL CHANGES IN THE SOUTH-EASTERN SØRKAPP LAND

The quickest ones have occurred in marginal zones of glaciers, uncovered because of deglaciation after 1936 (Fig. 1). Their retreat was the biggest during the last 50 years. Stabilizing of the landscape after deglaciation (e.g. increasing density of vegetation, creating a constant net of surface waters) is the quicker, the lower above sea level an area is situated. Hence the vegetation in the marginal zone

of Keilhau Glacier, situated below 20 m a.s.l., has extended enough for being visible in the infrared air photos of 1990. The opposite example is the marginal zone of the glaciers Svartkuv and Dumskolt. That is the highest (25-250 m a.s.l.) and most shaded of all marginal zones in the south-eastern Sørkapp Land. Because of that there is lack of plants there (Ziaja, 1993a).

The coast-line is influenced by marine accumulation or erosion. The coast on Bettybukta is an example of such accumulative plain created since the 17th century. Remains of huts, situated on the previous coast-line not earlier than in the 17th century (Ziaja, 1993b), are ca. 130 m from the sea today. Hence the rate of increasing the land may be estimated at ca. 40 m (of width) per 100 years. There is a clear (1 m) depression between the old coast with the remains of the huts and the high contemporary coastal ridge with a big quantity of driftwood. That testifies the thesis that the marine action in the end of the Little Ice Age was smaller than today (Ziaja, 1993a). The deposits accumulated on Bettybukta has had to be delivered by marine erosion wasting the rock cliffs of Skolthuken, Randberget and, during the 20th century, the majority of the coast north of Vasiliev Glacier.

The morainic ridges from the maximum extent of glaciers in the Little Ice Age undergo slow constant changes because of thawing their ice cores. The biggest of them is the lateral moraine of Keilhau Glacier 50-70 m high. That moraine might be formed at first during the Vistulian Glaciation and rebuilt afterwards.

The plains are also influenced by denudation of slopes of adjacent mountains. The less resistant is their bedrock, the quicker is the denudation and covering up the plains with deposits. The outwash plain at the foot of Svartkuven has been terraced in the older and middle Holocene (Wójcik, Ziaja, 1993). That is evidenced by remains of the marine terraces sticking out up to 1 m from under outwash material. Reshaping of the plain in the younger Holocene had to be intensified during the last few centuries. The remains of the huts mentioned above have been covered partly with the outwash material. Lack of a vegetation evidences the continuity of burying the plain.

The changes of mountains are the quicker the more their foots are glaciated or eroded by the sea (Ziaja, 1993a). The area of slopes free of ice has increased considerably because of a big reduction of thickness of the glaciers during the 20th century. The impact of marine erosion was already mentioned above.

The contemporary rate of environmental changes is the smallest in Skoltsletta - the coastal plain terraced during the Holocene. The preserved marine terraces are modelled slowly by a complex of morphogenetic processes. The vegetation is quite dense in places there. That does not refer to the bed of the glacial river flowing across the plain and to the sea coast in the northern part of the plain, which undergo comparatively quick reshaping (Ziaja, 1993a).

ENVIRONMENTAL CHANGES IN THE NORTH-EASTERN SØRKAPP LAND

The mass of glaciers, their thickness and filling up their firn basins decreased since 1936. Hence the progress of erosion and denudation of slopes has been evidenced (Sokolowski, Ziaja, 1993). Glacial surges determined fluctuations of the ice cliff of Hamberg Glacier (Lefauconnier, Hagen, 1991) without a progressive retreat in spite of reduction of its mass after 1936.

Big retreat of the glaciers, advanced out in the sea in the beginning of the 20th century (Lefauconnier, Hagen, 1991), exposed the coast-line for the marine action, first of all for erosion.

