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Late Holocene distribution of lake sediment and peat in NE Uppland, Sweden

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Abstract

This report is part of a larger project conducted by SKB. The aim is to carry out investigations of eight lakes and one bog, with respect to stratigraphic and geographic distribution of sediment and peat. More than 150 corings were made with a Russian peat sampler. The bog was investigated regarding its isolation from the Baltic basin. This site is included in the shore displacement model elaborated from other sites situated at the same isobase for the Litorina Sea.

Northern Uppland is an area with a smooth topography, which also affects the lake basins. The water depth is generally shallow, 1–3 metres. The bedrock mainly consists of granitoides. A few areas consist of metavolcanics, younger granites and pegmatites. The Quaternary deposits in Uppland are more or less calcareous, which is reflected in the rich flora with *e.g.* orchids and saw grass. Till is the most common deposit in the area covering considerable areas but rarely forming geomorphological features. Glaciofluvial deposits *i.e.* eskers, stretches in more or less S-N direction, being generally small.
In northern Uppland, large areas are covered by mires. Most of them are affected by human activities in the form of ditching; some are used for cultivation or as pastureland.

One site, Vissomossen, with a levelled isolation threshold at 27.4 m a.s.l., is mainly a fen, with a bog developing in the central part. Diatom analyses and AMS dates show that the basin was earlier a bay of the Litorina Sea and isolated 3500–3600 ^{14}C years BP. The former lake basin was as large as the present extension of the mire. Accumulated material reveals that the lake during time has been filled in with sediment, overgrown and finally forming a mire.

The result of the present study is summarized as an extended shore displacement model for northern Uppland, and it reflects an ongoing regression in the area. A decline in regression can be compared with the Litorina transgression 3 (L3), which in the Stockholm area is dated to about 4500 ^{14}C years BP.

The Lakes Barsjö, Landholmssjön, Skälsjön, N. Åsjön, S. Åsjön, Eckarfjärden and Fiskarfjärden, located at elevations between 23 and 0 m a.s.l., are all shallow with a water depth < 2 m. An exception is Lake Limmaren with a maximum water depth of 6.5 m. The lakes are more or less covered by large reed belts and in many of them small islands and/or boulders protrude above the water surface. A typical sequence consists of, from bottom and up, glacial and postglacial clay, silt and sand, clay gyttja/gyttja clay and gyttja. In general the sediment thicknesses are rather thin. Despite the occurrence of calcareous material in the surrounding deposits, only two of the lakes display accumulation of calcareous gyttja.

Sammanfattning

Ett slutförvar för radioaktivt avfall kommer att existera i 10 000-tals år. För att kunna avgöra var radionuklider kan hamna vid ett eventuellt läckage behövs en förståelse för hur sediment förflyttas och ackumuleras samt hur sjöar bildas och växer igen. Detta arbete avser att ge underlag för hur bassänger i nordöstra Uppland har fyllts med sediment samt hur strandförskjutningen har påverkat detta förlopp. Den geografiska distributionen av sediment och torv är då viktig för att förutse var partiklar kan ackumuleras. Sammanlagt har åtta sjöar och en mosse undersökts i fält för klassificering och mätning av sedimentmäktigheter.

Lars Brydsten, Umeå Universitet, har tagit fram en GIS modell, som visar hur finkorniga sediment och organogent material har ackumulerats under postglacial tid, beroende på terrängtopografi och vågverkan. Denna modell ligger till grund för att förutse hur sediment och torv kommer att anhopas i framtiden ovanför slutförvaringsutrymmet vid Forsmark, allteftersom den isostatiska höjningen av berggrunden gör att allt större landytor växer fram.

Undersökningarna av Vissomossens stratigrafi, både i fält och i laboratorium, visar utvecklingen från en vik i Litorina havet, som sedan avsnördes till en sötvattenbassäng, och som slutligen blev en typisk igenväxningstorvmark med både kärr- och mosspartier. Diatoméanalysen visar en snabb och distinkt isolering av fornsjön. Avvägningen av pasströskeln visar en topografiskt komplicerad bild, då området är mycket flackt. Den troliga isoleringströskeln bör ligga ca 27,4 m ö h.

Fem bulkprover bestående av gyttja daterades med AMS ^{14}C-datering. Dessa visar att fornsjöns isolering från havet bör ha ägt rum ca 3500–3600 ^{14}C år BP. Denna ålder och tröskelnivå (27,4 m ö h) infogades i en tidigare framtagen strandförskjutningsmodell över norra Uppland. Den extrapolerade strandförskjutningsmodellen för området speglar en pågående regression, som tidvis har minskat i hastighet. Avstannandet i regressionshastighet kan jämföras med Litorinatransgression 3 (L3) som ses i Stockholmsregionen ca 4500 ^{14}C år BP.

Undersökningarna i fält visar en generell bild av sjöarna i Uppland som mycket grunda. Alla sjöar är mer eller mindre starkt antropogent påverkade genom dikningar, sänkningar osv.

Tunna lager av sediment avsatta före isoleringen tyder på att området har utsatts för erosion. Alggyttja återfanns i hälften av de undersökta lokalerna. Några av sjöarna ligger i mycket kalkrika berggrunds- och jordartsområden, vilket speglas i sedimentationen av kalkgyttja, i Barsjö och Eckarfjärden, i övriga sjöar återfanns förvånansvärt lite kalkhaltiga sediment bortsett från den glaciala leran, som till mycket stor del är kalkhaltig.

En generell lagerföljd nerifrån och upp, består av glacial och postglacial lera, silt och sand, lergyttja/gyttjelera och gyttja.

Contents

1 Introduction

The Swedish Nuclear Fuel and Waste Management Company (SKB) plan to store highly radioactive waste in a rock repository 500 m below present sea level, close to Forsmark in northeastern Uppland. Therefore, SKB has set up a programme to describe and predict how radioactive nucleids might be transported and spread to the biosphere in case of a future accidental leakage. Knowledge of the geographical and stratigraphical distribution of sediment and peat is important for predicting where the nucleid particles could accumulate.

Lars Brydsten, Umeå University, has presented a GIS model, which shows how fine grained sediments and organic material have accumulated in the area during post-glacial time (Brydsten, 1999). The model also predicts how sediment and peat will accumulate above the terminal storage site in the future. This depends on the topography of the terrain, wave action and wave fetch. These processes are, in turn, highly dependent on the speed and manner of the isostatic rebound of the bedrock, which causes the present land area to increase in size.

This work mainly concerns the Quaternary geology and evolution of the area during late Holocene *i.e.* the development of lakes and bogs and the accumulation of sediment and peat in an area of isostatic land uplift. The investigated sites are located within the Quaternary maps published by Persson (1984, 1985, 1986, 1997).

The aims of this investigation are:

1) To present detailed information on the geographical and stratigraphical distribution of sediment and peat in the field area of the GIS model constructed by Lars Brydsten.

2) To contribute one site for extension of the existing shore displacement model for northern Uppland.

The selection of localities (Figure 1) for the investigation was made to fulfil the following criteria: spread in altitude (m a.s.l.), distribution regarding variations in calcareous substrate, lake size, geographical position and possibilities for future levelling of isolation threshold.

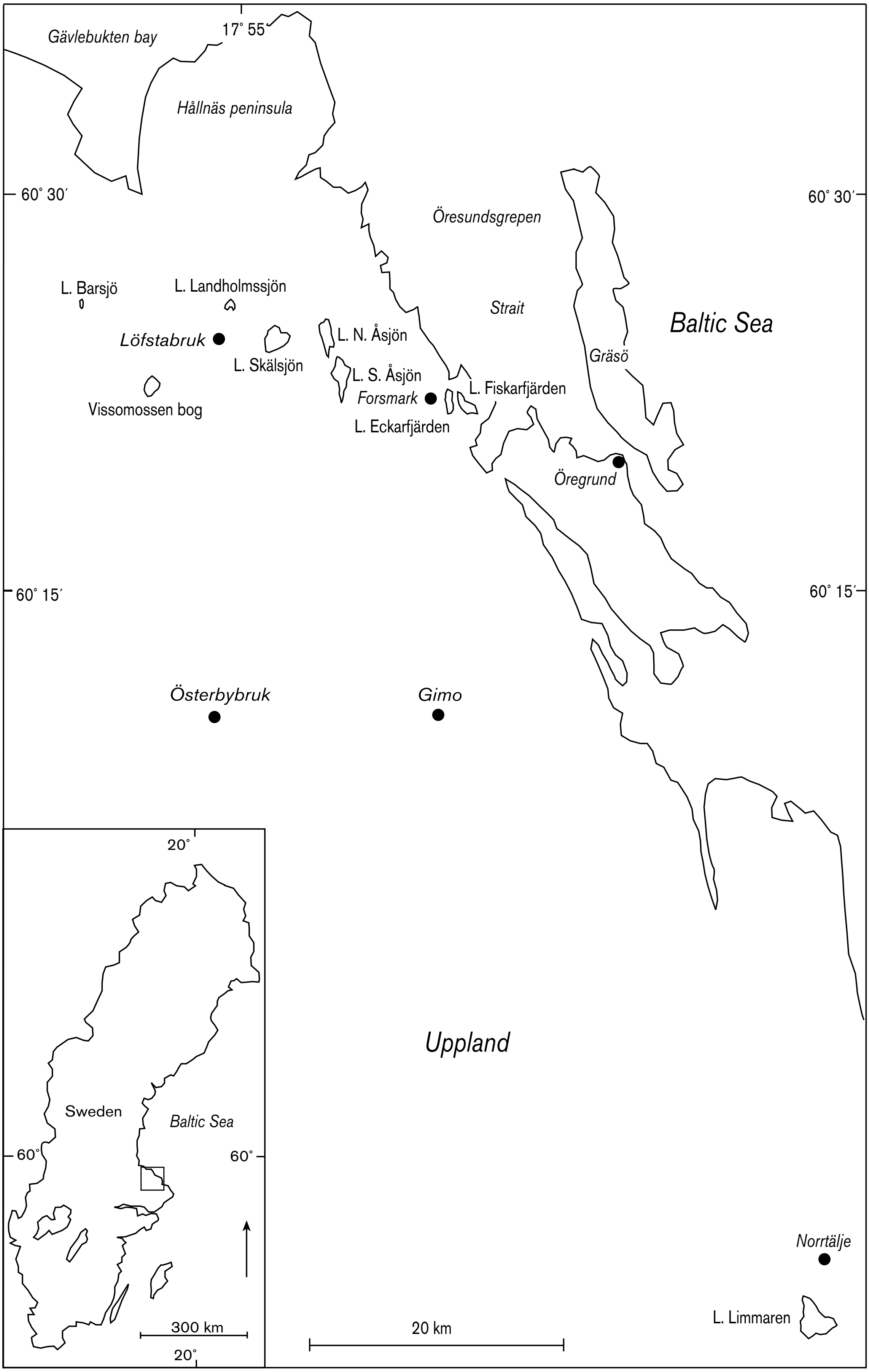

Figure 1. *Location of the investigated bog and lakes in the province of northeastern Uppland, Sweden.*

2 Topography, Quaternary deposits and shore displacement

Northern Uppland is part of an almost flat peneplain with only small variations in topography; the relative height is less than 30 m. The entire area lies below the highest coastline, developed after the Weichselian deglaciation, which is situated at 150 m a.s.l. Uppland is part of a fissure valley landscape, which dominates large areas in south-central Sweden. Also the lake basins are affected by the smooth topography. The investigated lakes are shallow. In general, the water depth is 1–3 metres but it can vary between 0.8 and 6.5 metres. Many of the former lakes are today filled with sediments and are now overgrown mires, *i.e.* fens and bogs.

The bedrock in the area mainly consists of granitoids, massive in extensive areas. A few areas consist of metavolcanics, such as leptite gneiss and leptite. Near Lake Barsjö and Vissomossen bog younger granites and pegmatites occur. In the western part of Uppland only small areas are outcropping, in the eastern part the areas of exposed bedrock increase.

Parts of Uppland are known for their calcareous soils (Ingmar & Moreborg, 1976). This is reflected in vegetation favoured by calcareuos soils, *e.g.* orchids and saw grass. The ordovician limestone originates from the southern part of the Gulf of Bottnia and Gävlebukten bay (Figure 1, *cf.* Strömberg, 1989). During the Weichselian Ice age, large amounts of limestone were transported long distances before deposition. During transport the limestone was crushed and mixed with other bedrock material, which build up the matrix of the tills. The amount of limestone in the soils varies locally in the area (Ingmar & Moreberg, 1976, Persson, 1992). The island of Gräsö and the Hållnäs peninsula display large amounts of limestone in the soils (20–40%). Other parts, such as the area around Forsmark nuclear power station and the northwestern part of Uppland, have less than 10% calcareous material in the soils (Persson, 1984, 1985, 1986, 1997).

Sandy-silty till is the dominating deposit and covers considerable areas. The till rarely forms surface patterns, but occur as a more or less even veneer. The thickness varies between 0.5 and 16 m but is usually less than 5 m. Compared to other nearby areas, till and other accumulations are rather thin. During the postglacial regressive shore displacement, large amounts of fine-grained sediment have been washed into the Baltic Sea. Therefore, the sediments in northeastern Uppland mainly consist of thin coarse-grained deposits.

Several large eskers stretch through the landscape of south and central Uppland, mainly in a N-S direction, the largest being Uppsalaåsen. In northeastern Uppland, the eskers are generally few and small. Zones of re-worked, sorted material, silt and sand, often follow the eskers (Persson, 1984, 1985, 1986, 1997, Ranheden, 1989).

Mainly, the glacial fine-grained sediment consist of occasionally exposed clay. The glacial varved clay is beige-reddish and calcareous, usually 15–30% $CaCO_3$. The amount of limestone is generally restricted to the lighter and somewhat coarser summer layers. The thickness of the glacial clay varies between 0.5 and 5 metres. The postglacial clay constitutes redeposited glacial clay and other fine-grained sediment. The colour is usually grey to bluish grey, often stained by sulphide precipitation and without calcareous matter. Postglacial clay is deposited in larger depressions and valleys.

Mires *i.e.* fens and bogs, cover large parts of northern Uppland. One of the largest complex is the nature reserve Florarna (Ingmar, 1963). During several thousands of years, the regressive shore displacement has caused former bays and inlets to close and form small freshwater lake basins. The lakes in the investigated area are nearly always surrounded by fens, a phase of the natural succession which converts lakes further to mires. Many mires are affected by ditching and some are used for cultivation and cattle breeding.

The catchment areas of the investigated lakes are dominated by forest. If the lakes have not been subject to drainage projects, both in- and outflow of water is diffuse. The investigated lakes in the area, except Lake Limmaren, are part of the SMHI (Swedish Meteorological and Hydrological Institute) catchments 54/55 and 55. Some of the lakes have been characterised as oligotrophic hardwater lakes, poor in nutrients with the exception of calcium (Brunberg & Blomqvist, 1997, 1999).

The combined changes in sea level, transgressions and regressions, as well as isostatic land uplift, are visualised in shore displacement models. The intensity of isostatic uplift varies in different parts of Sweden. The general trend is an increase towards the north with a maximum in Ångermanland. In northern Uppland, the uplift has been relatively rapid. Elevation of the investigated area took place as a result of the isostatic uplift when the pressure from the melting ice sheet disappeared. This process is still in progress and today, the relative uplift in this area is about 6 mm per year (Miller & Hedin 1988, Ekman 1996).

In the Stockholm region, four transgressive phases (L1–L4) of the Litorina Sea has been detected (Miller & Robertsson, 1981, Miller in Brunnberg *et al.*, 1985, Miller & Hedin, 1988, Risberg, 1991, Åse, 1994). Since isostatic rebound is faster in northern Uppland, the Litorina transgression 3 (L3), about 4500 ^{14}C BP correspond to a decrease in the regression rate (Risberg, 1999).

The isolation of a former bay to a freshwater basin can bee traced by diatom analysis as a change in salinity from brackish to freshwater. Sub-samples are taken and dated by AMS radiocarbon dating for an approximation of the age of the isolation event. To evaluate the dates in detail, knowledge about the reservoir effect is needed (Olsson, 1991, Miller & Hedin 1988, Risberg, 1991). For dates made on bulk samples collected in large basins, this error could be in the order of several hundreds of years. For material from small and shallow basins, the error could in most cases be neglected. The isolation threshold is levelled, *i.e.* the altitude where the sea was in contact with the basin just before its final isolation.

Different investigations have been published concerning various aspects of landscape history in central and northern Uppland. Ranheden (1989) describes the human impact and vegetation history in an area of sub-recent land uplift. Tord Ingmar has made thoroughly investigations of Florarna for several years (Ingmar, 1963). Limnological aspects concerning lakes and streams in Uppland have been published by Brunberg & Blomqvist (1997) and biostratigraphical studies of three mires in northern Uppland have been published by Robertsson & Persson (1989). An archaeological investigation on Neolithic, coastal settlement sites at the Bälinge bogs in Uppland has been published by Segerberg (1999). In this work, Risberg (1999) have put together a shore displacement model for northern Uppland including sites from Robertsson & Persson (1989). This model is now being extended with results from the site Vissomossen bog.

