

QUATERNARY STUDIES IN THE NORTHERN AND ARCTIC REGIONS OF FINLAND. Proceedings of the Workshop organised within the Finnish National Committee for Quaternary Research (INQUA). Edited by Antti E.K.Ojala, Geological Survey of Finland Special Paper No.40, Espoo, 2005; 130p.; Price: Not stated

The entire Scandinavian region (including Norway, Sweden, Denmark, Finland and Iceland) was buried beneath the continental ice sheet on several occasions during the Quaternary period. The last glaciation, which followed the Eemian interglacial (about 130,000-115,000 years BP) and named as the Weichselian glaciation (also called Wisconsinian glaciation), reached its maximum extent about 18,000-20,000 years BP. The Weichselian glaciers started melting about 10,000 years back and produced a landscape in Scandinavian region which is obviously a reflection of depositional and erosional processes of great ice sheets of that time. Thousands of lakes were formed in the southern part of Finland when the receding glaciers scoured and gouged this part of country's surface. Geographically known as Interior Lake District this region supports extensive forests. The other geographical regions are: the Archipelago Finland, the Coastal Finland and the Upland Finland. The Upland Finland extends beyond the Arctic Circle. The extreme north of this region is known as Lapland. Most of the papers included in the publication under review are related to the last named region, which is closer to Norway.

The publication consists of 14 papers. The first paper by Hirvas et al. entitled "Geological characteristics of the Halti-Ridnitšohkka region, Enontekiö, Finland" introduces us to some of the unique geological characteristics of NW Finnish Upland. In the Halti-Ridnitšohkka region, active periglacial processes operate on a layer of perennially frozen snow (permafrost) which is devoid of vegetation. The cirque and valley glaciers - the most distinct morphological feature of the area are discussed in the paper.

Vahhala et al.'s paper "Application of electrical and electromagnetic methods in studying frozen ground and bedrock - results from Ridnitšohkka, Northern Finland" deals with the occurrence and nature of the permafrost around Ridnitšohkka and Halti Fells. The use of ground resistivity sounding and airborne electromagnetic (EM) technique for mapping frozen ground and permafrost in regions of thin or discontinuous permafrost is highlighted. This paper will interest Indian researchers. If used judiciously ground resistivity sounding and the airborne EM technique may find great use in the central Himalayas where permafrost is covered with thin seasonal frost. Such studies

could be of strategic importance when we are required to delineate firm ground in glaciated areas for the construction of dwellings, roads, bridges etc.

Ojala et al. ("Dating of the Holocene glacier variations in the Halti-Ridnitšohkka region based on the distal lacustrine sediment cores") discuss the hydrological and erosional changes caused by the movements of valley glaciers in the NW Finnish Lapland, close to Swedish border. Results of the palaeolimnological and sedimentological investigations of the sediment sequence from two lake basins in the area are presented.

Johansson, in his paper entitled "Melting canyon lakes (saivos) in western Finnish Lapland", traces the polygenetic late Glacial/early Holocene history of Pakassaivo and Akassaivo in western Finnish Lapland. Saivo are the lakes or ponds with clear water, typically of a considerable depth and generally occurring in connection with glaciofluvial systems. They have no distinct surface flow or discharge streams.

Koskinen ("Glacial hydrology and the deglaciation in the Scandinavian ice sheet in the Paistuntit area of the Utsjoki region in the Northern Finnish Lapland") has presented various stages of deglaciation of the Scandinavian ice sheets in Northern Finnish Lapland based on the aerial photograph interpretation. Deglaciation has been estimated to have lasted between 200-300 years around 9500 years BP. It has been estimated by the author that the glacier margins retreated at the rate of 60 m per annum at the beginning of the deglaciation and 100 m per annum towards the end.

The Finnish Lapland is an intra-plate region. Neotectonic activity in this region is attributed to glacio-isostatic rebound. Sutinen, in his paper entitled "Timing of early Holocene landslides in Kittilä, Finnish Lapland", has expressed the opinion that a substantial number of landslides in the Finnish Lapland took place in early Holocene, much after the disappearance of the Weichselian glaciers. In the Himalayas, the degree of isostatic rebound as a result of Late Pleistocene-early Holocene deglaciation was on a smaller scale but it would be of interest to study the texture, fabric and age of the seismites, located in the immediate proximity to active faults in central Himalayas.