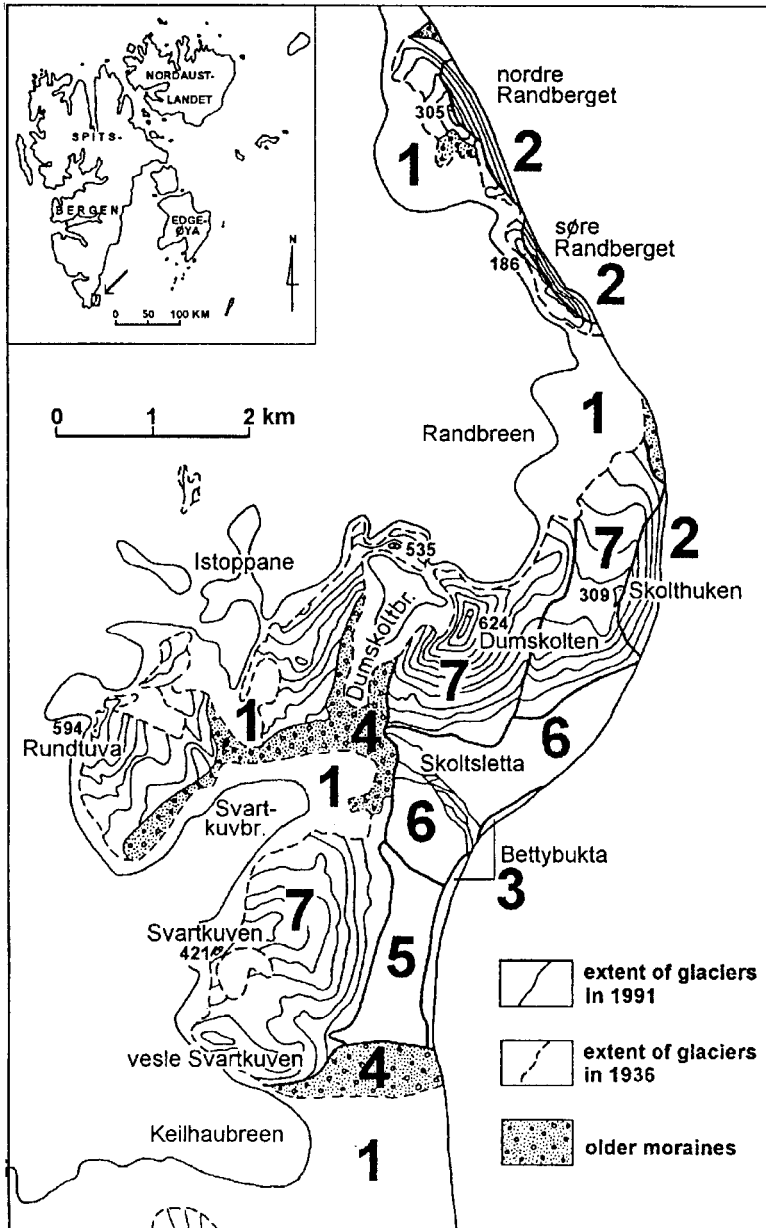


Fig. 1. The south-eastern coast of Sørkapp Land. Beginning of the contemporary stage of the landscape development: 1 - the 20th century, 2 - the end of the Little Ice Age, 3 - the 17th (or 18th) century, 4 - beginning of the Little Ice Age, 5 - the younger Holocene, 6 - beginning of the Holocene, 7 - the end of the Vistulian Glaciation

Intensification of marine erosion during the last few dozen years resulted in wasting not only the steep rock cliffs but also in wasting and covering with the sea the area of Davislaguna and neighbourhood from 1936 to 1971.

RECAPITULATION

The quickest changes have had place in the marginal zones of glaciers. Their retreat was particularly big during the last 50 years. It is worth of notice that stabilizing of the landscape after deglaciation is the quicker the lower above sea level an area is situated. The most important stabilizing properties are: increasing density of a vegetation and creating a constant net of surface waters.

The costal plains are the most changeable near the coast where marine accumulation or erosion is building or wasting big fragments of land.

The raised marine terraces are influenced by a rate and way of denudation of the slopes of the adjacent mountains. The less resistant is the bedrock of those mountains the quicker is denudation of them and covering up of the plains with deposits.

The changes of the mountainous massifs are the quicker, the more parts of their foots are glaciated or eroded by the sea.

REFERENCES:

- LEFAUCONNIER, B., HAGEN, J.O. (1991): Surging and calving glaciers in Eastern Svalbard. Norsk Polarinst. Medd., 116, 25-27.
- Norge Topografisk kart over Svalbard 1:100 000, Blad C13, Sørkapp. Norsk Polarinstitut, Oslo.
- SOKOLOWSKI, J., ZIAJA, W. (1993): Changes of glaciation of the NE coast of Sørkapp Land, Spitsbergen, 1961-1971. Pol. Polar Res., 14, 309-312.
- WÓJCIK, A., ZIAJA, W. (1993): Relief and Quaternary of the southern Sørkapp Land, Spitsbergen. Pol. Polar Res., 14, 293-308.
- ZIAJA, W. (1993a): Landscape differentiation and development of the south-eastern Sørkapp Land, Spitsbergen. In: XX Polar Symp., Lublin, 479-484.
- ZIAJA, W. (1993b): Discovery of remains of settlement in Bettybukta, SE Sørkapp Land, Spitsbergen. In: XX Polar Symp., Lublin, 121-123.