3 Sediment and peat – basic characteristics

Sediment consists of both organic and inorganic particles. The inorganic particles derive from bedrock and soil, which through weathering and transport are deposited in rivers, lakes and seas. The organic particles derive from decomposed plants and animals. Variation in sedimentation depends on different factors *e.g.* climate, primary production, erosion and currents. Knowledge about the future sediment types that will accumulate above the repository is crucial for interpretation of the spreading of eventual nucleids in the sediment. Generally, coarse grained, inorganic material with a high permeability will allow an efficient transportation, while fine-grained, highly decomposed organic material will to a large extent bind the nucleids.

3.1 Marine/brackish sediment

During the Litorina Sea, the soil surfaces in the area have been wave washed resulting in a coarsening of the till and a reduction in thickness of fine grained sediment. The fine fraction has been transported into deeper areas and accumulated where calm conditions prevailed. During this process, organic material might be incorporated resulting in gyttja clay (2–6% humic matter) and clay gyttja (6–20%). Due to the regressive shore displacement, these processes have been repeated several times during the Holocene.

3.2 Lake sediment

Most of the Swedish lake basins were formed during the latest glaciation, *i.e.* the Weichselian. Since then new lakes and mires form along the coastal areas as land rise above the Baltic Sea.

In connection with the deglaciation, fine material was transported by rivers of melt-water to ice-dammed lakes and accumulated on the lake floor. These accumulations are often laminated. Dark thin layers were formed during winter when the energy from waves and currents in the water was low, while the coarser lighter layers were accumulated during summer when the energy in the water was high because of the large amounts of melt-water from the ice.

Several factors regulate and are important for the rate of lacustrine sedimentation *i.e.* sediment influx, lake size, hydro-dynamics, topography, deposition, erosion, transport, wave action and currents.

The sedimentation depends on allochtonous influences from the inlets of the lake as well as the degree of autochtonous production, *i.e.* the production of material within the lake. The volume of clastic grains and the composition of minerals derived from land depend on several complex factors as hinterland geology, relief, climate, vegetation cover, drainage and basin size (Håkansson, 1981, Leeder, 1985, Pye, 1994).

The degree of sedimentation varies between different areas in a lake and it is dependent on the dynamic conditions of the lake floor, *i.e.* the distribution of depositional areas.

In the erosive zone of the lake, coarse-grained sediment such as boulders, gravel and sand accumulates.

The transportation area, with a discontinuous deposition, lies in the deeper parts of the lake basin. Here, sandy silt and clay accumulates. Periods of accumulation, often occurring during winter and summer, are interrupted by short periods of resuspension or erosion. Redeposition depends on currents, bio-turbation (digging animals) and the inclination of the lake bottom. An inclination of > 4% increases the rate of redeposition of the sediment (Håkansson, 1981).

The accumulation area of the lake lies in the deepest parts where the accumulation of fine-grained sediment is continuous. Fine sediment (silt) and very fine sediment (clay) accumulate in this area (Håkansson & Jansson, 1983).

The amount of organic carbon in lake sediment is dependent on the biogenic productivity in the water column (autochtonous) and the supply of organic material from the terrestrial surroundings (allochtonous). In general, if the plant-inhabited zone near the shore is broader, the shallower the lake is (Reineck & Singh, 1980, Håkansson & Jansson, 1983, Ranheden, 1989). Colonization by aquatic plants reduces the bottom currents, which often results in increased accumulation of sediment (Brunberg & Blomqvist, 1999).

Carbonate in sediment, as well as other inorganic particles, originates from the erosion of bedrock and soil in the surroundings of a lake. Because of leaching of the soils, the lakes will in due time become less exposed to carbonate (Håkansson & Jansson, 1983, Ranheden, 1989). As a result, older sediment contains more carbonates than younger. Humic acids from mires dissolve carbonates or prevent it from precipitate (Lundqvist, 1942). Since northern Uppland is covered by extensive areas of peat, it is possible that this process could explain the lack of carbonate in younger sediment.

The relationship between effective fetch and water depth decides, for lakes larger than 1 km^2, the lake floor dynamics and consequently the range of depositional areas at the bottom (Håkansson, 1981). The more supply of detrital material, the higher depositional rate. Swedish lakes are, in general, eutrophic with sedimentation of gyttja. A common rate of sedimentation is 2 mm/year (Kukal, 1971).

Directly after the formation of a lake, it will begin to fill up with material that have been transported by feeder streams. Water regulations and the use of fertilisers have resulted in an enhanced inflow of organic material and an accelerating overgrowth of basins. This will lead to a lack of oxygen in bottom waters. Low oxygen levels slow down the degradation process of organic material, which means an increase in the rate of accumulation (Brunberg & Blomqvist, 1997). Since many of the lakes in northeastern Uppland are both shallow and affected by anthropogenic activities they are most likely to be filled in with sediment rather fast and transferred into mires.

Clay and gyttja deposit in areas where water turbulence is low. Gyttja clay accumulates in bays when the isolation event of a lake basin is in progress. After this process, clay gyttja deposit in the newly isolated, freshwater basin (Lundqvist, 1942).

Gyttja accumulates in open water and consists of more or less fine remnants (detritus) of weeds, plants, algae, plankton and other organisms. Gyttja is common in all types of lakes, oligotrophic as well as eutrophic ones, where the organic productivity is high. The content of humic matter is more than 20%. In this investigation, the gyttja deposits are rich in algae causing a characteristic consistency.

3.3 Fens and bogs

In Scandinavia, mires cover extensive land areas. Excluding human impact, the formation of peat can be regarded as one of the most important factors, which have altered the terrestrial environment in this region since the latest glaciation (Korhola, 1992).

According to a classification system developed by Granlund and von Post (1926), soils are divided according to their different ways of deposition. Material is classified as sedentary (autochtone), when it accumulates *in situ*, *e.g.* peat. Sedimentary (allochtone) material, *e.g.* gyttja, has been transported prior to sedimentation. Peat is defined as unconsolidated material consisting of semi-carbonised plant remains accumulated in a water-saturated environment.

Formation of mires are common in the investigated area. They cover former overgrown lake basins and surround basins with open water. Mires are separated into fens and bogs, depending on the ground water situation, pH, access of nutrients and plant community. Fens represent a phase of the lake ontogeny before forming a bog. The mires in the area are of a mixed character of pine bogs, poor fens, rich fens and extremely rich fens (Brunberg & Blomqvist, 1999). The rich and extremely rich fens are favoured by the calcareous soils in the area, which is seen as an abundance of orchids and saw grass. The Stormossarna mire near Lake Norra Åsjön is considered to be a rich fen, as is the mire surrounding Lake Barsjö. Many of the mires, especially on the Hållnäs peninsula, are rich in carbonates, especially in their younger phases of succession (Ranheden, 1989).

The telmatic zone is defined as the area of the shore, which is periodically covered by water. Plants like *Carex*, *Cladium* and *Equisetum* thrive and are often forming extensive peat accumulations. In the terrestric zone, the ground surface is sometimes covered by water. In this environment trees like birch and alder grow. Depending on the local conditions, bog peat of *Sphagnum* or fen wood peat accumulates.

A raised bog ecosystem is the final succession of lake ontogeny and represents an autonomous hydrological system exclusively fed by precipitation. The vegetation on a raised bog consists of moss peat (*Sphagnum*), which serves as a cation exchanger for water entering the mire as precipitation (Brunberg & Blomqvist, 1999).

Humus is formed when organic matter decomposes and consists of a complex mixture of organic acids. The surface area per unit mass of clay and humus is very high because of the small size of the individual particles. The specific surface (m^2/g) increase with decreased grain size. The high specific surface is of major importance for the ability of binding some nuclides spread during an accidental leakage (Wiklander, 1976, Brady, 1990). As long as the peat is not cut due to quarrying, areas covered by mires can theoretically bind leaking nuclides for a long time period.

4 Field methods

Corings

The choice of coring sites was made to achieve as high a representativity as possible for sediment and peat accumulations in the investigated lakes and the bog (*cf.* Karlsson & Risberg, 1998). At all sites, except for Lake Barsjö, two cross-sections were made to cover representative parts of the studied basins.

Lithostratigraphy of the lakes and the bog were obtained by a Russian peat sampler (5 cm diameter and 100 cm length). Samples from the bog were obtained by a Russian peat sampler with a diameter of 10 cm and a length of 70 cm. For practical reasons, the lake investigations were made from the ice during winter. The corings in the bog Vissomossen were made during autumn and spring.

Isolation threshold levelling

The purpose of the levelling is to locate the highest topographical point where the former connection with the Baltic basin took place. Due to erosion, this point does not exist today. Therefore, levelling along the recent outlet gives indication of where to locate this area (*cf.* Risberg, 1989). No levelling perpendicular to the outlet was performed. This is motivated by the flat surface giving little additional information to the levelling along the outlet. Since organic soils have accumulated after the isolation event, they were excluded when levelling.

A benchmark at 30.46 m a.s.l., in the Swedish height system RH 70, was used for comparison. A possible outlet, nowadays ditched, in the southern part of Vissomossen bog was dispatched after thorough investigations both on maps and in the field.

5 Laboratory methods

The below described laboratory methods were applied only on material collected from the Vissomossen bog.

Diatom analysis

Diatoms are microscopic algae (*c.* 0.01–0.1 mm), with siliceous frustules consisting of biogenic silica, SiO_2. They thrive in wet and humid environments such as lakes, ponds and rivers. The composition of a diatom flora is dependent on several factors, *e.g.* salinity, pH, depth, light, nutrient status and currents. The frustules are resistant and often preserved in sediment, which makes them useful for biostratigraphical and palaeoecological investigations (Birks & Birks, 1980, Miller, 1984, Battarbee, 1986, Miller & Florin, 1989).

Slices of 1 cm thick sediment were preparated according to the method described by Battarbee (1986). Carbonates were dissolved using 10% HCl (hydrocloric acid). Organic material was oxidised by using 15% H_2O_2 (hydrogen peroxide). The diatom analysis was made under a microscope with x 1000 magnification and immersion oil.

At each level analysed, more than 300 diatom frustules were counted. The results are illustrated as separate curves for different salt-ecological groups: brackish (-marine), lagoonal, indifferent, halophilous and freshwater. Diatom analyses were carried out between 160–280 cm below surface. Identification and ecological classification of diatoms were made according to Cleve-Euler (1951–1955), Mölder & Tynni (1967–1973), Tynni (1975–1980), Krammer & Lange-Bertalot (1986, 1988, 1991a, 1991b), Snoeijs (ed. 1993), Snoeijs & Vilbaste (ed. 1994), Snoeijs & Potapova (ed. 1995), Snoeijs & Kasperoviciene, (ed. 1996), Snoeijs & Balashova, (ed. 1998) and Forsström (1999). The results were compiled in the computer program Tilia and the diagrams were drawn with Tilia graph.

Measurement of carbon content

The content of organic carbon in the dried samples were measured in an Eltra, Metalyt 80W. The dried sediment was burned at 550°C under overpressure of oxygen, causing the organic content of the sample to produce CO_2. The carbon content was measured in an IR-detector and displayed as weight % of dry sample.

Measurement of water content

The measurement of water content was made by weighing a moist sample before and after drying at 105°C overnight. The water content was calculated as the ratio between the sample weights before and after drying.

AMS carbon dating

Five radiocarbon AMS datings of samples from Vissomossen bog have been carried out at the Ångström Laboratory, Uppsala University using the tandem accelerator technique (Possnert, 1990). Caused by insufficient amounts of macrofossils, bulk samples were collected from the material sampled. Rootlets were removed under a stereo microscope. The samples were measured with respect to the soluble fraction (SOL). The five radiocarbon dates have been calibrated in order to get approximated calender years BP (Stuiver *et al.*, 1998).

6 Site descriptions

Locations and basin characteristics are shown in Table 1.

In general, the stratigraphy in the investigated area consist of, from bottom upwards, glacial and postglacial clay, silt and sand, clay gyttja/gyttja clay and gyttja. As deduced from the great variations in boundary appearances, periods with accumulation were frequently interrupted by periods of erosion, *i.e.* the formation of hiatuses. Gyttja deposits are often unconsolidated (Sw. ävja). The thickness of the gyttja layers varies from centimetres to over one metre, the average thickness is however between 30 and 50 cm.

Table 1. Information about the investigated sites: Numbers and information are taken from Brydsten, 1999, Brunberg & Blomqvist, 1997 and descriptions to the Quaternary maps Östhammar NV, Östhammar NO, Österlövsta SO/Grundkallen SV Österlövsta SV, Norrtälje NV (Persson, 1984, 1985, 1986, 1997).

Site	m a.s.l.	Latitude	Longitude	Max depth (m)	Average depth (m)	Length (m)	Width (m)	Area (km^2)	Turnover (days)
Vissomossen bog	27.5*	60°23′N	17°46′E	–	–	1500	1250	–	–
Lake Barsjö	23	60°27′N	17°39′E	1.0	0.9	125	50	–	–
Lake Land-holmssjön	16	60°26′N	17°51′E	2.6	1.5	430	270	0.07	58
Lake Skälsjön	13	60°24′N	17°56′E	1.6	0.8	2200	1400	1.83	14
Lake N. Åsjön	12	60°25′N	18°01′E	4.0	2.1	2890	1040	1.77	31
Lake S. Åsjön	12	60°23′N	18°03′E	3.8	2.3	2950	1550	1.98	28
Lake Eckarfjärden	4	60°22′N	18°12′E	2.6	1.5	870	410	0.23	383
Lake Limmaren	4	59°44′N	18°44′E	6.5	4.2	3400	2800	–	–
Lake Fiskarfjärden	> 0.5	60°22′N	18°13′E	2.0	0.7	1770	600	0.61	251

* Levelled mire surface.

6.1 Vissomossen bog (27.5 m)

The bog has been formed through the overgrowth of an ancient lake. The investigated area is about 1.5 x 1.2 km large. Vissomossen is partly a bog, partly a fen, located in a depression bordered by till to the east. Through the northern part of the bog a small feeding esker to Uppsalaåsen stretches in SW-NE direction. To the northeast, areas of glacial clay and sand border Vissomossen (Figure 2). The outlet flows towards the northeast. The bog is ditched to gain more arable land and large areas around the bog are cultivated or used as pasture for sheep. The vegetation on the bog mainly consists of *Sphagnum*, *Carex*, *Calluna* and *Pinus*. On the surfaces characterised as fens, the vegetation consists of *Pinus*, *Betula*, *Carex* and *Ledum palustre*. A characteristic feature for the lithology of Vissomossen bog is the relatively thick accumulations of algal gyttja with various colours (Figure 3 and Appendix 1).

The outlet flows through an area covered by sand and through till where the final isolation threshold is levelled. There are two possible isolation contacts, one at 27.4 and the other at 26.8 m a.s.l. (Figure 4). The sediment at the lowest threshold consist of, from bottom up, till, clay, sand and peat. The sediment have accumulated in the area before the isolation event of the basin from the Litorina Sea. The initial threshold cuts through the sand, which to some extent have been eroded by waves and currents. This shelter of sand made it possible for gyttja rich in algae, *e.g. Vaucheria*, to accumulate. The somewhat higher levelled isolation threshold cuts through till and is probably the final isolation threshold.

