The Deglaciation and Vegetational History of a Former Ice-dammed Lake Area at Skåbu, Nord-Fron, Southern Norway

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Cores obtained from a small peat bog within the area of a former ice-dammed lake show that 1.7 m of silt were deposited during the ice lake phase. The pollen in the silt is dominated by grasses and other NAP. A small transitional zone with coarse gyttja above the silt was radiocarbon dated at 8780 ± 210 yrs B.P. The pollen diagram shows Betula and Hippophäe maxima at the dated level. This date gives a minimum age for the drainage of the lake, and indicates that it existed for only a short period. Contrary to earlier suggestions, a valley fill of till and sediments at Skåbu was not able to maintain the lake after the deglaciation. In a 2.1 m-thick peat layer, above the gyttja, Pinus is the dominating pollen, indicating the presence of a dense pine forest. The Alnus Rise is radiocarbon dated at 7870 ± 80 yrs B.P.

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Introduction

A large ice-dammed lake, Storsjøen, is known to have existed in the Vinstra river system during the last deglaciation (Rekstad 1898, Ramsli 1947, Bergersen 1971). Delta terraces at the mouths of inflowing rivers indicate a lake water level corresponding to the lowest point of the watershed to the south (Fig. 1).

The lake was probably dammed by remnants of the Scandinavian ice sheet. There has, however, also been discussion as to whether the thick valley fill of till and waterlaid sediments at Skåbu (Fig. 1) could have dammed the lake even after the ice had disappeared (Ramsli 1947, Mangerud 1963, Bergersen 1971). The latter problem has now been solved, and the ice lake phase dated, by coring the ice lake sediments in a small depression on the former bottom of the ice-dammed lake. Sedimentological and palynological analyses and radiocarbon dating were carried out on the core, which includes the peat on the top of the ice lake sediments. The investigation has therefore also provided information on the vegetational history of the area.

Field and laboratory methods

The borings were carried out with a 54 mm piston corer. For pollen analysis the peat sampled were prepared by Erdtman's acetolysis method; the minerogenic samples were also prepared by acetolysis and then treated with HF acid (Faegri & Iversen 1975). Grain size distributions from silt were obtained using the pipette

