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RIUKOJIETNA'S SENSITIVITY TO CLIMATIC CHANGES

(Abstract)

by

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Riukojietna (lat. 68 °N., long. 18 °E.), which is classified as an ice cap, is located 35 km north-west of Kebnekaise, northern Sweden. The glacier is situated between 1140 and 1456 m a.s.l. and covers an area of 4.6 km^2. The surrounding mountains reach the 1600 m level. Two maps, based on air photographs taken 1960 and 1978, have been produced. A study of sediments from two lakes receiving meltwater from Riukojietna has yielded information on Riukojietna's ability to produce rock flour during the Holocene. Several factors affect the production and removal of rock flour of which the most important are ice thickness, basal ice temperature and water discharge. It is assumed that maximum in silt production for a warm-based glacier will closely follow or coincide with maximum in ice volume. Thus the variation of the relative amount of silt in proglacial lacustrine sediments provides a continuous record of fluctuations in glacier activity. Riukojietna either was small and inactive or may have disappeared totally during a long period between 9500 and 2500 years B.P. Between 2500 and 2000 years B.P. the climatic conditions were such that a reactivation of Riukojietna could occur. The Scandinavian glaciers reached a distinct maximum at the beginning of the 20th century According to topographical maps, Riukojietna was then more than 10 km^2 larger in extent than at present. In order to understand the pattern of glacier variation during the Holocene, the relation between climatic fluctuations and behaviour of Riukojietna is under observation. The purpose is to define those factors that make Riukojietna more sensitive to climatic changes than neighbouring glaciers.

The mass balance of Riukojietna has been investigated during the balance years 1985–86, 1986–87 and 1987–88. In spring 1986 the subglacial topography was monitored with a low frequency radio-echo sounder. Based on these results, holes were drilled in August 1988 for temperature recordings. Winter balances have been rather equal over the years. Differences in net balance values are primarily caused by fluctuating summer balances. A high degree of correlation between summer balance and summer temperature can be expected and has been calculated for Storglaciären. Since the net and summer balances of Riukojietna fluctuate in phase with those from Storglaciären, a similar dependence of the mass balance on summer temperature may exist. Because of the gently-sloping surface and even distribution of the accumulation, a rather uniform and negative summer balance occurs over the whole glacier surface.

During years with some net accumulation on the glacier, the accumulation area is located on the easterly, lee side of the ice cap, in the height interval 1360–1400 m a.s.l. The lowering of the surface profile between 1960 and 1978 was negligible between 1360 and 1400 m as compared to the lowering of the rest of the glacier surface. The maximum ice thickness, 105 m, also occurs in this interval, whereas the mean ice thickness of Riukojietna is only 36 m.

Mass-balance studies have continuously been carried out on Storglaciären since 1945. Between 1959 and 1980 the mean value of the net balance for Storglaciären was −0.33 m w.eq. By using maps from 1960 and 1978 a corresponding value for Riukojietna can be calculated. The result, −0.6 m w.eq., shows that Riukojietna is far from being in balance with the existing climate, while Storglaciären is close to a steady state. According to the "summit method" the glaciation limit is located at 1550 m a.s.l. in the vicinity of Riukojietna. Since the ice-covered bedrock only reaches 1400 m a.s.l., Riukojietna will not reform after a disappearance unless a climatic deterioration generates an approximately 150 m lower glaciation limit. Since the glacier does not experience any net accumulation at present, it will finally disappear if present trends continue; its present condition is probably similar to that experienced during the early Holocene. A distinct climatic deterioration, like the one that occurred between 2500 and 2000 years B.P., would allow a reactivation and expansion of the ice cap.

Riukojietna, which covers a mountain plateau, comprises a relatively small vertical extent. Since it is relatively low-lying as compared to cirque glaciers, which often have a larger vertical extent, it is much more sensitive to changes in the climate. Once the ELA rises over 1400 m a.s.l. or is depressed below 1300 m a.s.l. a major part of the ice cap becomes either ablation or accumulation area. After a presumed disappearance, Riukojietna has to reform at a much lower altitude as compared to a cirque glacier. While a minor lowering of the glaciation limit is enough to reactivate cirque glaciers, a more distinct lowering is necessary before a reformation and a reactivation of Riukojietna can occur. If the climatic deterioration is severe enough, Riukojietna will quickly expand over the plateau. The areal extent of the ice cap then becomes much larger as compared to cirque glaciers that are forced to expand to lower altitudes where melting increases.

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