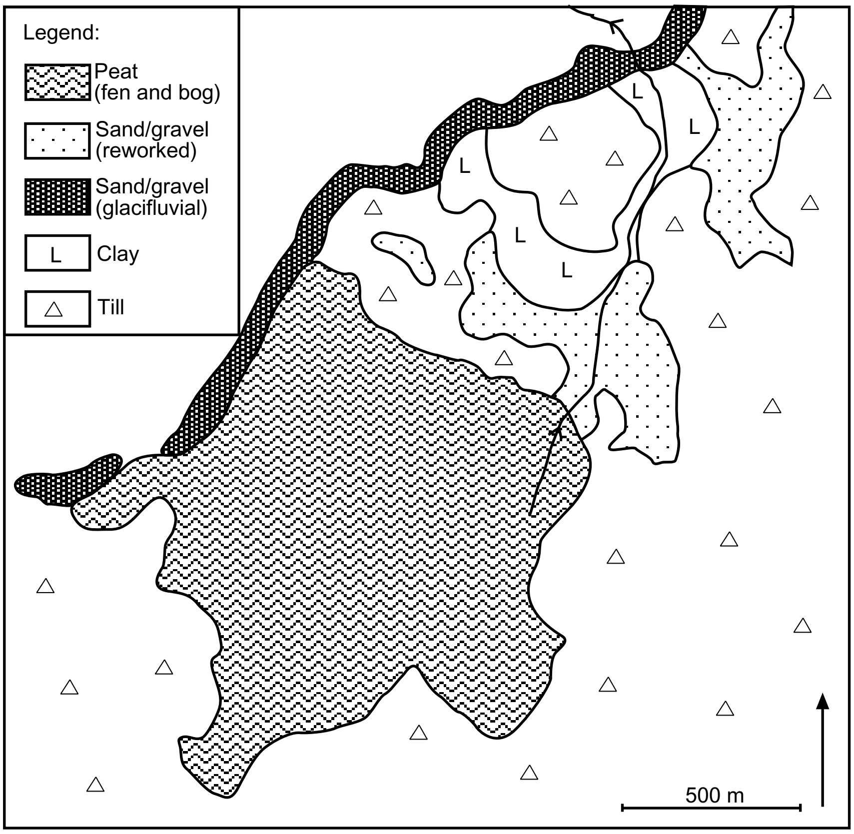

Figure 2. *The outlet and the most important Quaternary deposits surrounding the Vissomossen bog. Redrawn and simplified from Persson (1984).*

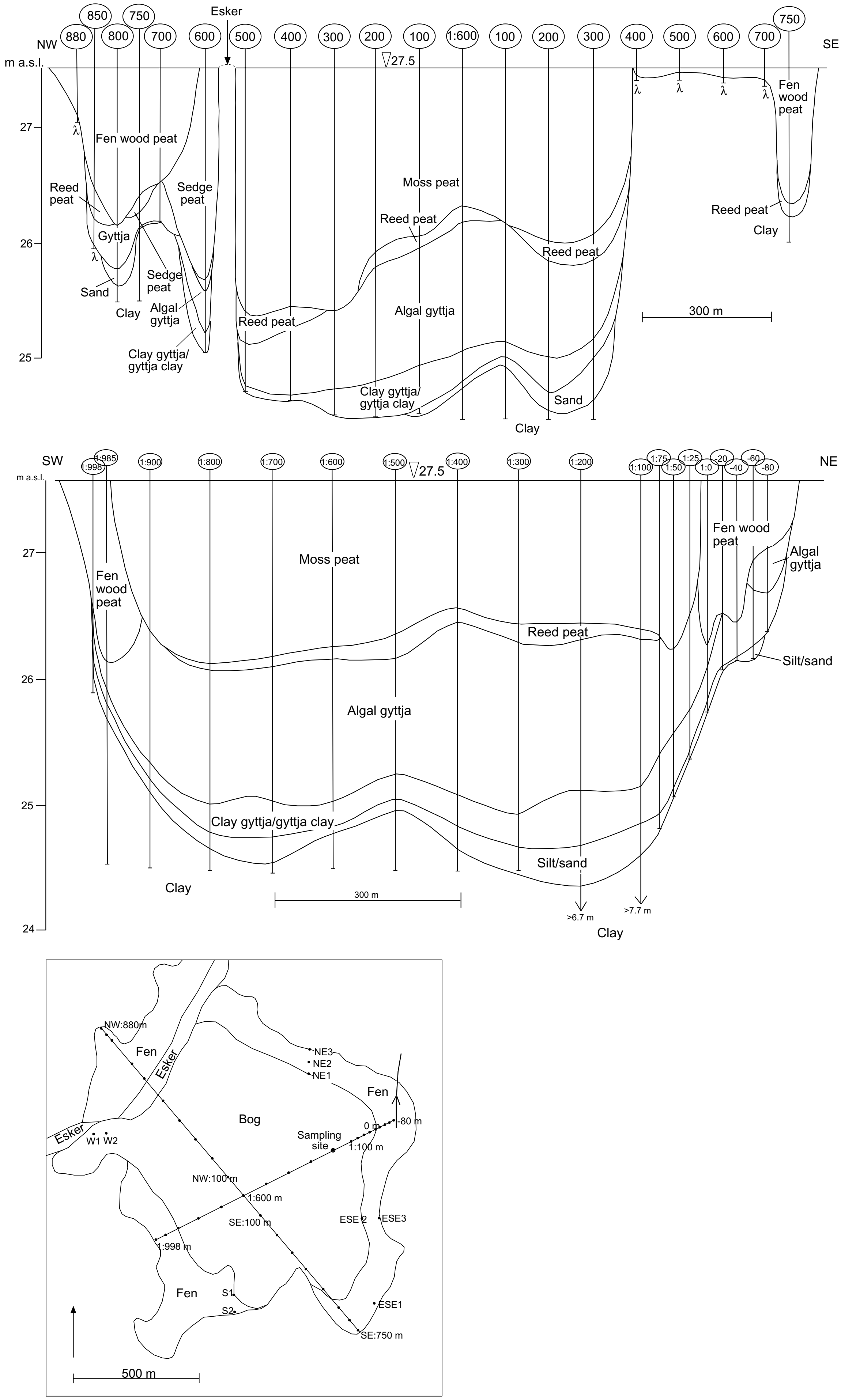

Figure 3. *Cross-sections of Vissomossen bog in NW-SE and SW-NE direction. The results from the field control of the corings are presented in the appendices and give more precise information.*

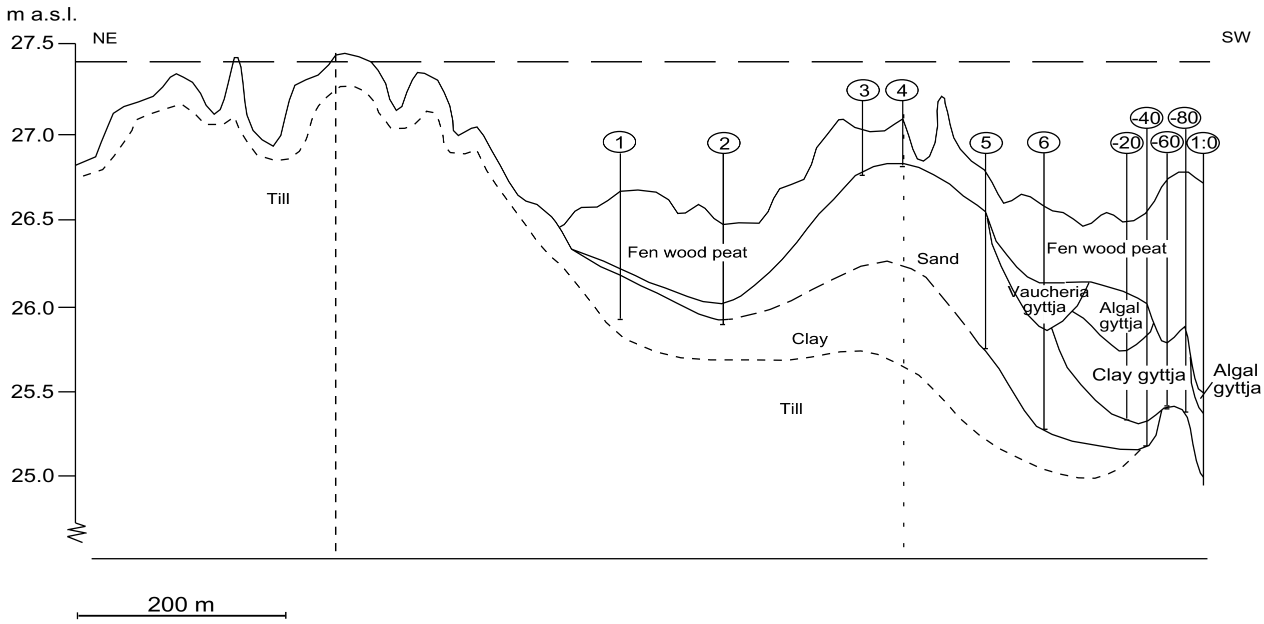

Figure 4. Cross-section of the isolation threshold level at 27.4 m a.s.l. at the Vissomossen bog. The isolation threshold cuts through till. A possible initial isolation threshold cuts through sand.

6.2 Lake Barsjö (23 m)

Lake Barsjö with an area of 125 x 50 m, is the oldest and most westerly situated lake. East of the lake, till covers a large area. West and north of the lake, large belts of reed grow in an elongated rich fen (Persson, 1986). In due time, the reed will spread and sediment will fill in the lake. The water depth is shallow, about 70–80 cm.

In Lake Barsjö, calcareous gyttja with a high content of mollusc shells have been found. The thickness of the calcareous gyttja is half a metre, and on top of it algal gyttja has accumulated. The accumulation of calcareous gyttja (Sw. bleke) reflects the locally high amounts of calcium in the soils *i.e.* till and glacial clay (Figure 5 and Appendix 2).

6.3 Lake Landholmssjön (16 m)

Lake Landholmssjön is situated 3.5 km north of Lövsta bruk. Till covered with forest occurs in an area east of the lake, while swamps cover large areas in the western, northern and southern side of the lake. Lake Landholmssjön is oligotrophic and has a moderate buffer capacity against acidification (Brunberg & Blomqvist, 1997). Like many lakes in northern Uppland, Lake Landholmssjön has been affected by anthropogenic activities. The surface has been lowered to gain more arable land and the outlet flows through two trenches, one to the southeast and one to the northeast. The inflow takes place through the extensive peat areas that surround the lake. A transition in future will form the lake to wetlands (Brunberg & Blomqvist, 1997). Characteristic features of the lithology are the lack of gyttja clay and the relatively thick sequence of gyttja (Figure 6 and Appendix 2).

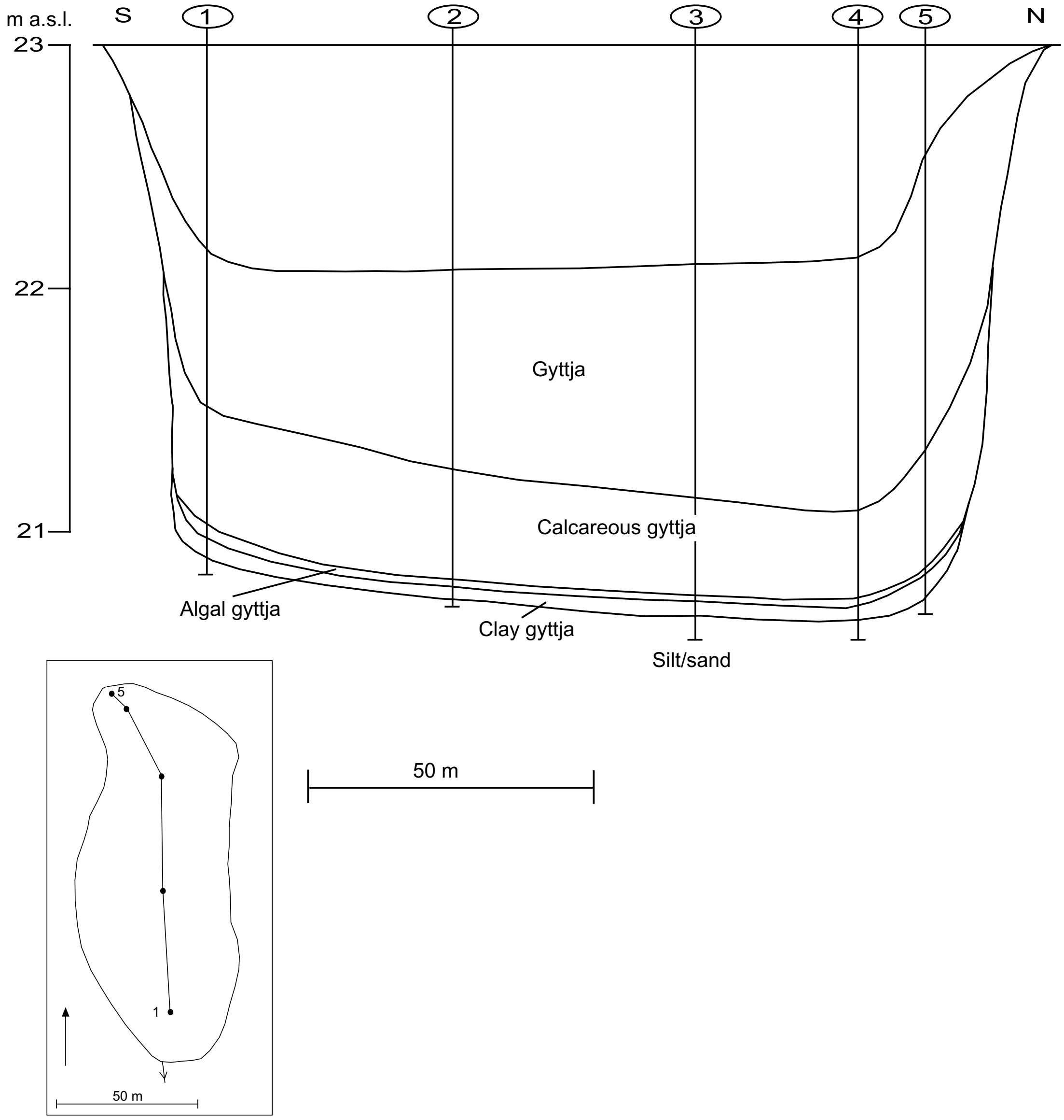

Figure 5. *Cross-section of Lake Barsjö. Characteristic sediment in this lake is the calcareous gyttja, which is only found in Lake Barsjö and Lake Eckarfjärden. The sedimentation of calcareous gyttja reflects the locally high amount of calcium in the soils.*

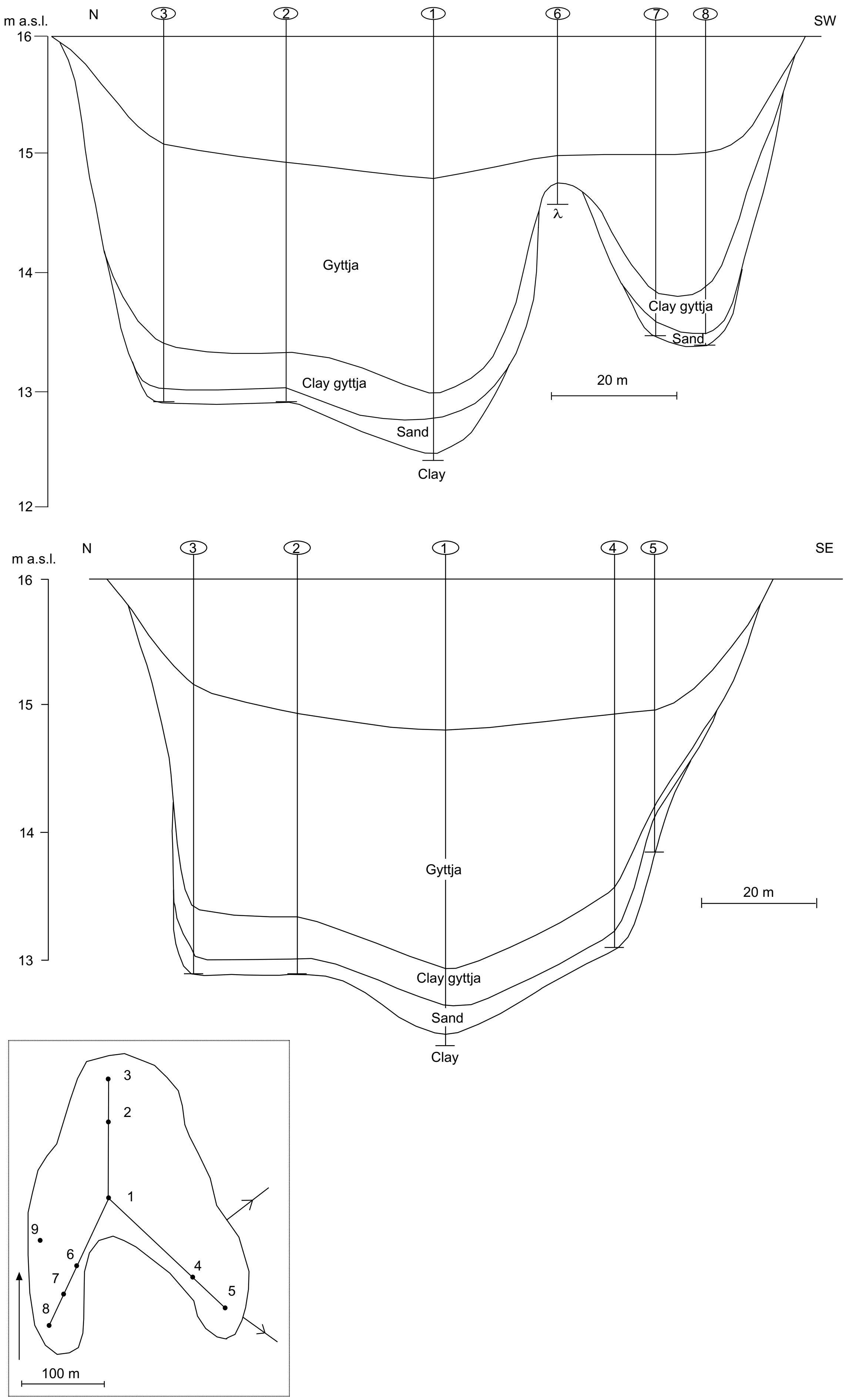

Figure 6. *Cross-section of Lake Landholmssjön in N-SW and N-SE direction.*

6.4 Lake Skälsjön (13 m)

Skälsjön is one of several lakes near the old ironworks of Forsmark and Lövsta bruk. The dam constructions at Forsmark have severely influenced the watercourse. The inlet is a large ditch. Belts of *Phragmites* cover extensive parts of the in- and outlets. In the western and central parts of the lake, boulders and gravel cover large areas of the lake bottom. In the western part of the lake there are several small, forested islands. Due to lowering of the water level, shallow areas in the northern part of the lake have been overgrown and now form fens. In the eastern part of the lake there is an area earlier dominated by sand and a long beach, which has been overgrown and which now partly forms a fen. The lake is eutrophic with a good buffer capacity against acidification. A characteristic feature is the absence of gyttja clay and extensive accumulations of clay gyttja (Figure 7 and Appendix 2). In the western part of the basin, the bottom is covered by boulders and minerogenic material making coring difficult.

