

Stratigraphical Methods Applied to Shore Displacement Studies

Abstract

Stratigraphical methods applied to shore displacement studies used within the framework of « Project Eastern Svealand : The Development of the Holocene Landscape » are described. Of importance are the presence of suitable basins, accurate levellings of the isolation thresholds of the basins, stratigraphical corings, careful analysis of the diatom content in the sediments and radiocarbon datings. Material needed for reliable datings has been taken from 15-20 cores, sampled within an area of 1-2 m². The exact levels for subsampling have been correlated by means of soil stratigraphy and diatom analysis. A selected list of references concerning shore displacement studies in Fennoscandia has been compiled.

Introduction

One of the most important goals of « Project Eastern Svealand : The Development of the Holocene Landscape » is to construct a reliable shore displacement curve for the central part of the peninsula Södertörn, south of Stockholm, Sweden (Fig. 1). Lake basins have been chosen as the main type of investigation sites. An important presumption for this kind of investigation is the presence of basins with well defined thresholds at different altitudes, situated in an area with land uplift. It is also important that the basins are situated at the same isostatic isobase. The construction of a shore displacement curve is built up on two kinds of investigations ; the levelled topographical isolation of the basins on the y-axis and the radiocarbon dated biological isolation on the x-axis. An example of a shore displacement curve is shown in MILLER (this volume, p. 149, Fig. 12).

Below, the studies are described in more detail and some difficulties concerning the interpretation of the results are pointed out.

Levelling of isolation thresholds

The isolation threshold level is that which existed at the time when the basin was cut off from some earlier stage of the Baltic Sea. After

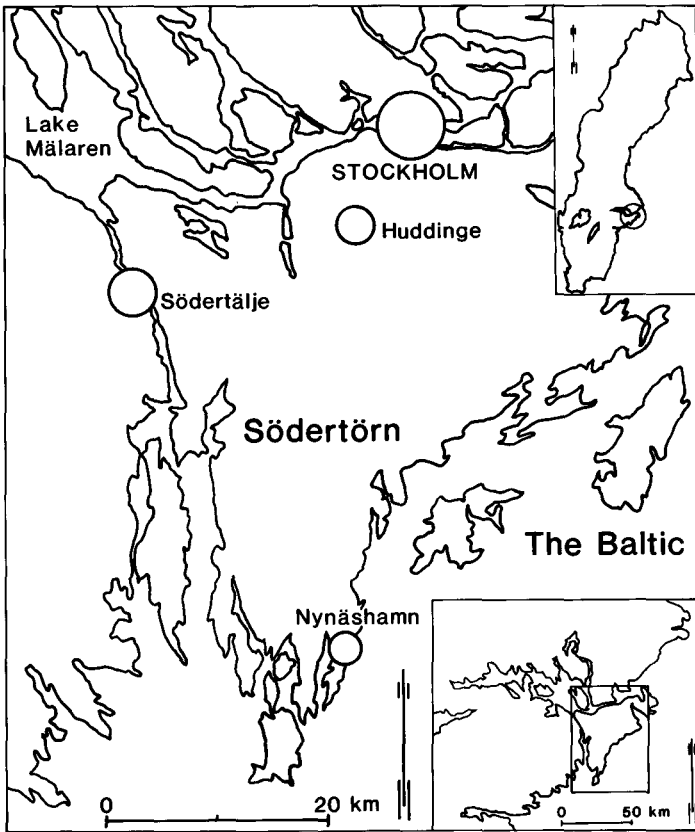


Fig. 1. Location map, showing the main investigation area, the peninsula Södertörn, in Project Eastern Svealand : The Development of the Holocene Landscape.

isolation, the threshold level has been altered by means of outlet erosion, peat growth and anthropogenic activities. To obtain the altitude, levellings along the present outlet were carried out. At the highest level, cross-sections were carried out. The cross-section with the highest value is considered to correspond to the isolation level (Fig. 2). All levels must be measured on a ground surface which is thought to have been unaffected by erosion since the time of isolation. Important parameters to consider are :

1. the stratigraphy of the soils in the outlet area ;
2. an estimation of the amount of erosion in the outlet ;
3. an estimation of the amount of anthropogenic influence ;
4. to decide if the outlet has changed its position after the isolation event.

The accuracy of the result is $+ 0,5 - 0,0$ m, *i.e.* the value is considered to be a minimum level.

c - location of coring site representative for the deepest part of the lake
 e - location of coring site representative for the outlet area