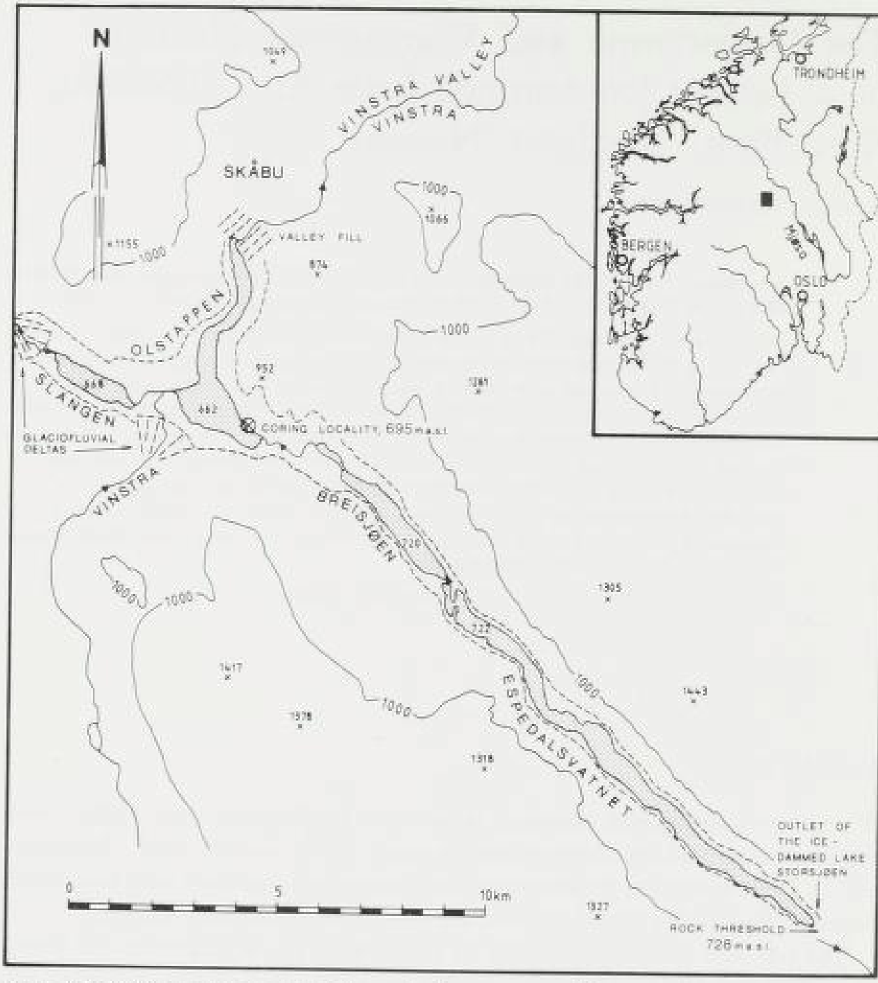

Fig. 1. Map of the ice lake area of the Vinstra drainage system, with present-day drainage direction (dark arrows) and lakes. During the existence of 'Storsjøen' ice lake, glaciofluvial material accumulated in waters reaching the rock threshold to the southeast. The approximate outline of Storsjøen (ice remnants excluded) is indicated by the dashed line. The location of the area is shown on the index map of southern Norway.

method. The radiocarbon datings were carried out at the Radiological Dating Laboratory, University of Trondheim.

Lithostratigraphy

The coring locality is situated near the top of a small rocky headland (Fig. 1). Soundings showed the thickness of sediment in the bog to be about 5 m. Resting on bedrock there is one metre of coarse, minerogenic material, either till or glaciofluvial gravel, which is overlain by 1.7 m of glaciolacustrine silt. The piston corer penetrated only one metre of the silt, and consequently only this part is