6.5 Lake Norra Åsjön (12 m)

The lakes Norra Åsjön, S. Åsjön and Skälsjön are connected through shallow straits. Near the inlet, in the northern part, large areas of *Phragmites* cover the lake floor. Coarse-grained sediment dominates the bottom of the basin floor (Figure 8 and Appendix 2). The lake is oligotrophic-mesotrophic with high buffer capacity against acidification. North of the lake, Stormossarna bog stretches out and covers the outlet from Lake Skälsjön. Stormossarna bog is a rich fen with a typical vegetation of orchids and saw grass. Mires cover large areas around other parts of the lake.

6.6 Lake Södra Åsjön (12 m)

Lake Södra Åsjön is one of several lakes, which is part of river Forsmarksån´s watercourse. The basin is mainly surrounded by wetlands. On the eastern side, south of the outlet, there is an area of wooded till. Otherwise the lake is mainly surrounded by bedrock outcrops and fens.

Frebbenbomossarna bog is a large area covered with marshes and bogs, which is located west of the lake. A small esker stretches through Frebbenbomossarna in a NE-SW direction. The water level in the lake is controlled by the dams at Forsmarks bruk.

The three lakes in the same watercourse have several characteristics in common, such as their large lake areas and large belt of *Phragmites* near in- and outlets. Sediment accumulations are sparse in the central parts of the lakes, while sediment, mainly gyttja, accumulate in the calm and small bays of the lakes, *i.e.* where *Phragmites* grows (Figure 9 and Appendix 2).

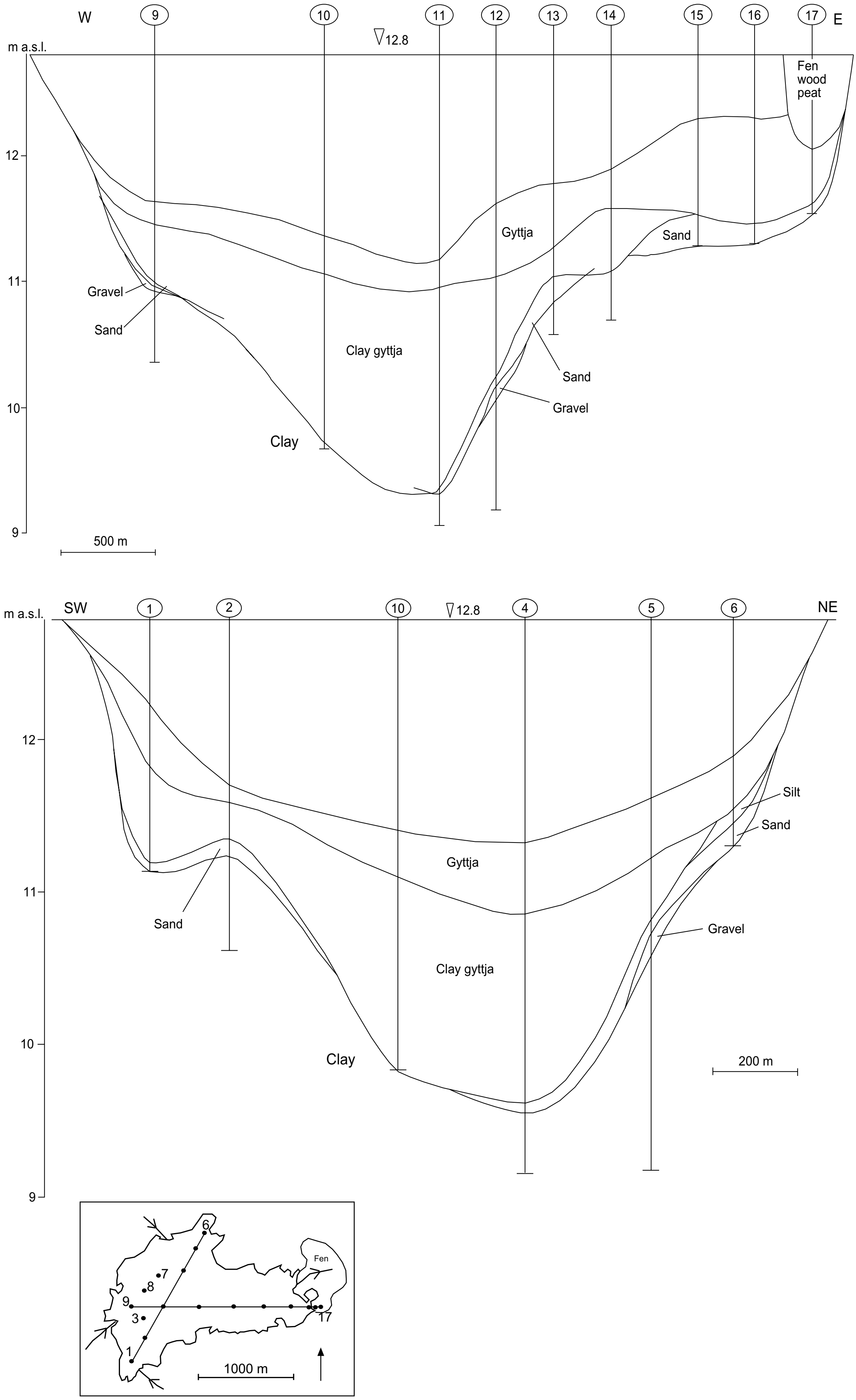

Figure 7. Cross-section of Lake Skälsjön in W-E and SW-NE direction. Notice the thin gyttja sequence.

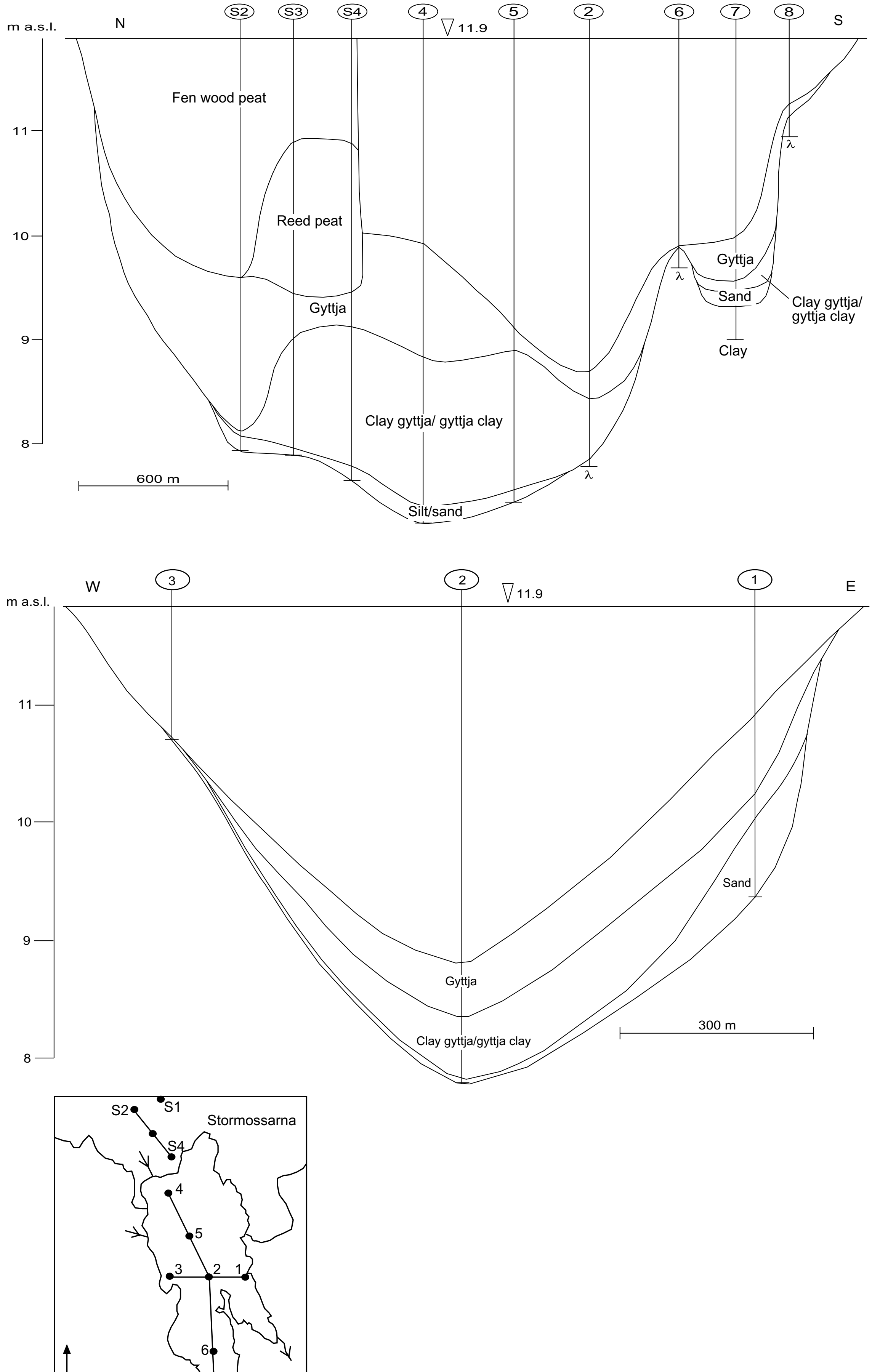

Figure 8. *Cross-section of Lake Norra Åsjön in N-S and W-E direction.*

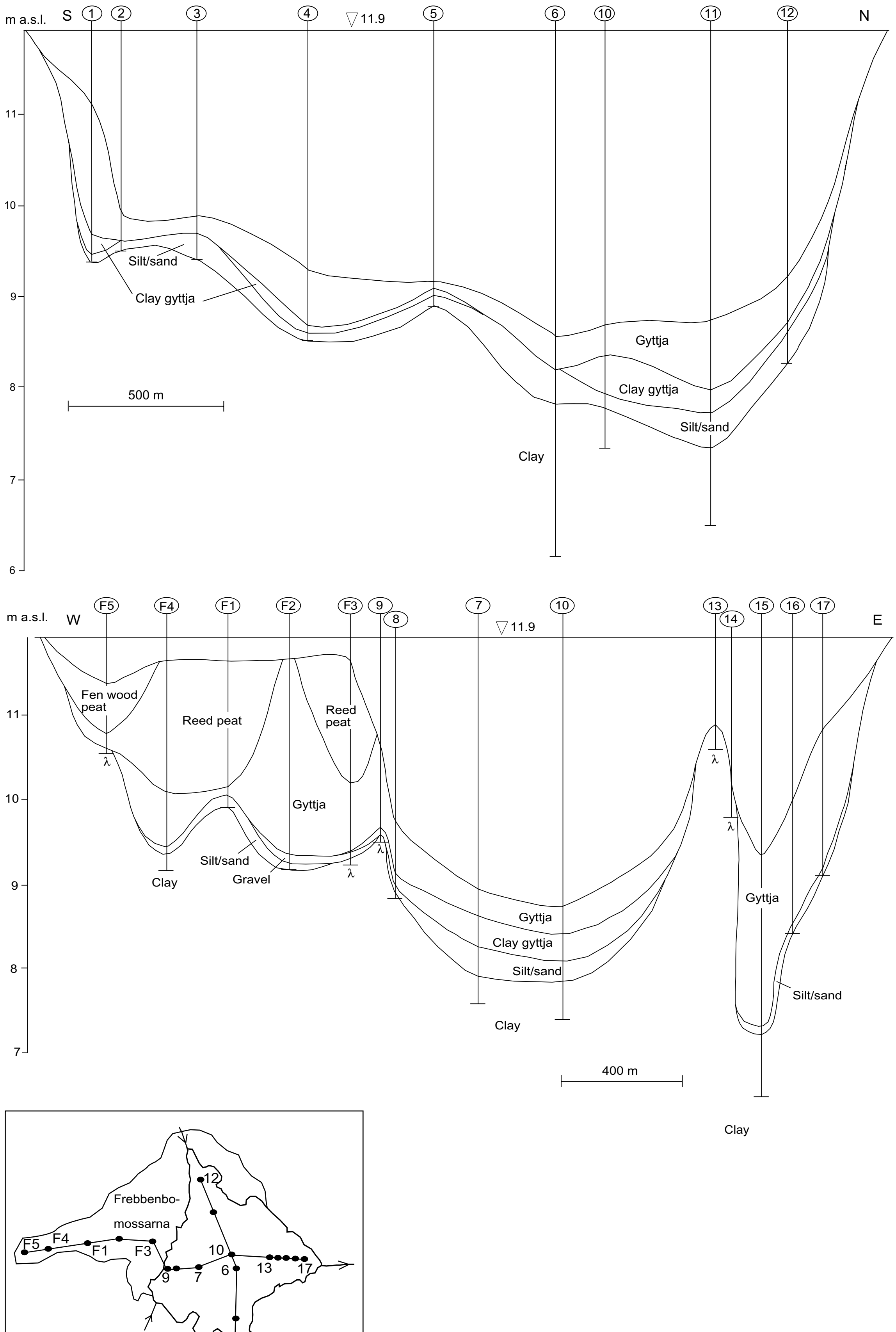

Figure 9. Cross-section of Lake Södra Åsjön in S-N and W-E direction.

6.7 Lake Eckarfjärden (4 m)

Like most of the investigated lakes in the area, a flat landscape surrounds Lake Eckarfjärden. The lake is situated about 4 km from the present coastline. Till, bedrock outcrops as well as fens surrounds the lake and narrow belts of *Phragmites* cover large parts of the lake, particularly in the northern and southeastern part. Gyttja clay was not observed in this basin (Figure 10). A typical erosive contact between clay and (clay) gyttja was observed. Thin lenses consisting of calcareous gyttja was found within the gyttja sequence (Appendix 2), which indicate that the lake has a good buffer capacity against acidification. The outlet has been ditched and as a result the water level in the lake has been lowered.

6.8 Lake Limmaren (4 m)

Lake Limmaren is situated approx. 60 km south of the other investigated lake basins (Figure 1). The landscape surrounding the lake, is part of the undulating fissure valley landscape. In the surroundings of the lake, till is the dominating Quaternary deposit.

Lake Limmaren is large, 2 x 3 km, with a maximum water depth of 6.5 m. The typical sediment found in the lake is composed of clay gyttja/gyttja clay with a thickness exceeding three metres in some parts (Figure 11 and Appendix 2).

6.9 Lake Fiskarfjärden (> 0.5 m)

Lake Fiskarfjärden is situated less than 2 km from the present coastline. Due to the regressive shore displacement, the basin has recently been topographically isolated from the Baltic Sea. Like many of the lakes in northeastern Uppland, Lake Fiskarfjärden is surrounded by large belts of *Phragmites*. Small islands and boulders of different sizes protrude above the water surface in the basin. Till covers most of the area in the close vicinity, while marshes and sand dominate near the inlet. Lake Fiskarfjärden is a brackish water lake in a late phase of isolation from the Baltic Sea. Since the lake is still below the high water level in the Baltic Sea, periodic inflow of brackish water still affect the lake. Lake Fiskarfjärden is mesotrophic (Brunberg & Blomqvist, 1997). The gyttja sequence is relatively extensive, while clay gyttja is absent (Figure 12 and Appendix 2).