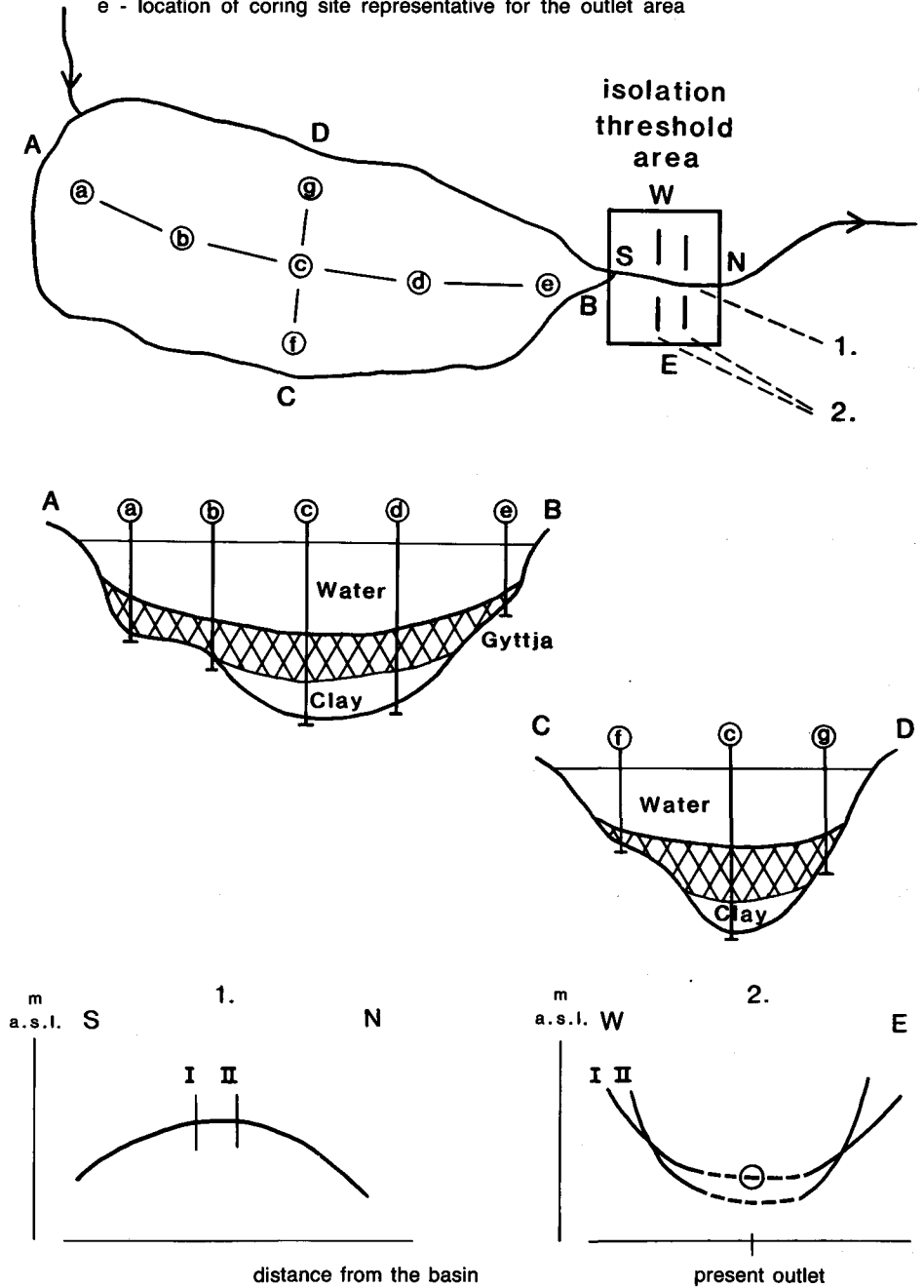


Fig. 2. An example of a lake with the position of coring sites (a-g), stratigraphical cross-sections (A-B and C-D) and isolation threshold area. A length-section (1) and two cross-sections (2) within the isolation threshold area are schematically drawn. Cross-section I is considered to show the isolation threshold value.

The isolation contact as shown in the sediments

In order to determine the isolation level in the sedimentary sequence it is important to use a representative sediment core. This can be achieved by stratigraphical corings within the basin (Fig. 2). The core analysed should show continuous sedimentation, *i.e.* no hiatus. Accurate analysis of the susceptibility in different sediment cores can be used to estimate if the analysed core is representative for the basin.

When a basin is cut off from the Baltic a change in the water chemistry occurs which will in turn affect the composition of the diatom flora. By identification of the different species and a knowledge of their environmental demands it is possible to detect the isolation level within the sedimentary sequence, often with an accuracy of a few cm.

The organic carbon content in the sediments has also been measured. Usually, there is a characteristic rise of carbon content in connection with the isolation. This is due to a higher organic production in the isolated lake and less erosion on the shores, *i.e.* less deposition of minerogenic material. Fluctuations of the organic carbon content, before or in connection with the isolation, could indicate changes in the water level, *i.e.* transgressions and/or regressions.

Radiocarbon datings

The sediment from the isolation level is radiocarbon dated. In this project, material from 15-20 cores with a diameter of 10 cm, sampled from an area of approx. 1-2 m², has been used. In one of the cores, detailed diatom analysis has been carried out and correlation has been made using lithostratigraphical levels. Slices, c. 2 cm thick, have been taken out from the other cores, mixed together and dated. At least three levels (before and after the isolation event) should be dated to get reliable results.

In order to convert the radiocarbon datings to calendar years it is important to correct and calibrate for variations of ¹⁴C in the atmosphere, apparent age, reservoir effect and isotope fractioning (¹³C). In future work accelerator datings will be carried out on the same sediment core as the one used for diatom and pollen analysis. An interpretation of reliability of the datings also includes a discussion about the origin of the sediment and the deposition rate.

Pollen analysis

In eastern Svealand the immigration of different tree species into the area is relatively well known. Therefore an analysis of the pollen content in connection with the datings will indicate the reliability of the result. The same core should be used for both pollen and diatom analysis.

Restrictions and limitations of a shore displacement curve

The curve is restricted to a geographical area with the same isostatic uplift.

In the Södertörn area, the bedrock is crossed by many joint fissure systems. There have been discussions whether different blocks have been lifted unequally. This could be one reason why basins situated at the same height sometimes show different isolation ages.

It is also uncertain if transgressions are only partly recorded in lake basins. The basins may have a too large water volume to registrate short changes in the water depth and chemistry. There are some indications that transgressions are recorded in lake sediments as more or less stable water levels for a certain time span.

The correct interpretation of the diatom stratigraphy in each basin is very important. The fossil diatom flora include redeposited frustules from older sediments around the basin and contamination from earlier isolated basins higher up in the water system. There may also have been dissolution of frustules or transportation of diatom frustules out from the basin.

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