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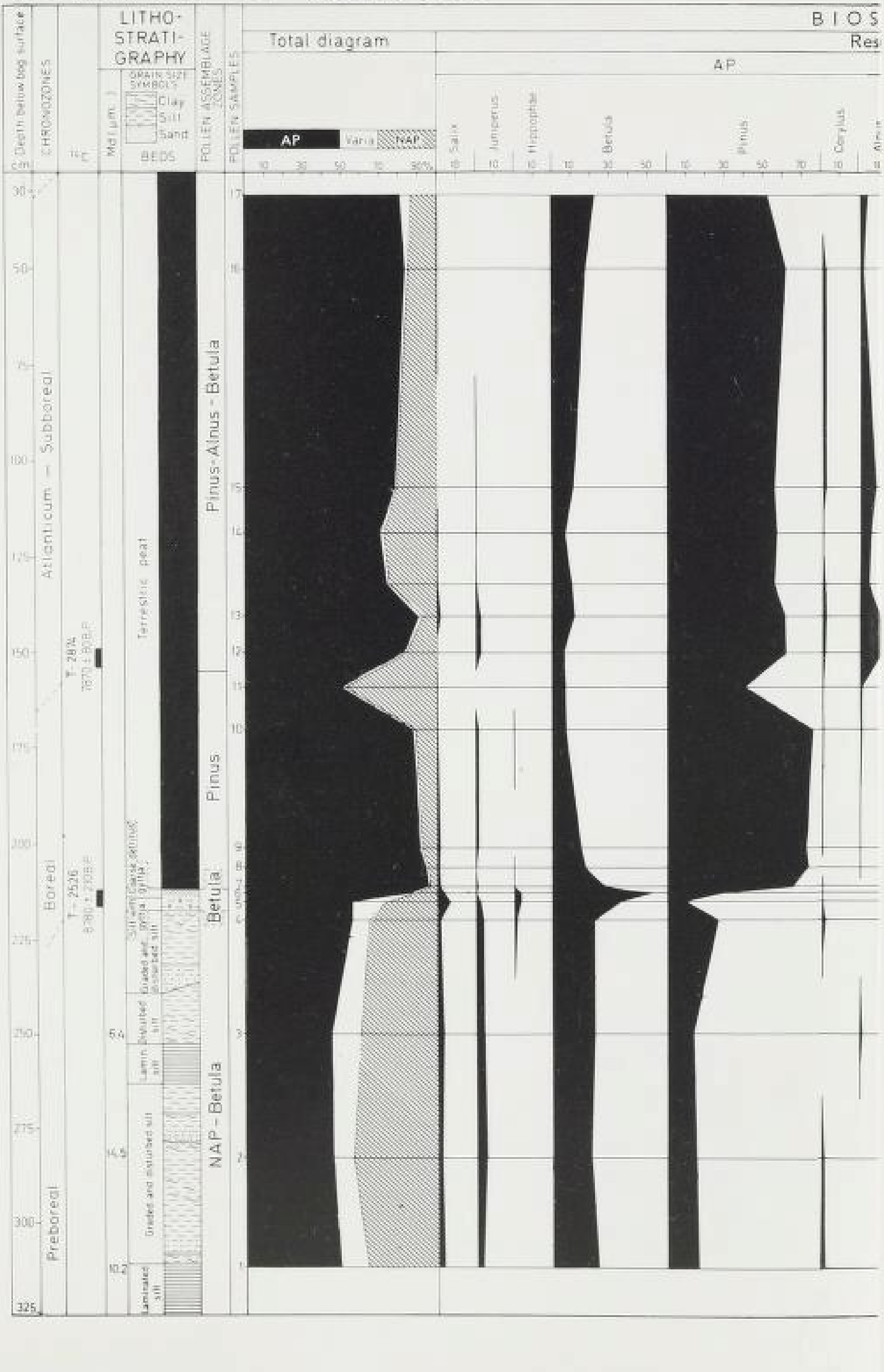