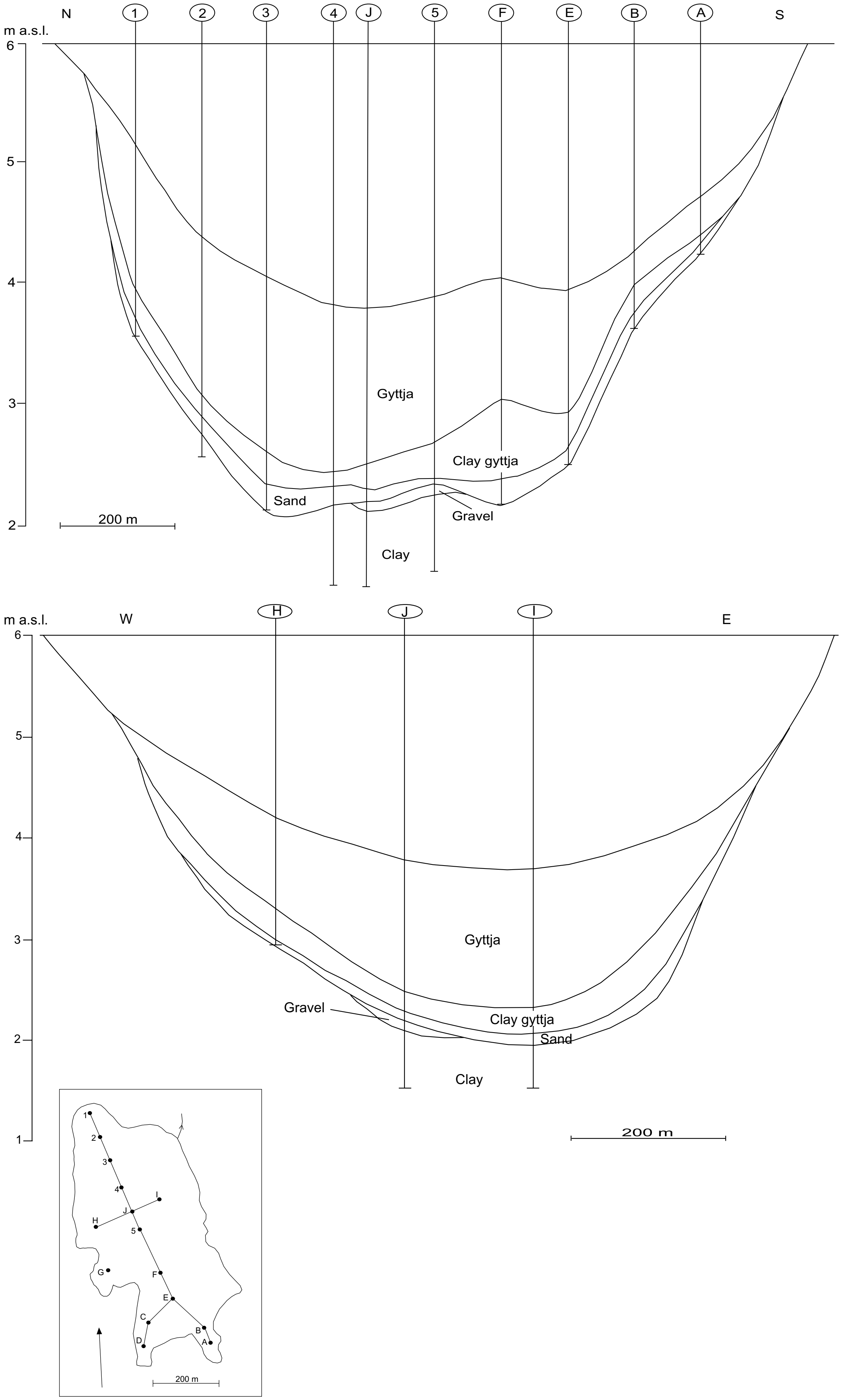

Figure 10. Cross-section of Lake Eckarfjärden in N-S and W-E direction.

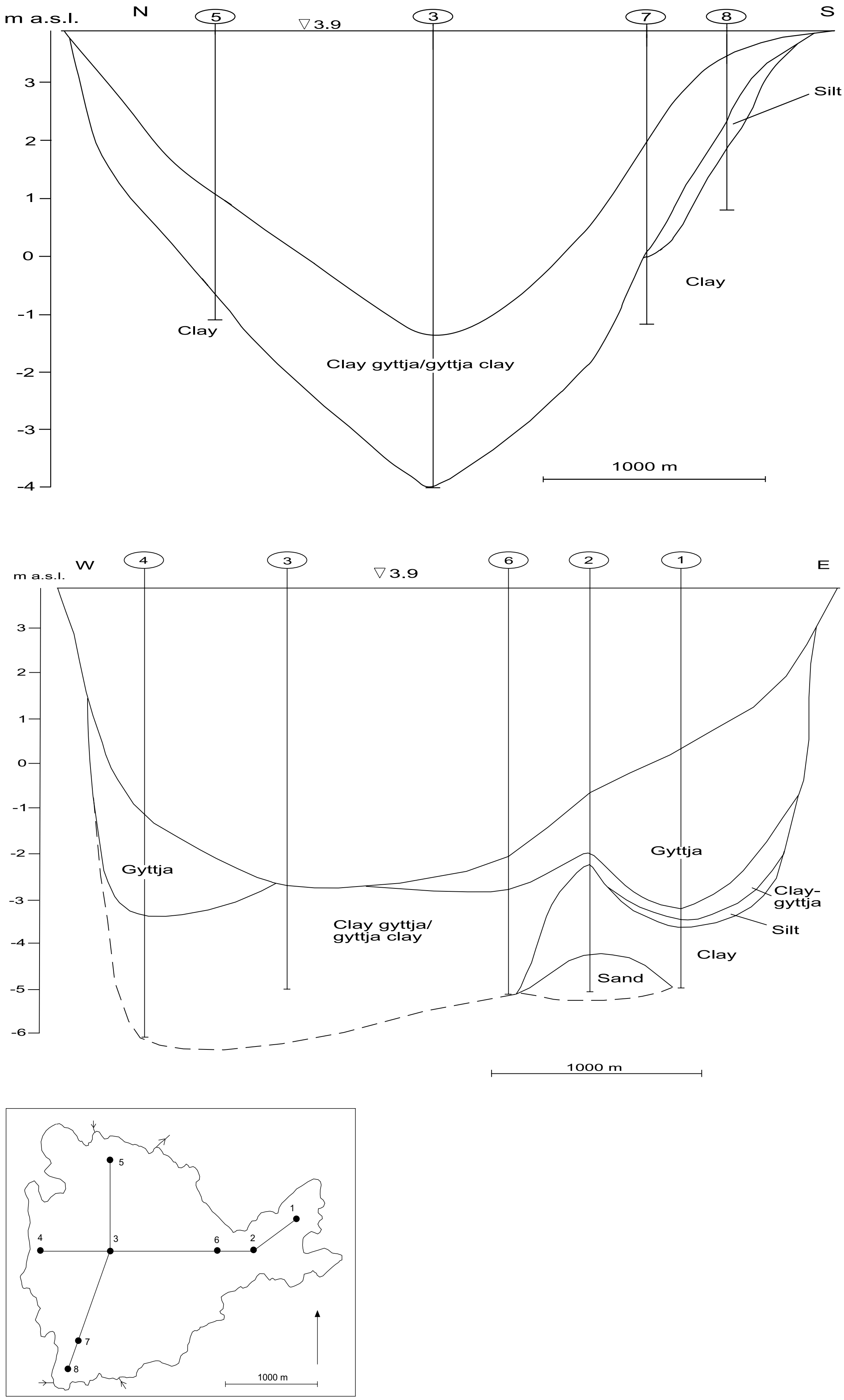

Figure 11. *Cross-section of Lake Limmaren in N-S and W-E direction. Notice the rather thick sequence of clay gyttja/gyttja clay.*

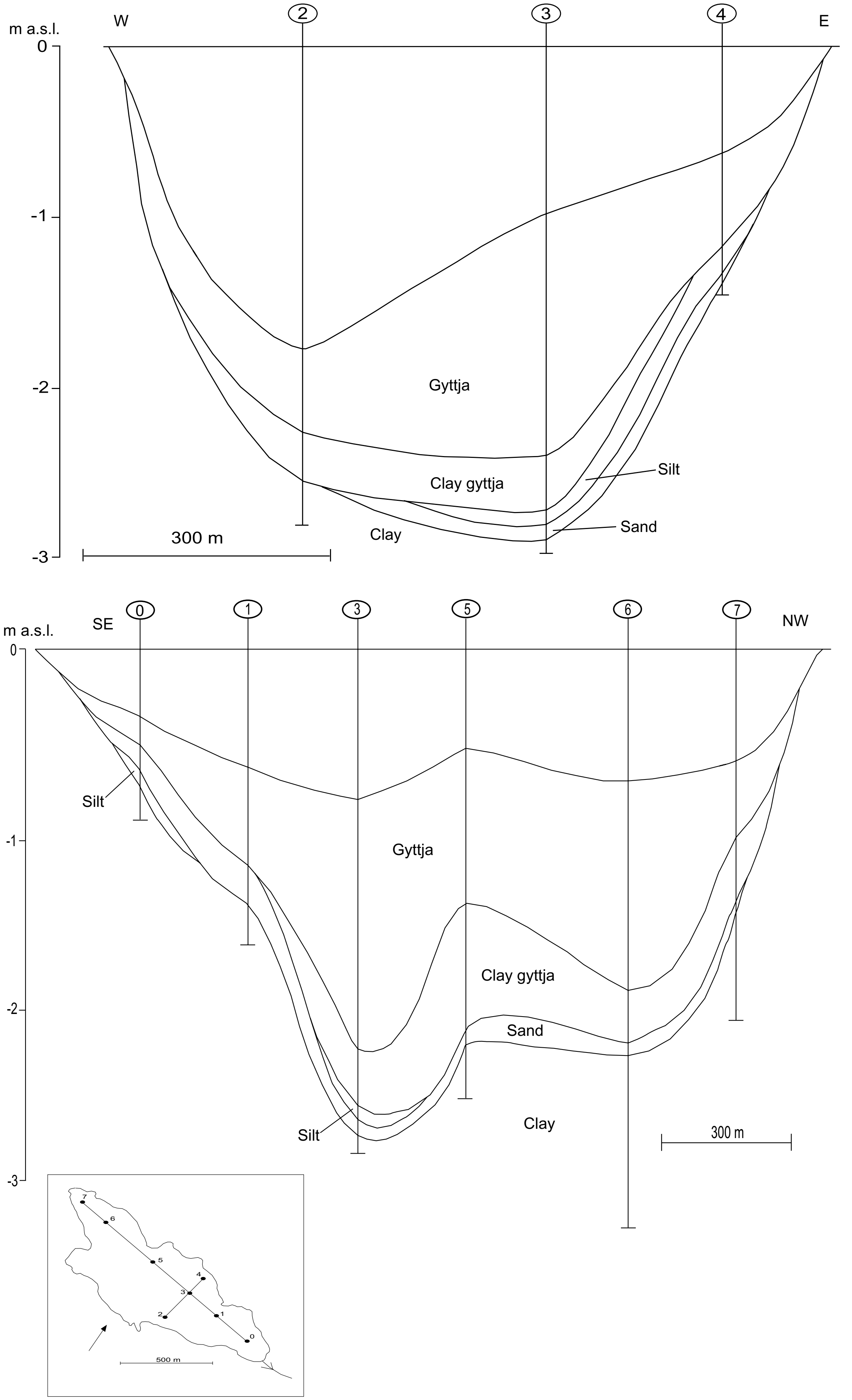

Figure 12. *Cross-section of Lake Fiskarfjärden in W-E and SE-NW direction.*

7 Results and discussion

Vissomossen bog

The diatom stratigraphy in Vissomossen bog shows an example of the natural succession in lake ontogeny from sediment accumulation in the Litorina Sea, followed by the isolation and the formation of a freshwater lake. Lacustrine sedimentation filled in the lake and the latest stage in the succession is an overgrown lake *i.e* when mosses dominated the vegetation, *i.e.* a bog is formed.

The isolation of the basin is interpreted to have been distinct and fast, as reflected by changes in the diatom flora (Figures 13 and 14). The lithostratigraphy shows a relatively thin sequence with silt/sand and clay gyttja/gyttja clay. The thickness of the algal gyttja is 1–1.5 metres. A thin layer of reed peat is upwards covered by moss peat. In the surrounding fen, the moss peat is replaced by fen wood peat.

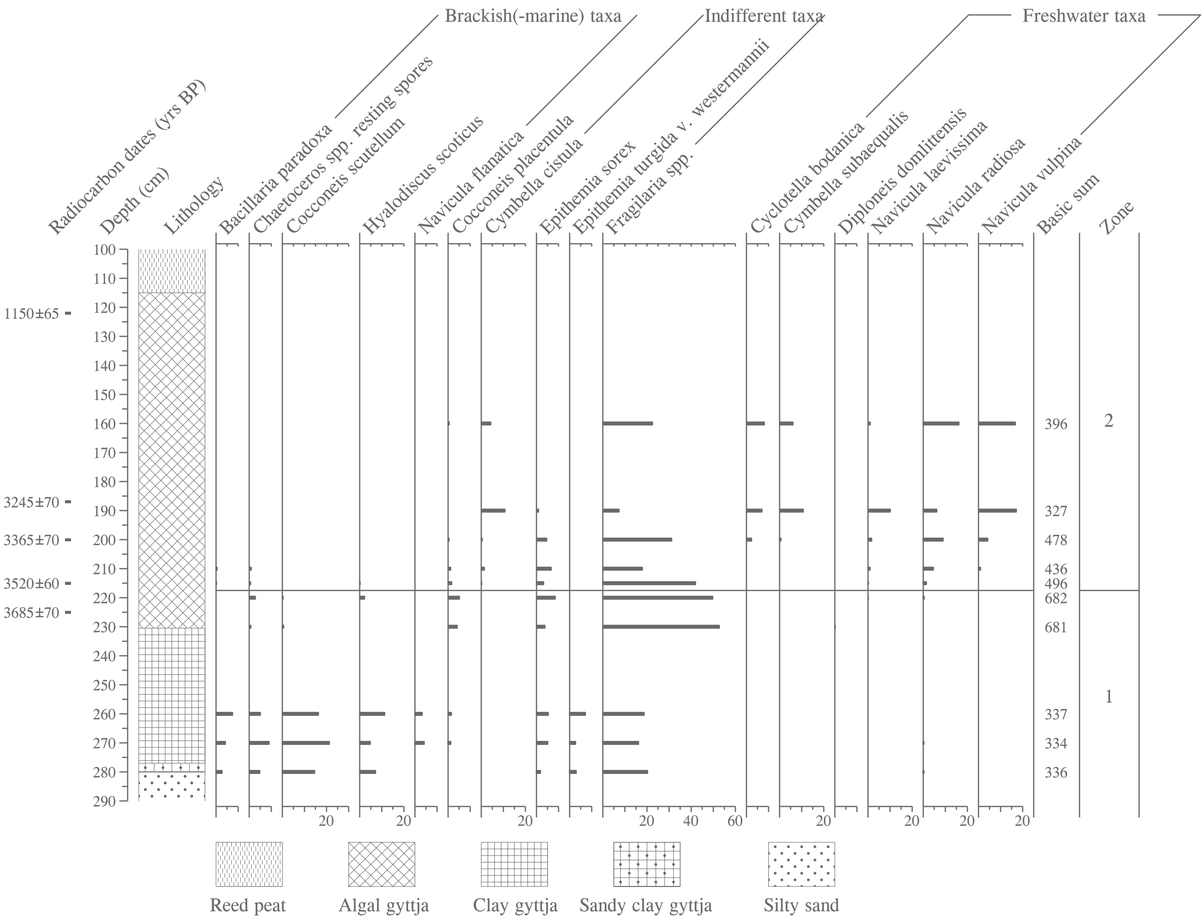

Figure 13. *The diatom diagram from Vissomossen bog show the most abundant species found in the ten levels analysed. Zone 1 shows the diatom taxa before the isolation of the basin. Zone 2 shows the most abundant taxa thriving after the isolation.*

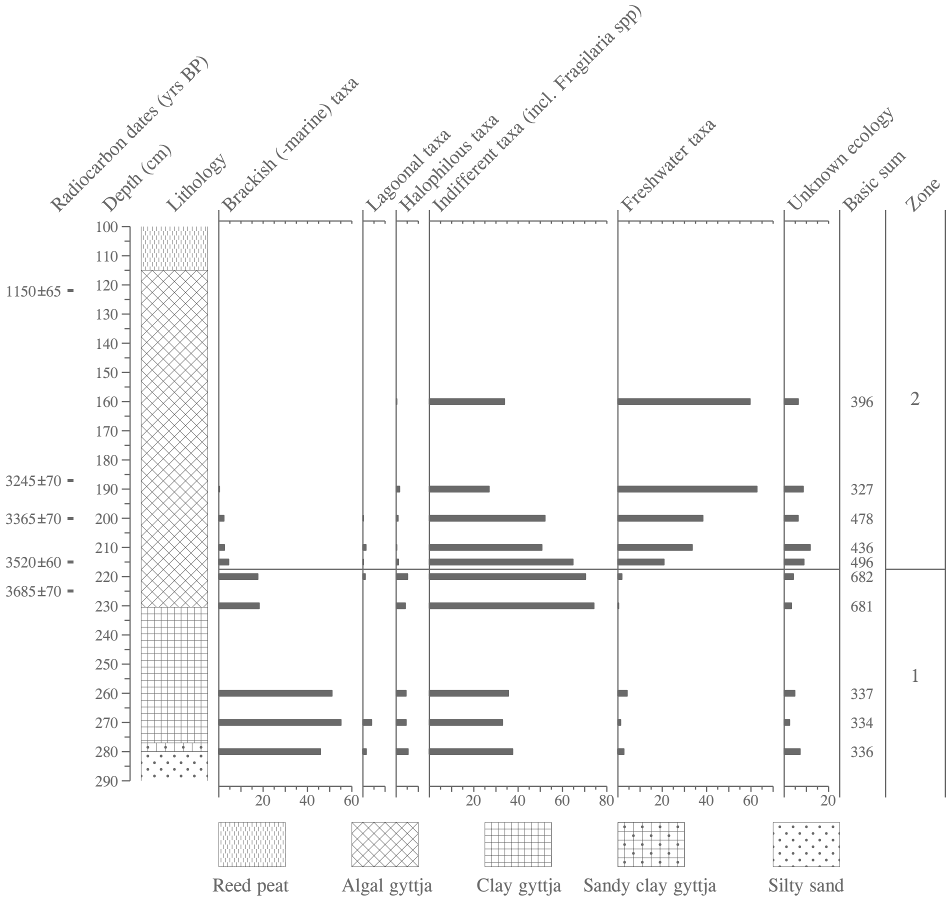

Figure 14. *The diatom diagram show a distinct isolation of the basin. Zone 1 shows a predominance of brackish (-marine) water diatoms. The indifferent taxa are abundant in all ten levels, but mainly just before, during and after the isolation event. Zone 2 show the predominance of the freshwater diatoms during and after the isolation of the basin from the slightly brackish Litorina Sea.*

Zone 1 in the diatom diagram shows a range of diatom species, which thrive in a brackish-marine environment *e.g. Hyalodiscus scoticus* and *Cocconeis scutellum* (Figure 13). Prior to the isolation, during the lagoonal phase, species like *Campylodiscus clypeus* are normally common but here only a few of them were found. In the sediment reflecting the isolation of the lake (at 217.5 cm) the flora is dominated by species tolerant to low salinity, *i.e.* the indifferent taxa. *Epithemia sorex* and *Fragilaria* spp. have been found in large quantities. The latter genus is probably not significant to determine the isolation level (*cf.* Stabell, 1985). The indifferent taxon *Epithemia turgida* var. *westermannii* has only been found before the isolation and *Cymbella cistula* has been found after the isolation.