The paper by Sarala on "Landform development during the Weichselian glaciation in Perapohjola, Finland" is an attempt to describe glacial morphology and till stratigraphy of a region that was situated in the central area of former glaciation. The occurrence of drumlins and a variety of ribbed moraines are very well illustrated. Two glacial phases of Weichselian glaciation separated by a warmer ice-free phase have been distinguished in the area.

The paper on dating of the Weichselian deposits of southwestern Finnish Lapland by Kalevi Mäkinen is very interesting as it attempts to establish chronostratigraphy of SW Lapland and correlating it with that of NW Europe and deep sea isotope stages. In Arctic region, many sudden climatic jumps are recorded in the post Eemian interglacial, especially in Denmark. This paper is also a step in the same direction in which pollen analyses, ^{14}C , Uranium/thorium, TL and OSL dating methods for the interstadial deposits have been used to establish Weichselian stratigraphy in relation to climatic changes.

Seppälä outlines the main problems in the dating of palsas, one type of peatland in Finnish Lapland that is characterized by high mounds with a permanently frozen core. Hagberg presents results of a high-resolution study of the pollen-climate and pollen-vegetation relationship in a permafrost zone of northern Lapland. Problems in dating palsas are discussed.

In the paper entitled "A proposal for formal lithostratigraphical names in the Suopohja Region, Western Finland", Pitkaranta suggests well-considered lithostratigraphical names for different units of the Suopohja region in southern Ostrobothnia. They range in age from Early Pleistocene or Middle Pleistocene (?) to Holocene. In this area majority of the sediments were deposited in glacial or ice-marginal environment. However, aeolian deposits were presumably deposited during the ice-free period extending from the Eemian (~125 k y BP) to the Middle Weichselian Substage (~74 k y BP).

Breiliani et al. in their paper entitled "The unique moraine morphology, stratigraphy and ongoing geological processes at the Kvarken Archipelago on the land uplift area in the Western coast of Finland" describe, with excellent illustrations, many of the exceptional geomorphological features of Kvarken Archipelago developed during the gradual deglaciation of the continental ice sheets developed during the Weichselian glaciation. The paper assumes great importance because of the following

distinctive history of the Kvarken Archipelago since the last glaciation.

During the Weichselian glaciation more than three kilometres thick ice sheets covered Finland, so that it depressed the earth's crust to such a degree that a considerable part of the country's present area lay beneath the waters of the Baltic basin immediately after deglaciation. As the burden of the overlying ice was released the crust began to rise rapidly. It is estimated that the total rise up to the present time has been in the range of 300-700 metres in different part of Finland. It has been estimated that if the present rate of uplift is maintained, Finland and Sweden will get connected with a land bridge across the Kvarken strait in about 2500 years. In view of this uniqueness the Kvarken Archipelago on the west coast of Finland has been proposed as a prospective UNESCO's natural World Heritage site. This site will complement Sweden's "High Coast" which lies on the other side of the Gulf of Bothnia and has been listed as a world natural heritage site since 2000. In this area new land emerges from the sea approximately 100 ha annually.

Rankama and Kankaanpää's paper on "History and Prehistory of Lake Vetsijärvi" The archaeological sites are located 6 metres above the present lake level suggesting that the lake-level may have been higher during the Stone Age than it is today.

Finally, in the paper entitled "Chemical constraints on the influence of subsurface and surface melting of lake Basen, western Dronning Maud Land, Antarctica" Lehtinen and Luttinen present results from a geochemical investigation.

The book containing text-book examples of geomorphological features of glaciated areas should surely interest glaciologists working on the geomorphology, climatic changes, limnology, and related aspects in the Himalayan region. We can learn quite a few lessons from the papers presented in the volume on Arctic region. Although uplift of the Himalaya as a result of glacio-isostatic rebound due to melting of glaciers in the post-Weichselian glacial period must have been on a very small scale as compared to the Arctic region, it will nevertheless be of great interest if researchers are able to calculate the degree of uplift as a result of glacio-isostatic rebound in the rising Himalaya.

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