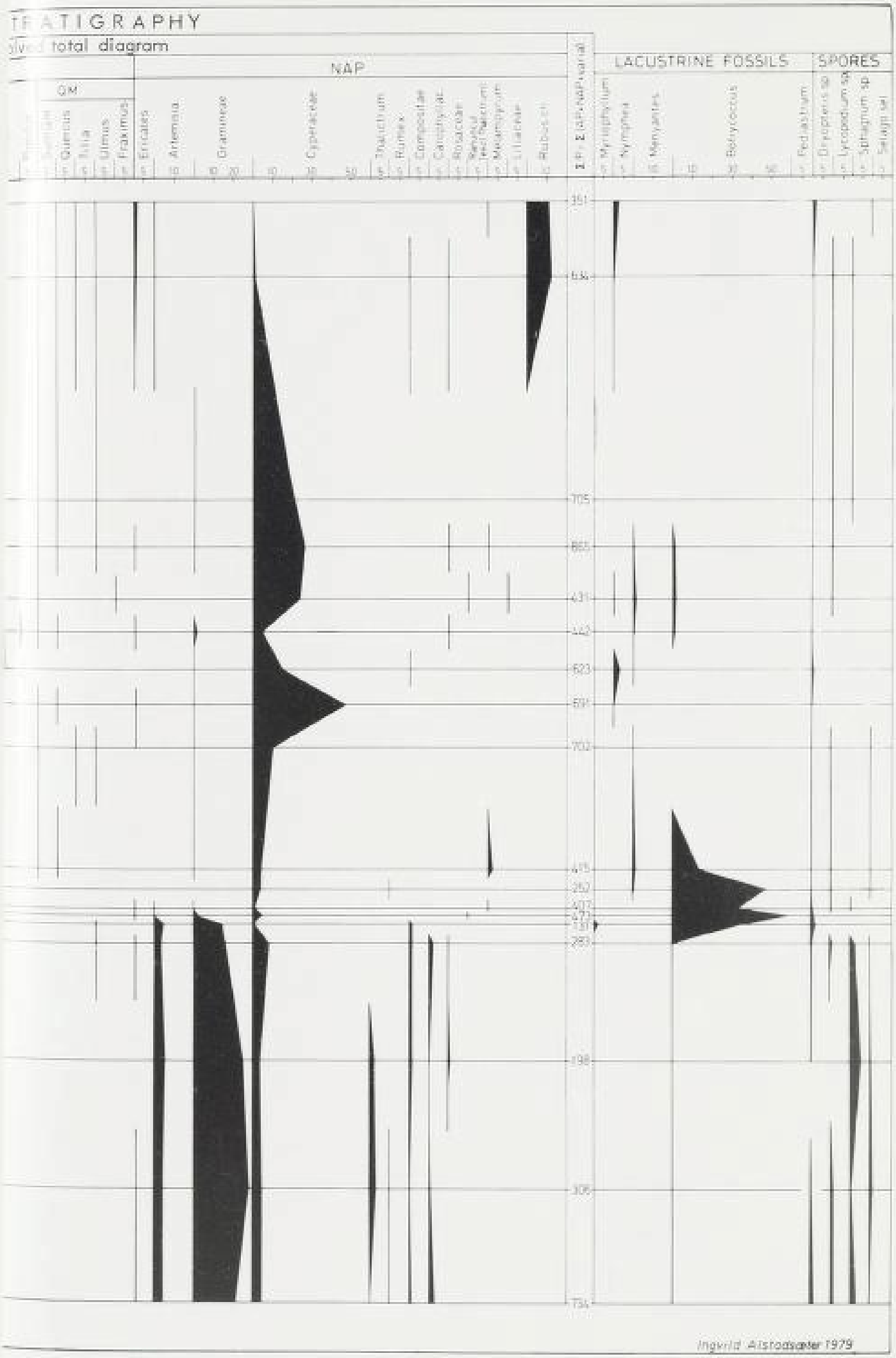
TRATIGRAPHY
total diagram
NAP
LACUSTRINE FOSSILS
SPORES
QM
Quercus
Tilia
Ulmus
Fraxinus
Ericales
Artemisia
Gramineae
Cyperaceae
Thalictrum
Rumex
Compositae
Caryophyl.
Rosaceae
Melampyrum
Liliaceae
Rubus
Myriophyllum
Nymphaea
Menyanthes
Botryococcus
Pediastrum
Dryopteris sp.
Lycopodium sp.
Sphagnum sp.
Selaginella
351
634
705
865
431
442
623
691
702
415
262
407
473
283
198
306
734
Ingvild Alsrodsæter 1979

recorded in Fig. 2. Above the silt is 5 cm of silty gyttja, and a 5 cm zone of coarse gyttja with 2.1 m of peat on top. The bog basin has been completely filled in.

The glaciolacustrine silt consists of regularly repeated thin graded bedding, and therefore appears laminated. Grain size distributions (Fig. 2) gave an Md in the middle silt fraction. About 10 clayey laminations were found in the sequence. At irregular intervals 4 prominently graded beds were passing from sandy to clayey silt. These particular beds contain both the coarsest and the finest material in the core. At least one of these layers rests on an erosional surface.

The very limited drainage area of the small depression, with no brooks leading into the bog basin, points to the deposition of the thick glaciolacustrine silt unit in a larger lake, presumably the ice-dammed Storsjøen. The sandy-clayey silt beds could have been deposited by turbidity currents, triggered e.g. by spring floods. The repeated graded laminae may reflect some rhytmical change in discharge during the ablation season. None of the beds or laminae can be proved to represent annual varves, even though some of them probably are.

The silty gyttja was probably deposited by a redeposition of silt while a small lake or pond occupied the basin. The conditions of sedimentation soon stabilized, with very low input of minerogenic material, during which time the coarse detritus gyttja was deposited. As the lake became shallower peat started to accumulate.