Zone 2 is rich in freshwater taxa *e.g. Cyclotella bodanica*, *Navicula vulpina*, *Navicula radiosa* and *Cymbella subaqualis*.

Organic carbon and water content display peaks at 190 and 230 cm depth (Figure 15). These are most likely caused by small rootlets in the sediment.

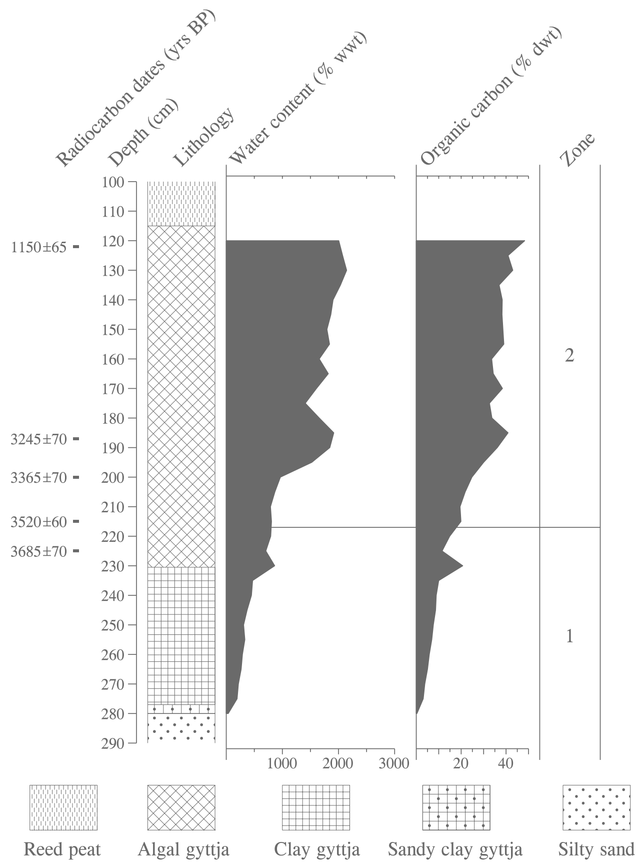

Figure 15. *Diagram showing the water content (% wwt) and organic carbon content (% dwt). Notice that the measured interval is between 280 and 120 cm. The lithology is made according to laboratory analysis.*

The isolation of the former bay to a freshwater basin occurred between 3500–3600 ^{14}C years BP (Table 2, Figure 16). The rate of sedimentation has been estimated to 0.3–1.1mm/year. The rate of sedimentation was probably constant throughout the interval covered by the lower four dates. The age of the youngest date (122 cm) indicates a decrease in sedimentation rate. This could be normal, but could also depend on the fact that the uppermost date has, to a higher degree, been contaminated from small rootlets or particles in the sediment, which gives too a young age.This is also applied for the four older dates, which are thought to represent minimum ages *cf.* Åkerlund *et al.* (1995).

The age of the isolation (~3550 ^{14}C years BP) and the isolation threshold level of the basin (27.4 m a.s.l.) have been inserted in the shore displacement model for northern Uppland. This model is based on studies of a number of sites located along the 70 m isobase for the Litorina Limit (Figure 17). The model shows a constant regression with a slight decrease at about 4500 ^{14}C years BP, which in time could be correlated with the transgressional Litorina (L3) identified in the Stockholm region (Figure 18).

Field determinations of the lithostratigraphy and measurements of organic carbon on the sample cored in Vissomossen bog are in agreement.

Table 2. AMS-datings from Vissomossen bog. Calibrated years according to Stuiver *et al.* (1998).

Lab number	Sample	$\delta^{13}C$ ‰ PDB	^{14}C yrs BP	Calibrated yrs BP
Ua-16055	122 cm	−19.2	1150 ± 65	1100
Ua-16056	187 cm	−16.9	3245 ± 70	3450
Ua-16057	200 cm	−19.1	3365 ± 70	3600
Ua-16058	215 cm	−22.6	3520 ± 60	3800
Ua-16059	225 cm	−19.2	3685 ± 70	4000

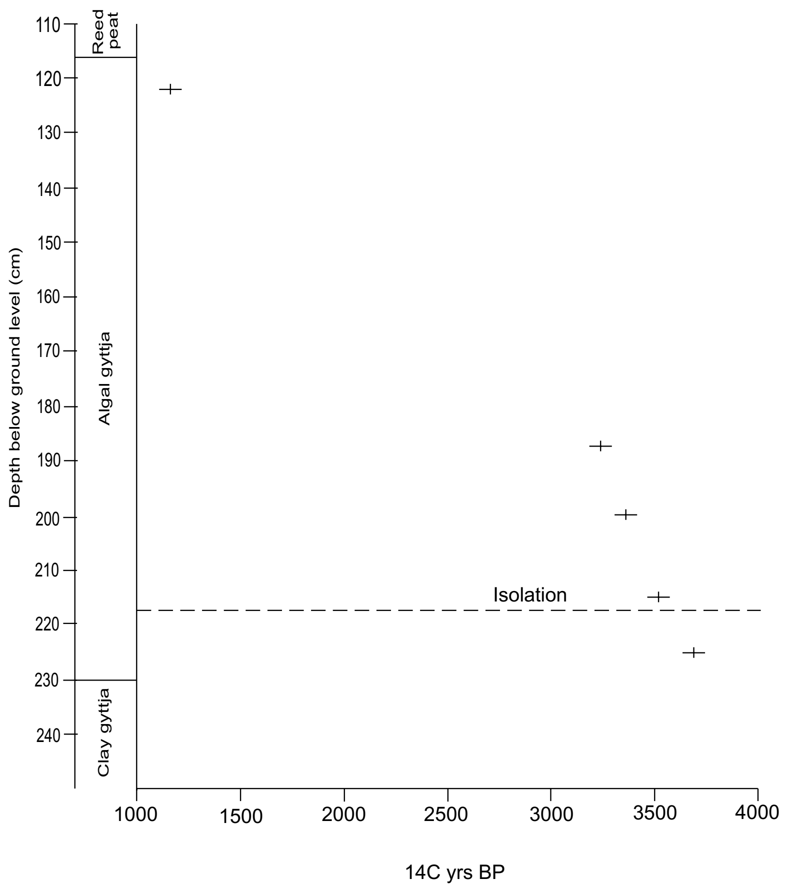

Figure 16. *The AMS dates from five bulksamples in Vissomossen bog. The dates show an isolation of the former lake at 3500–3600 ^{14}C years BP. The rate of sedimentation has been calculated according to the AMS-dates. The sedimentation rates fluctuate between 0.3–1.1 mm/year.*

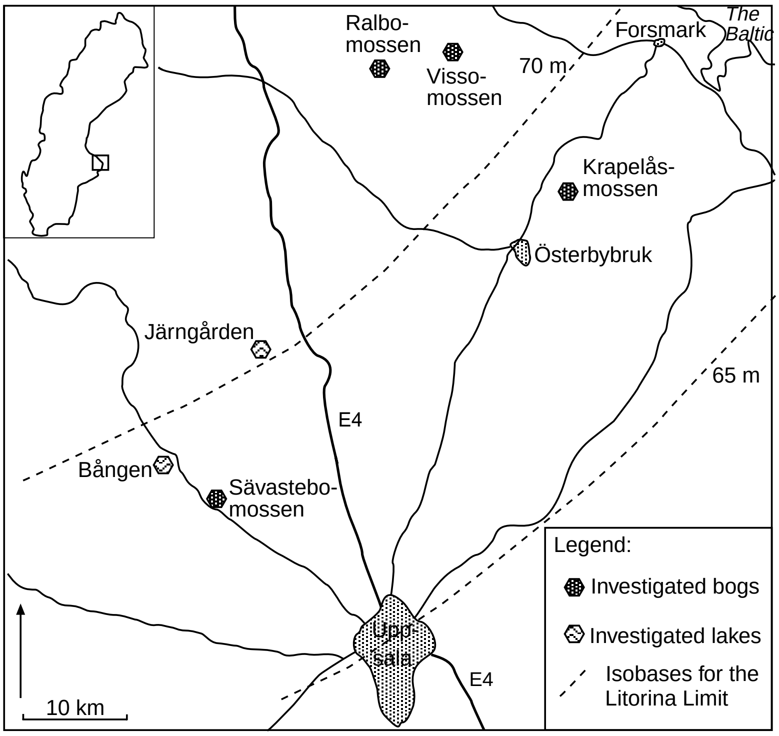

Figure 17. *The investigated sites around the 70 m Litorina isobase, which have been compiled to construct the shore displacement model for northern Uppland.*

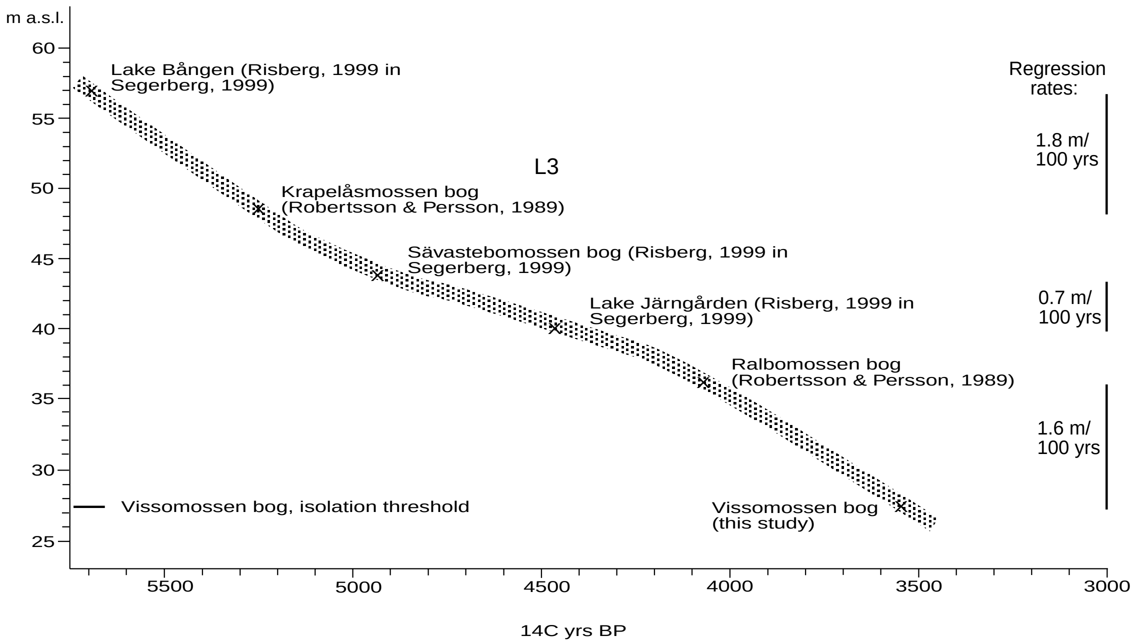

Figure 18. *The shore displacement model for northern Uppland with Vissomossen bog included. The decrease in regression rate around 4500 BP can be correlated with Litorina 3 (L3), a transgressional phase which is noted in the Södertörn peninsula, south of Stockholm. The slowest rate of regression occurs at the same time as L3.*

Distribution of lake sediment

A general sediment stratigraphy consists of, from bottom and up: till, glacial clay (varved), postglacial clay, silt and sand (gravel), clay gyttja/gyttja clay and gyttja. Normally, the sequences of clay gyttja/gyttja clay are rather thin or absent. Exceptions are Lake Skälsjön, Lake Norra Åsjön and Lake Limmaren, where clay gyttja/gyttja clay displays thicknesses of up to 3.5 m. The thickness of gyttja also varies considerable between the investigated lakes.

Different composition of gyttja has been found in the investigated basins. Algal gyttja, reddish to green, have been found in 50% of the investigated sites. *Charales* is one of the components in the formation of algal gyttja. *Vaucheria* gyttja (found when levelling the isolation threshold at Vissomossen bog) is a stratified greyish-brown gyttja (Sw. pappersgyttja) also with algae as the main component. *Vaucheria* gyttja is supposed to form during an early lagoonal stage, with a salinity of 5–6‰, before the water becomes lacustrine (Ranheden, 1989).

The calcareous gyttja, found in Lake Barsjö and Lake Eckarfjärden reflects the calcareous soils in the area. Remains of freshwater mollusc shells have been found in this sediment type to a large extent.

Sedimentation of calcareous gyttja reflects the locally high amounts of calcium in the soils *i.e.* till and glacial clay (*cf.* Persson, 1992). The use of hydrocloric acid on sediment have shown traces of limestone in the calcareous gyttja but very seldom and only in the gyttja found in Lake Barsjö and Lake Eckarfjärden.

The lake basins are generally shallow with protruding rocks, skerries or small, forested island. They are strongly affected by human activities in form of dams, ditching, water regulations or lowered lake surfaces, which most likely affect the rate of sedimentation. The only exception is Lake Limmaren, the most southern situated site. This lake is fairly deep and lies in a undulating fissure valley landscape.

Another common feature is the overgrowth by belts of reed, a result of the ongoing infilling and overgrowth of the lakes. Several factors cause lakes to fill in, such as the rate of sediment supply, productivity, lake size, anthropogenic activities and the size of the catchment area.

Many of the lakes will in due time fill in and turn into mires. Especially, fens might delay the spreading of radionucleids during a leakage to the biosphere since peat filters and binds nucleids. This process could, however, cause a high dose input to the biosphere if released.

General features for the lakes Skälsjön, N. Åsjön and S. Åsjön, which are all part of the same watercourse of Forsmarksån, are the thin accumulations of sediment. Coarse-grained sediment accumulates where the water energy is high, while gyttja accumulate in the shallow parts of the lakes, where calmer conditions prevail. The thin accumulations could be caused by erosion of the floors of the basins before isolation. Future lakes in the area will likely show the same thin accumulations of pre-isolation sediments. Thin layers of sediment accumulated before the isolation of the basins could be of importance for the spreading of nucleids during a leakage since thin accumulations will cause more efficient nucleid spreading.

Some lakes are dystrophic with high amounts of humus in the water. This is dependent on the drainage and runoff from mires and forested areas. The turnover in lakes is dependent on water supply from the areas nearby. In Uppland the water supply is high and the turnover relatively fast (Brunberg & Blomqvist, 1997).

8 Conclusions

- The lakes in the investigated area are relatively shallow basins with skerries and small islands protruding above the lake surface. In general, the basins are strongly affected by water regulating activities, such as the construction of ditches and dams.
- Sediment sequences accumulated prior to the isolation event of the basins have generally shown to be thin. Future lake basins will probably show a similar thin sediment accumulation.
- The accumulation of calcareous gyttja in Lake Barsjö and Lake Eckarfjärden reflects the locally high amounts of calcium ($CaCO_3$) in the soils.
- The isolation threshold for Vissomossen bog was determined at 27.4 m a.s.l.
- The diatom stratigraphy shows a distinct isolation of the Vissomossen bog from the Litorina Sea at 3500–3600 ^{14}C years BP. The date correspond to 3800 calibrated years BP.
- The Litorina transgression, L3, corresponds to a decrease in the regression rate in the investigated area around 4500 ^{14}C years BP.

9 Acknowledgements

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Appendix 1

Lithostratigraphy in Vissomossen bog (27.5 m a.s.l.) as obtained with a Russian peat corer, except otherwise stated. All depths are stated in cm below ground surface.

1 (spade)
000 – 045 Fen wood peat
045 – 050 Sand
> 050 Clay

2 (spade)
000 – 045 Fen wood peat
045 – 055 Sand
> 055 Clay

3 (spade)
000 – 025 Fen wood peat
> 025 Sand
Stop at coarse min. material

4 (spade)
000 – 025 Fen wood peat
> 025 Sand
Stop at coarse min. material

5 (spade)
000 – 020 Fen wood peat
020 > 100 Sand
Stop at coarse min. material

6 (spade)
000 – 045 Fen wood peat
045 – 070 Vaucheria gyttja
070 > 150 Sand
Stop at coarse min. material

1: –80 m
000 – 040 Fen wood peat
040 – 075 Algal gyttja, red
075 > 110 Clay gyttja
Stop at coarse min. material

1: –60 m
000 – 050 Fen wood peat
050 – 071 Algal gyttja, red
071 – 112 Clay gyttja
112 – 117 Sandy clay gyttja
117 > 130 Silty sand
Stop at coarse min. material

1: –40 m
000 – 097 Fen wood peat
097 – 130 Clay gyttja
Stop at coarse min. material

1: –20 m
000 – 090 Fen wood peat
090 – 135 Clay gyttja
135 – 140 Sandy clay gyttja
Stop at coarse min. material

1:0 m
000 – 120 Fen wood peat
120 – 132 Algal gyttja, red
132 > 170 Clay gyttja
Stop at coarse min. material

1:25 m
000 – 075 Moss peat
075 – 095 Sedge and reed peat
095 – 138 Algal gyttja, red
138 – 165 Algal gyttja, green
165 – 198 Clay gyttja
198 > 200 Sandy clay gyttja
Stop at coarse min. material

1:50 m
000 – 120 Moss peat
120 – 175 Algal gyttja, red
175 – 185 Algal gyttja, green
185 – 225 Clay gyttja
225 – 230 Sandy gyttja
Stop at coarse min. material

1:75 m
000 – 110 Moss peat
110 – 115 Reed peat
115 – 160 Algal gyttja, red
160 – 190 Algal gyttja, green
190 – 225 Clay gyttja
225 – 232 Sandy clay gyttja
232 > 250 Silty sand
Stop at coarse min. material

1:100 m
000 – 105 Moss peat
105 – 113 Reed peat
113 – 180 Algal gyttja, red
180 – 230 Algal gyttja, green
230 – 250 Clay gyttja
250 – 255 Sandy clay gyttja
255 – 282 Silty sand
282 – 290 Silty clay, grey
290 – 390 Clay , sulphide precipitation
390 > 770 Clay, beige

1:200 m (inv. in field & lab).
000 – 100 Moss peat
100 – 115 Reed peat
115 – 190 Algal gyttja, red
190 – 230 Algal gyttja, green
230 – 270 Clay gyttja
270 – 280 Sandy clay gyttja
280 – 312 Silty sand
312 > 670 Clay, sulphide precipitation

1:300 m
000 – 100 Sedge and moss peat
100 – 115 Reed peat
115 – 200 Algal gyttja, red
200 – 250 Algal gyttja, green
250 – 270 Clay gyttja
270 – 280 Sandy clay gyttja
280 > 300 Silty sand
Stop at coarse min. material

1:400 m
000 – 090 Sedge and moss peat
090 – 100 Reed peat
100 – 210 Algla gyttja, red
210 – 235 Algal gyttja, green
235 – 255 Clay gyttja
255 – 263 Sandy clay gyttja
263 – 282 Silty sand
282 > 300 Clay

1:500 m
000 – 110 Moss peat
110 – 130 Reed peat
130 – 195 Algal gyttja, red
195 – 220 Algal gyttja, green
220 – 230 Clay gyttja
230 – 245 Sandy clay gyttja
245 > 250 Silty sand
Stop at coarse min. material

1:600 m
000 – 120 Moss peat
120 – 130 Reed peat
130 – 223 Algal gyttja, red
223 – 245 Algal gyttja, green
245 – 261 Clay gyttja
261 – 266 Sandy clay gyttja
266 – 268 Sand
268 > 300 Clay

1:700 m
000 – 130 Moss peat
130 – 140 Reed peat
140 – 234 Algal gyttja, red
234 – 242 Algal gyttja, green
242 – 268 Clay gyttja
268 – 272 Sandy clay gyttja
272 – 296 Silty sand
296 > 300 Clay, grey

1:800 m
000 – 135 Moss peat
135 – 140 Reed peat
140 – 217 Algal gyttja, red
217 – 245 Algal gyttja, red
245 – 267 Clay gyttja
267 – 273 Sandy clay gyttja
273 – 285 Silty sand
285 > 300 Clay

1:900 m
000 – 120 Moss peat
120 – 197 Algal gyttja, red
197 – 210 Algal gyttja, red
210 – 223 Clay gyttja
223 – 230 Sandy clay gyttja
230 – 235 Sand
235 – 295 Clay, grey
295 > 300 Clay, beige

1:985 m
000 – 135 Fen wood peat
135 – 160 Algal gyttja, red
160 – 168 Sandy clay gyttja
168 – 178 Silty sand
178 > 300 Clay

1:998 m
000 – 075 Fen wood peat
075 – 077 Reed peat
077 – 120 Algal gyttja, red, with wood
120 – 125 Sandy clay gyttja
125 – 145 Sand
145 > 170 Silty clay

NW: 100 m
000 – 145 Moss peat
145 – 150 Reed peat
150 – 225 Algal gyttja, red
225 – 255 Algal gyttja, green
225 – 285 Clay gyttja
285 – 292 Sandy clay gyttja
292 > 300 Silty sand
Stop at coarse min. material

NW: 200 m
000 – 155 Moss peat
155 – 167 Reed peat
167 – 245 Algal gyttja, red
245 – 269 Algal gyttja, green
269 – 290 Clay gyttja
290 > 295 Sandy clay gyttja
Stop at coarse min. material

NW: 300 m
000 – 210 Moss peat
210 – 266 Algal gyttja, red
266 – 275 Algal gyttja, green
275 – 295 Clay gyttja
295 > 300 Sandy clay gyttja
Stop at coarse min. material

NW: 400 m
000 – 205 Moss peat
205 – 215 Reed peat
215 – 267 Algal gyttja, red
267 – 278 Algal gyttja, green
278 > 280 Clay gyttja
Stop at coarse min. material

NW: 500 m
000 – 212 Moss peat
212 – 235 Reed peat
235 – 247 Algal gyttja, red
247 – 273 Algal gyttja, green
273 > 275 Sandy clay gyttja
Stop at coarse min. material

NW: 600 m
000 – 179 Sedge peat
179 – 184 Reed peat
184 – 200 Algal gyttja, red
200 – 221 Algal gyttja, green
221 – 238 Clay gyttja
238 > 240 Sandy clay gyttja
Stop at coarse min. material

NW: 700 m
000 – 100 Fen wood peat
100 > 130 Gyttja, coarse detritus
Stop at coarse min. material

NW: 750 m
000 – 105 Fen wood peat
105 – 120 Sedge and reed peat
120 – 137 Gyttja, coarse detritus
137 – 140 Sandy gyttja with gravel
140 – 165 Clay, grey
165 > 200 Clay, beige

NW: 800 m
000 – 135 Fen wood peat
135 – 173 Gyttja, coarse detritus, brown
173 – 180 Sand with gravel
180 > 200 Clay, grey

NW: 850 m
000 – 105 Fen wood peat
105 – 128 Reed peat
128 > 150 Gyttja, coarse detritus
Stop at bedrock or boulder

NW: 880 m
000 > 040 Fen wood peat
Stop at bedrock or boulder

SE: 100 m
000 – 135 Moss peat
135 – 240 Algal gyttja, red
240 – 245 Sandy gyttja clay
245 – 255 Silty sand
255 – 295 Clay, grey
295 > 300 Clay, beige

SE: 200 m
000 – 150 Moss peat
150 – 168 Reed peat
168 – 240 Algal gyttja, red
240 – 250 Algal gyttja, green
250 – 272 Clay gyttja
272 – 283 Sandy clay gyttja
283 – 295 Silty sand
295 > 300 Clay, grey

SE: 300 m
000 – 150 Moss peat
150 – 165 Reed peat
165 – 235 Algal gyttja, red
235 – 248 Clay gyttja
248 – 255 Sandy silt with gyttja
255 – 275 Sand
275 – 283 Sand with gravel
283 > 300 Clay

SE: 400 m
000 > 010 Fen wood peat
Stop at bedrock or boulder

SE: 500 m
000 > 005 Fen wood peat
Stop at bedrock or boulder

SE: 600 m
000 – 010 Fen wood peat
Stop at bedrock or boulder

SE: 700 m
000 – 010 Fen wood peat
Stop at bedrock or boulder

SE: 750 m
000 – 115 Fen wood peat with wood
115 – 125 Reed peat
125 > 150 Clay

ESE 1
000 – 030 Moss peat
030 – 152 Fen wood peat
152 – 160 Reed peat
160 – 171 Algal gyttja, green
171 > 200 Clay

ESE 2
000 – 100 Fen wood peat
100 – 130 Sedge and moss peat
130 – 152 Reed peat
152 – 175 Algal gyttja, red
175 > 200 Algal gyttja, green
Stop at coarse min. material

ESE 3
000 – 165 Fen wood peat
165 > 175 Algal gyttja
Stop at bedrock or boulder

S 1
000 – 135 Fen wood peat
135 – 150 Reed peat
150 > 190 Algal gyttja
Stop at bedrock or boulder

S 2
000 – 114 Fen wood peat
114 > 125 Sand
Stop at bedrock or boulder

NE 1
000 – 020 Moss peat
020 – 095 Fen wood peat
095 – 170 Reed peat
170 – 195 Gyttja, brown
195 – 205 Clay gyttja, green
205 > Gyttja clay
Stop at bedrock or boulder

NE 2
000 –120 Fen wood peat
120 – 168 Reed peat
168 – 195 Gyttja
195 > 275 Clay gyttja
Stop at coarse min. material

NE 3
000 – 030 Fen wood peat
030 > 045 Gyttja
Stop at till

W 1
000 – 095 Fen wood peat
095 – 105 Clay gyttja
105 > 120 Sand
Stop at coarse min. material

W 2
000 – 090 Fen wood peat
090 – 095 Coarse detritus gyttja
095 > 115 Clay gyttja
Stop at coarse min. material

Appendix 2

Lake sediment stratigraphy as obtained with a Russian peat corer. All depths are stated in cm below lake surface.

Lake Barsjö (23 m a.s.l.)
Bp 1
000 – 090 Water
090 – 150 Gyttja, brown
150 – 205 Gyttja, calcareous
205 – 207 Algal gyttja, red
207 – 212 Gyttja, greenish
212 – 218 Clay gyttja
> 218 Silty sand
Stop at coarse min. material

Bp 2
000 – 090 Water
090 – 175 Gyttja, uncon.
175 – 225 Gyttja, calcareous, pink
225 – 226 Algal gyttja, reddish brown
226 – 228 Gyttja, greenish brown
228 – 234 Clay gyttja
234 > 240 Silty sand
Stop at coarse min. material

Bp 3
000 – 090 Water
090 – 185 Gyttja, uncon.
185 – 232 Gyttja, calcareous, pink
232 – 234 Algal gyttja, reddish brown
234 – 236 Gyttja, green
236 – 248 Clay gyttja
248 > 250 Silty sand
Stop at coarse min. material

Bp 4
000 – 090 Water
090 – 195 Gyttja, uncon.
195 – 232 Gyttja, calcareous, pink
232 – 236 Algal gyttja, reddish brown
236 – 238 Gyttja, greenish brown
238 – 246 Clay gyttja
246 > 260 Silty sand
Stop at coarse min. material

Bp 5
000 – 045 Water
045 – 165 Gyttja, brown
165 – 220 Gyttja, calcareous
220 – 222 Algal gyttja, brownish red
222 – 224 Gyttja, green
224 – 235 Gyttja clay
Stop at coarse min. material

Bp 6 Lat. 60° 26′ 30′′ Long. 17° 38′ 36′′ (In the fen south of the road)
000 – 050 Fen wood peat
050 – 095 Reed peat
Stop at till

Bp 7 Lat. 60° 26′ 36′′ Long. 17° 38′ 36′ (In the fen north of the road near a trench)
000 – 080 Fen wood peat
080 > 150 Reed peat with horse-tail
Stop at bedrock or boulder

Bp 8 Lat. 60° 26′ 40′′ Long. 17° 38′ 33′′ (North of Bp 7)
000 – 040 Sedge peat
040 – 120 Reed peat
120 – 224 Gyttja, coarse detritus
224 – 226 Silt
226 > 230 Clay
Stop at till

Bp 9 Lat. 60° 26′ 45′′ Long. 17° 38′ 37′′ (North of Bp 8)
000 – 050 Fen wood peat
050 – 220 Reed peat
220 – 223 Gyttja
223 – 229 Silty clay gyttja/ gyttja clay
229 – 230 Gyttja silt
230 > 240 Silty sand with gravel
Stop at coarse min. material

Lake Landholmssjön (16 m a.s.l.)
Bp 1
000 – 120 Water
120 – 200 Gyttja, uncon.
200 – 265 Algal gyttja, red
265 – 305 Gyttja, greenish brown
305 – 335 Clay gyttja
335 – 355 Sand, coarse downwards
> 355 Clay

Bp 2
000 – 105 Water
105 – 180 Gyttja, uncon.
180 – 228 Algal gyttja, red
228 – 265 Gyttja, greenish brown
265 – 298 Clay gyttja
298 > 300 Silt
Stop at coarse min. material

Bp 3
000 – 085 Water
085 – 200 Gyttja, uncon.
200 – 210 Algal gyttja, red
210 – 260 gyttja, brown
260 > 298 Clay gyttja
Stop at coarse min. material

Bp 4
000 – 103 Water
103 – 193 Gyttja, uncon.
193 – 218 Algal gyttja, red
218 – 245 Gyttja, green
245 – 275 Clay gyttja
275 > 280 Silty sand
Stop at coarse min. material

Bp 5
000 – 107 Water
107 – 160 Algal gyttja, red
160 – 175 Gyttja
175 > 180 Clay gyttja
Stop at coarse min. material

Bp 6
000 – 100 Water
100 > 120 Algal gyttja, red
Stop at boulder, bedrock or till

Bp 7
000 – 100 Water
100 – 185 Gyttja, uncon.
185 – 205 Algal gyttja, red
205 – 220 Gyttja, greenish brown
220 – 242 Clay gyttja
242 > 250 Gyttja silt
Stop at coarse min. material

Bp 8
000 – 100 Water
100 – 160 Gyttja, uncon.
160 – 186 Algal gyttja, red
186 – 212 Gyttja, green
212 > 255 Clay gyttja
Stop at coarse min. material

Bp 9
000 – 090 Water
090 – 170 Gyttja, uncon.
170 – 195 Algal gyttja, red
195 – 210 Gyttja, green
210 – 255 Clay gyttja
255 > 260 Clayey silt
Stop at coarse min. material

Bp 10 Lat. 60° 25′ 45′′ Long. 17° 52′ 6′′(Near the three ditches in the fen, west of the esker at Sillbo)
000 – 065 Fen wood peat
065 – 120 Silty clay with gyttja
120 > 150 Gyttja clay/clay gyttja
Stop at till

Bp 11 Lat. 60° 26′ 21′′ Long. 17° 53′ 24′′ (Gökshaga fen)
000 – 030 Sedge peat
030 – 165 Gyttja, brownish red
165 – 263 Silty clay gyttja
263 > 275 Sandy silt
Stop at coarse min. material

Bp 12 (Lat. 60° 26′ 41′′ Long. 17° 53′ 24′′ (North of Bp 11 in Gökshaga fen)
000 – 150 Moss peat
150 – 200 Reed peat
200 – 230 Gyttja, red
230 – 255 Gyttja, brown
255 – 310 Clay gyttja
310 > 315 Silty clay gyttja
Stop at coarse min. material

Bp 13 Lat. 60° 26′ 37′′ Long. 17° 38′ 37′′ (West of Bp 12, between L. Landholmssjön and Gökshaga fen)
000 – 110 Moss peat
110 – 175 Sedge peat
175 – 255 Reed peat
255 – 290 Gyttja
290 > 302 Clay gyttja
Stop at coarse min. material

Lake Skälsjön (13 m a.s.l.)
Bp 1
000 – 050 Water
050 – 087 Gyttja, uncon.
087 – 095 Gyttja, brown with roots of reed
095 – 159 Silty clay gyttja
159 > 160 Sandy silt

Bp 2
000 – 110 Water
110 – 120 Gyttja, uncon.
120 – 147 Clay gyttja, greenish brown
147 – 155 Sand
155 – 160 Clay, postglacial, bluish grey
160 > 210 Glacial clay, calcareous

Bp 3
000 – 120 Water
120 – 138 Gyttja, uncon.
138 – 140 Silt
140 > 150 Sand
Stop at coarse min. material