Biostratigraphy and chronostratigraphy

The pollen sequence (Fig. 2) is subdivided into biostratigraphic assemblage zones, as outlined by Fægri & Iversen (1975). The chronozones are according to Mangerud et al. (1974). In this context, the two oldest pollen zones are of special interest; however, a few comments are also given on the younger zones.

1. NAP – Betula zone

This assemblage zone is restricted to the minerogenic part of the sediment sequence. The pollen from the silt were well preserved and devoid of corrosion. The NAP is dominated by grasses and by Artemisia, and the open vegetation indicates that the zone was deposited during or soon after the deglaciation. The very minor changes in pollen composition within the zone may indicate that the assemblage was deposited during a very short time interval.

2. Betula zone

The Betula zone has a vertical extent of about 10 cm at the contact between the silt and the organic sediment. It is characterized by a rapid rise in the Betula curve and corresponding decline in the NAP constituents. Hippophäe has a distinct maximum within the zone.

A sample covering most of the zone was radiocarbon dated at 8780 ± 210 yrs B.P. (T–2525) on the NaOH-insoluble fraction of the gyttja. A sample from another core at the same level yielded $9080 \pm$ yrs B.P. (T–2875) on the NaOH-soluble fraction.

Moe (1979) reported a short Betula-Hippophäe phase, similar to the one described in this paper, characteristic of the oldest organic sediment of the Hardangervidda mountain plateau. There, the deglaciation is dated at 8900–9000 B.P., which is approximately the same age as that obtained in the present investigation.

The light-demanding Hippophäe probably thrived on exposed lake bottoms and along the earth slides of the Vinstra valley fill, while being 'shadowed' out by birch on more stable ground. The birch itself was soon overtaken by the pine forests of the next zone.

3. Pinus zone

Pinus expanded rapidly and reached very high percentages just above the dated level. The pine must have constituted the main element in the forest vegetation from the early Boreal Chronozone. This implies that the bio- and chronostratigraphic zones were more or less coincident.

4. Pinus–Alnus-Betula zone

The Alnus Rise at the bottom of this zone was radiocarbon dated at 7878 ± 80 yrs B.P. (T–2874), which is the early Atlanticum Chronozone. The Q.M. constituents have been recorded only sporadically, as could be expected at this altitude. The dating of the Alnus Rise, which probably reflects the time of migration, corresponds well with the nearest lowland sites in eastern Norway (Henningsmoen 1975). Within this central area it might be taken as a fairly constant level.

The increase of Rubus ch. and decline in Cyperaceae in the upper part of the peat show a development towards the present vegetation on the bog surface. The diagram (Fig. 2) is not intended to cover the last part of the Holocene sequence.

Conclusions

The dated coarse gyttja and the terrestric peat show that the ice-dammed lake was drained before the early Boreal Chronozone. This dating indicates that the valley fill at Skåbu could not have dammed Storsjøen after the disappearance of the ice, and the existence of lake Storsjøen was thus entirely dependant on the presence of an ice dam.

The Storsjøen ice lake was situated between the main watershed and the vertically downwasting ice remnants (Garnes & Bergersen 1980). In these central parts of southern Norway the deglaciation and drainage patterns have mainly been investigated by the abundant geomorphological features rather than by stratigraphy. The dates from Skåbu indicate that stratigraphical investigations could also provide significant contributions, not least from the many sites with ice-dammed lake sediments in eastern Norway. It consequently provides a possible link between the dates from the frontal ice-recession of west Norwegian fjords (see review in Andersen 1980) and eastern Norway (Sørensen 1979), and the inland area of downwasting ice.

The vegetational succession of forest elements corresponds well with that from the nearest lowland sites in eastern Norway (Hafsten 1974, Henningsmoen 1975). Pine forests were establishes after a comparatively short-lived Betula zone. This development, and the Alnus Rise, are elements recognizable even in the mountain valley districts.

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