Bp 4
000 – 150 Water
150 – 158 Gyttja, uncon.
158 – 193 Gyttja, brown
193 – 320 Clay gyttja, greenish brown
320 – 325 Sand
325 > 350 Clay, postglacial, sulphide precipitation

Bp 5
000 – 120 Water
120 – 160 Gyttja, uncon.
160 – 200 Clay gyttja
200 – 205 Silty sand
205 – 215 Gravel
215 > 350 Clay, glacial and postglacial, calcareous

Bp 6
000 – 090 Water
090 – 132 Gyttja, uncon.
132 – 135 Silt
135 > 150 Sand
Stop at coarse min. material

Bp 7
000 – 085 Water
Stop at bedrock or boulder

Bp 8
000 – 120 Water
Stop at bedrock or boulder

Bp 9
000 – 115 Water
115 – 128 Gyttja, uncon.
128 – 130 Gyttja, brown
130 – 172 Clay gyttja, greenish brown
172 – 181 Silty sand
181 – 183 Gravel
183 > 230 Clay with sulphide precipitation

Bp 10
000 – 140 Water
140 – 170 Gyttja, brown
170 > 300 Clay gyttja
Stop at bedrock or boulder

Bp 11
000 – 160 Water
160 – 183 Gyttja, brown
183 – 338 Clay gyttja, greenish brown
338 – 347 Sand
347 > 360 Clay, bluish grey with sulphides

Bp 12
000 – 115 Water
115 – 130 Gyttja, uncon.
130 – 174 Gyttja, brown
174 – 249 Clay gyttja, greenish brown
249 – 258 Sand
258 – 261 Gravel
261 > 340 Clay with sulphides

Bp 13
000 – 100 Water
100 – 153 Gyttja, uncon.
153 – 168 Clay gyttja
168 – 179 Sandy silt
179 – 193 Sand
193 > 200 Clay with sulphide precipitation

Bp 14
000 – 090 Water
090 – 103 Gyttja, uncon.
103 – 120 Gyttja, brown
120 – 166 Clay gyttja, greenish brown
166 > 195 Clay, glacial

Bp 15 (Reed belt)
000 – 050 Water
050 – 125 Gyttja, brown
125 > 150 Sand
Stop at coarse min. material

Bp 16 (Reed belt)
000 – 050 Water
050 – 133 Gyttja, brown
133 – 140 Gyttja silt
140 > 150 Sand
Stop at coarse min. material

Bp 17 (Alder fen)
000 – 075 Fen wood peat
075 – 115 Gyttja, brown
115 > 120 Silty sand
Stop at coarse min. material

Bp 18 (Near the inlet in the NW part of L. Skälsjön)
000 – 100 Fen wood peat
100 – 105 Clay gyttja
105 > 110 Silty sand
Stop at coarse min. material

Lake Norra Åsjön (12 m a.s.l.)
Bp 1
000 – 090 Water
090 – 160 Gyttja, brown with roots of reed
160 – 174 Clay gyttja, greenish brown
174 > 250 Clayey silty sand with pebbles
Stop at coarse min. material

Bp 2
000 – 300 Water
300 – 345 Gyttja, brown
345 – 400 Clay gyttja, greenish brown
Stop at coarse min. material

Bp 3
000 – 110 Water
110 > 130 Gyttja, uncon.
Stop at coarse min. material and roots

Bp 4
000 – 200 Water
200 – 225 Gyttja, uncon.
225 – 309 Gyttja, brown
309 – 465 Clay gyttja/gyttja clay, greenish brown
465 > 475 Silt
Stop at coarse min. material

Bp 5
000 – 280 Water
280 – 285 Gyttja, uncon.
285 – 300 Gyttja, brown
300 – 430 Clay gyttja/gyttja clay, greenish brown
430 > 440 Silt with pebbles
Stop at coarse min. material

Bp 6
000 – 200 Water
Stop at coarse min. material

Bp 7
000 – 190 Water
190 – 205 Gyttja, uncon.
205 – 233 Gyttja, brown with roots
233 – 241 Clay gyttja, greenish brown
241 – 254 Sand with gravel
254 > 290 Clay, glacial, calcareous

Bp 8
000 – 060 Water
Stop at coarse min. material

S1 (Stormossarna bog)
000 – 100 Fen wood peat
100 – 106 Gyttja sand
106 > 115 Sand
Stop at coarse min. material

S2
000 – 232 Fen wood peat
232 – 378 Gyttja
378 – 380 Clay gyttja/gyttja clay
380 – 388 Silty sand with humic matter
388 > 390 Silty sand with gravel
Stop at coarse min. material

S3
000 – 100 Fen wood peat
100 – 254 Reed peat
254 – 285 Gyttja, greenish brown
285 – 395 Clay gyttja/gyttja clay
395 – 400 Silty sand with gyttja
400 > 402 Silty sand with gravel
Stop at coarse min. material

S4
000 – 100 Fen wood peat
100 – 248 Reed peat
248 – 277 Gyttja, greenish brown
277 – 410 Clay gyttja/gyttja clay
410 > 425 Sandy silt
Stop at coarse min. material

Lake Södra Åsjön (12 m a.s.l.)
Bp 1
000 – 080 Water
080 –100 Gyttja, uncon.
100 – 195 Gyttja and peat with roots
195 – 220 Gyttja, reddish brown with roots
220 – 247 Clay gyttja
247 > 250 Silt
Stop at coarse min. material

Bp 2
000 – 200 Water
200 – 225 Gyttja, uncon.
225 – 230 Gyttja, brown
230 > 240 Silt
Stop at coarse min. material

Bp 3
000 – 203 Water
203 – 210 Gyttja, uncon.
210 – 220 Gyttja
220 – 225 Silt
225 > 250 Sand
Stop at coarse min. material

Bp 4
000 – 260 Water
260 – 295 Gyttja, uncon.
295 – 305 Gyttja, dark brown
305 – 325 Gyttja, greenish brown
325 – 330 Clay gyttja
330 > 340 Silty sand
Stop at coarse min. material

Bp 5
000 – 270 Water
270 – 273 Gyttja, uncon.
273 – 277 Gyttja, dark brown
277 – 285 Clay gyttja
285 > 300 Silty sand
Stop at coarse min. material

Bp 6
000 – 330 Water
330 – 350 Gyttja, uncon.
350 – 370 Gyttja, greenish brown
370 – 385 Silt
385 – 400 Sand
400 – 402 Clay, green
402 – 405 Sand
405 – 470 Clay, bluish grey with sulphide precipitation
470 > 570 Glacial clay, beige

Bp 7
000 – 300 Water
300 – 330 Gyttja, uncon.
330 – 335 Gyttja
335 – 367 Clay gyttja
367 – 405 Silty sand
405 > 430 Clay, calcareous, glacial

Bp 8
000 – 220 Water
220 – 250 Gyttja, uncon.
250 – 282 Gyttja, reddish brown
282 – 300 Clay gyttja, green
300 – 310 Sand with gravel
310 > 320 Clay, beige

Bp 9
000 – 130 Water
130 – 165 Gyttja, uncon.
165 – 225 Gyttja, reddish brown
225 – 227 Clay gyttja, green
227 > 230 Sandy gravel
Stop at coarse min. material

Bp 10
000 – 320 Water
320 – 350 Gyttja, uncon.
350 – 355 Gyttja
355 – 385 Clay gyttja
385 – 403 Silt
403 – 406 Clay, green
406 – 410 Silt with pebbles
410 > 450 Clay with sulphide precipitation

Bp 11
000 – 315 Water
315 – 350 Gyttja, uncon.
350 – 394 Gyttja, brown
394 – 415 Clay gyttja
415 – 437 Silty sand
437 – 441 Clay
441 – 458 Silt
458 > 540 Clay with sulphide precipitation

Bp 12
000 – 265 Water
265 – 295 Gyttja, uncon.
295 – 315 Gyttja
315 – 325 Clay gyttja
325 > 360 Sand with gravel
Stop at coarse min. material

Bp 13
000 – 110 Water
Stop at coarse min. material or roots

Bp 14
000 – 200 Water
Stop at coarse min. material

Bp 15
000 – 260 Water
260 – 340 Gyttja, uncon.
340 – 467 Gyttja, green
467 – 470 Sand
470 > 550 Clay with sulphide precipitation

Bp 16
000 – 190 Water
190 – 200 Gyttja, uncon.
200 – 277 Gyttja, red
277 – 335 Gyttja, green
335 > 350 Silty sand
Stop at coarse min. material

Bp 17
000 – 110 Water
110 – 185 Gyttja, uncon.
185 – 265 Gyttja, brown
265 – 273 Gyttja, green
273 > 285 Silt
Stop at coarse min. material

F1 (Frebbenbomossarna bog)
000 – 030 Water
030 – 180 Reed peat
180 – 185 Gyttja, green
185 – 188 Gyttja, brown
188 – 191 Silty gyttja, green
191 > 200 Gyttja sand with gravel
Stop at coarse min. material

F2
000 – 030 Water
030 – 220 Gyttja, brown
220 – 260 Gyttja, green
260 – 268 Gyttja with gravel
268 > 270 Sand with gravel
Stop at coarse min. material

F3
000 – 030 Water
030 – 180 Reed peat
180 – 210 Gyttja, coarse detritus brown
210 – 227 Gyttja, brown
227 – 229 Gyttja, green
229 – 232 Gyttja, brown
232 – 240 Gyttja, green
240 – 248 Gyttja, grey
248 > 260 Silty gyttja, green
Stop at bedrock or boulder

F4
000 – 030 Water
030 – 185 Reed peat
185 – 205 Gyttja, coarse detritus, brown
205 – 230 Gyttja, green
230 – 232 Gyttja, brown
232 – 250 Gyttja, grey
250 – 251 Sandy silt
251 – 265 Silty clay
265 > 275 Clay with gravel
Stop at bedrock or boulder

F5
000 – 060 Water
060 – 115 Fen wood peat
115 – 127 Gyttja, green
127 > 135 Gyttja, brown
Stop at bedrock or boulder

Lake Eckarfjärden (4 m a.s.l.)
Bp 1
000 – 085 Water
085 – 155 Gyttja, uncon.
155 – 200 Algal gyttja, red with shells
200 – 220 Clay gyttja, green
220 > 230 Silty sand
Stop at coarse min. material

Bp 2
000 – 165 Water
165 – 240 Gyttja, uncon.
240 – 260 Algal gyttja, red with shells
260 – 295 Algal gyttja, green
295 – 310 Clay gyttja, green
310 – 322 Silty sand
322 > 340 Clay, bluish grey, calcareous

Bp 3
000 – 190 Water
190 – 322 Algal gyttja, red, with shells
322 – 342 Gyttja, green
342 – 365 Clay gyttja, greenish brown
365 > 390 Silty sand
Stop at coarse min. material

Bp 4
000 – 220 Water
220 – 330 Algal gyttja, red with shells
330 – 355 Gyttja, greenish brown
355 – 367 Clay gyttja
367 – 380 Silty sand
380 > 450 Clay, bluish grey

Bp 5
000 – 210 Water
210 – 283 Algal gyttja, red
283 – 290 Gyttja, calcareous, beige
290 – 298 Algal gyttja, red
298 – 300 Gyttja, calcareous, beige
300 – 320 Algal gyttja, red
320 – 330 Gyttja, greenish brown
330 – 360 Clay gyttja, greenish brown
360 – 365 Sand
365 – 373 Gravel
373 – 380 Clay, grey
380 – 403 Clay, black with sulphide precipitation
403 > 440 Clay, pink, calcareous

Bp A
000 – 125 Water
125 – 151 Gyttja, uncon.
151 – 166 Gyttja, calcareous
166 – 167 Gyttja
167 – 170 Clay gyttja
170 > 175 Sand
Stop at coarse min. material

Bp B
000 – 170 Water
170 – 195 Gyttja, uncon.
195 – 200 Algal gyttja, with shells
200 – 210 Gyttja, green
210 – 225 Clay gyttja
225 > 235 Sand
Stop at coarse min. material

Bp C
000 – 190 Water
190 – 230 Gyttja, uncon.
230 – 278 Algal gyttja with shells
278 – 285 Gyttja, green
285 – 315 Clay gyttja
315 > 320 Sand
Stop at coarse min. material

Bp D
000 – 110 Water
110 – 250 Gyttja, uncon.
250 – 265 Gyttja, green
265 – 276 Clay gyttja
276 – 280 Sand
280 > 350 Clay, bluish grey

Bp E
000 – 205 Water
205 – 270 Gyttja, uncon.
270 – 298 Algal gyttja with shells
298 – 310 Gyttja, green
310 – 340 Clay gyttja
340 > 350 Sand
Stop at coarse min. material

Bp F
000 – 195 Water
195 – 295 Gyttja, uncon.
295 – 313 Algal gyttja, red
313 – 327 Gyttja, green
327 – 367 Clay gyttja
367 > 380 Sand
Stop at coarse min. material

Bp G
000 – 140 Water
140 – 221 Gyttja, uncons.
221 – 270 Algal gyttja, red with shells
270 – 273 Gyttja, green
273 – 295 Clay gyttja
295 > 300 Sand
Stop at bedrock or boulder

Bp H
000 – 180 Water
180 – 210 Gyttja, uncon.
210 – 230 Algal gyttja with shells
230 – 240 Gyttja, calcareous, beige
240 – 245 Algal gyttja with shells
245 – 270 Gyttja, green
270 – 300 Clay gyttja
300 > 305 Sand
Stop at coarse min. material

Bp I
000 – 230 Water
230 – 325 Gyttja, uncon.
325 – 363 Algal gyttja, red with shells
363 – 370 Gyttja, green
370 – 392 Clay gyttja
392 – 408 Sand
408 – 420 Clay, grey with sulphide precipitation
420 > 450 Clay, beige, calcareous

Bp J
000 – 220 Water
220 – 300 Gyttja, uncon.
300 – 342 Algal gyttja, red
342 – 350 Gyttja, green
350 – 368 Clay gyttja
368 – 375 No recovery
375 – 380 Sand
380 – 385 Gravel
385 – 440 Clay, bluish grey with sulphide precipitation
440 > 450 Clay, beige

Lake Limmaren (4 m a.s.l.)
Bp 1
000 – 350 Water
350 – 450 Gyttja, uncon.
450 – 740 Gyttja, brown
740 – 744 Clay gyttja/gyttja clay
744 – 755 Silt with pebbles
755 > 850 Clay, bluish grey with sulphide precipitation

Bp 2
000 – 450 Water
450 – 572 Gyttja
572 – 574 Silty gyttja
574 – 577 Gyttja silt
577 – 800 Clay
800 > 900 Silty sand
Stop at coarse min. material

Bp 3
000 – 650 Water
650 > 895 Clay gyttja/gyttja clay, greenish brown

Bp 4
000 – 500 Water
500 – 720 Gyttja, greenish brown
720 > 1000 Clay gyttja, sulphide precipitation, few shells
Method stop

Bp 5
000 – 410 Water
410 – 572 Gyttja clay
572 > 600 Clay, bluish grey with sulphide precipitation

Bp 6
000 – 600 Water
600 – 663 Gyttja, greyish greenish brown
663 > 900 Clay gyttja/gyttja clay, few shells
Method stop

Bp 7
000 – 260 Water
260 – 494 Clay gyttja/gyttja clay greyish brown, few remains of shells
494 – 499 Sandy silt
499 – 534 Clay, grey
534 > 600 Clay, beige

Bp 8
000 –130 Water
130 – 160 Gyttja uncon.
160 – 300 Clay gyttja/gyttja clay, greyish greenish brown
300 – 305 Sandy silt
305 – 355 Clay, bluish grey
355 > 400 Clay, beige

Lake Fiskarfjärden (0 m a.s.l.)
Bp 1
000 – 070 Water
070 – 128 Gyttja, greenish brown
128 – 151 Sand with gravel
151 – 155 Clay, bluish grey with pebbles
155 > 170 Clay, beige

Bp 2
000 – 180 Water
180 – 185 Gyttja, uncon.
185 – 223 Gyttja with roots
223 – 254 Clay gyttja, greenish brown with pebbles
254 > 280 Clay

Bp 3
000 – 090 Water
090 – 120 Gyttja, uncon.
120 – 238 Gyttja, brown
238 – 271 Clay gyttja, greenish brown
271 – 277 Silt
277 – 285 Sand
285 > 290 Clay

Bp 4
000 – 060 Water
060 – 115 Gyttja, uncon.
115 – 132 Silt
132 – 145 Sand
145 > 146 Clay

Bp 5
000 – 060 Water
060 – 070 Gyttja, uncon.
070 – 153 Gyttja with roots
153 – 224 Clay gyttja, greenish brown
224 – 233 Sand
233 > 260 Clay

Bp 6
000 – 080 Water
080 – 115 Gyttja, uncon.
115 – 203 Gyttja, brown
203 – 333 Clay gyttja, greenish brown
333 – 337 Sand
337 > 350 Clay with sulphide precipitation

Bp 7
000 – 070 Water
070 – 090 Gyttja, uncon.
090 – 112 Gyttja, brown
112 – 148 Clay gyttja, greenish brown
148 – 151 Sand
151 > 170 Clay