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Oskarshamn site investigation

Investigation of Quaternary deposits at Simpevarp peninsula and the islands of Ävrö and Hålö

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Keywords: Quaternary deposit, Extension, Thickness, Glacial striae, Stratigraphy, Exposed bedrock.

This report concerns a study which was conducted for SKB. The conclusions and viewpoints presented in the report are those of the author and do not necessarily coincide with those of the client.

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Sammanfattning

SKB genomför undersökningar i Forsmark och Oskarshamn för att lokalisera en lämplig plats för förvaring av landets kärnkraftsavfall. Ett moment i det platsspecifika programmet i Oskarshamn är att undersöka jordarterna inom det sk regionala modellområdet. Detta sker genom att beskriva jordarternas sammansättning, mäktighet och utbredning. Den insamlade informationen används bl a för hydrogeologisk modellering. Under år 2003 påbörjades arbetet genom en detaljerad undersökning av jordartsgeologin på Simpevarpshalvön och de närliggande öarna Hålö och Ävrö.

Jordarterna i det undersökta området är tunna och därför har berg i dagen en mycket stor utbredning i markytan. Närmare 50 % av det undersökta området utgörs av kalt berg. Bergets yta har eroderats och omformats av landisar. På många platser finns välformade sk rundhällar med tydliga isräfflor. Riktningen av dessa räfflor visar att den senaste landisen i regionen rörde sig från nordväst till sydost ut mot östersjösänkan.

Morän med mäktigheter på upp till 3 m är den vanligaste jordarten. I berggrundens sänkor kan mäktigheten lokalt vara något större. Mestadels är moränen sandig men det förekommer även en grusig moräntyp. Blockhalten i ytan är normal med strödda, allmänt förekommande små och medelstora block. Det finns dock ganska stora ytor som är blockrika.

Lera förekommer på några få ställen spridda över området i landskapets lågpartier. Den är tunn med mäktigheter på upp till ca 2 m och avsattes i östersjösänkan då den senaste landisen försvann från området för ca 14 000 år sedan. Hela det undersökta området var då täckt av vatten. På grund av landhöjningen har området sakta stigit upp ur havet. Då bildades svallsediment i form av grus, sand och klapper genom att moränens ytlager omlagrades av vågor vid stränder. Dessa sediment uppträder framför allt i kustnära områden på Ävrö. Väl utbildade klapperstensfält finns där i strandzonen.

Torvmarkerna i det undersökta området är få och har indelats i kärr och mossar. Torvens mäktighet är i allmänhet endast någon meter.

Stora ytor kring kärnkraftsverket har kraftigt förändrats genom sprängning, schaktning, fyllning eller andra former av grundarbeten. Den ursprungliga markytan täcks av främmande material och det är omöjligt att där kartlägga jordarternas utbredning. Dessa ytor har därför fått en enhetlig beteckning, fyllning.

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1 Introduction

SKB performs site investigations in order to find a deep repository for high level radioactive waste. The site investigations are performed at two sites, Oskarshamn and Forsmark. This document reports the data gained 2003 within the activity Investigation of unconsolidated Quaternary deposits at Oskarshamn. The investigation area is shown in Figure 1-1. The work was conducted according to activity plan AP PS 400-03-022 (SKB internal controlling document) however limited to the Simpevarp peninsula and the adjacent islands. The investigations are planned to continue at Laxemar subarea and the regional area during 2004.

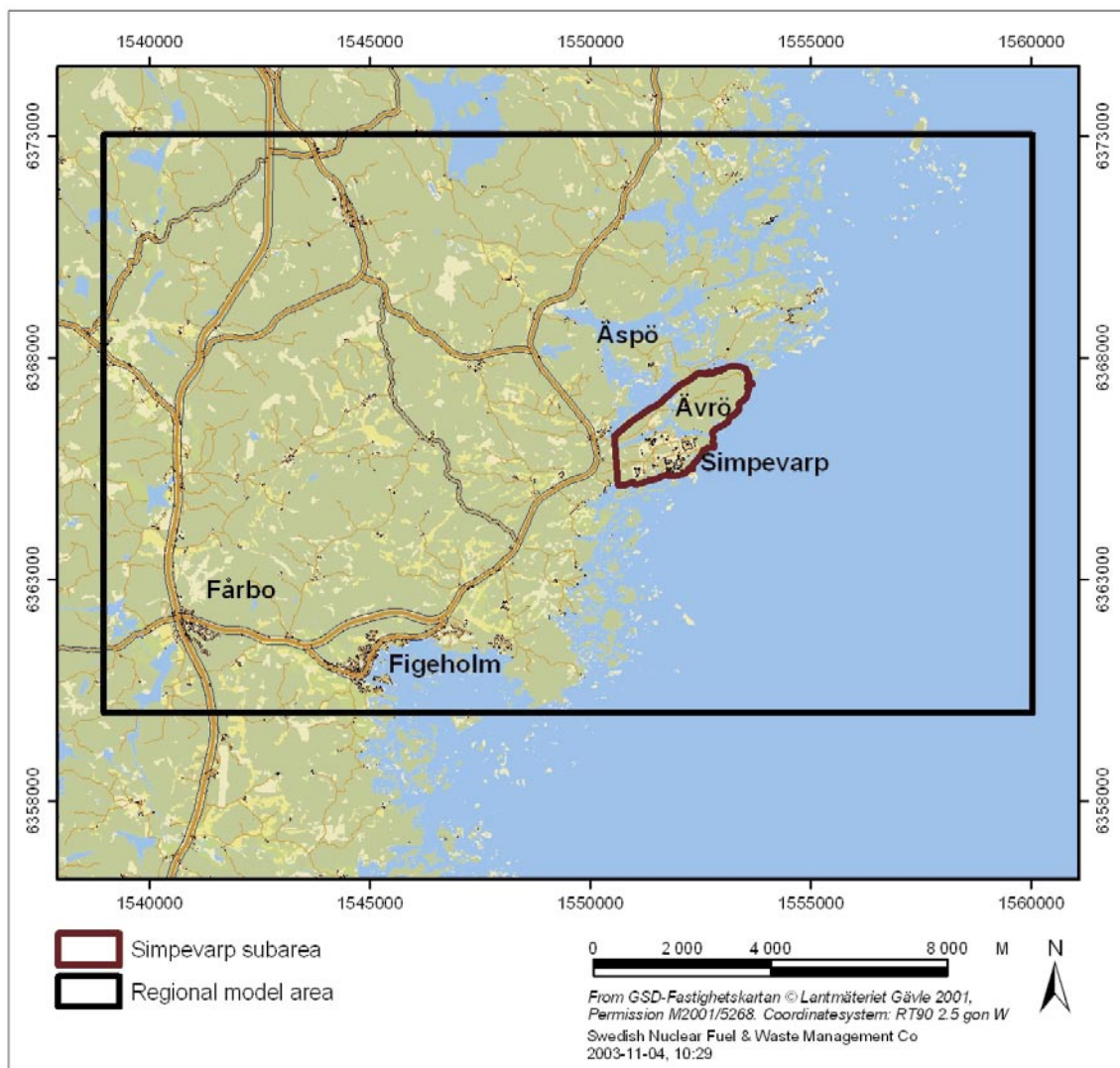


Figure 1-1. The investigation area of Quaternary deposits at Oskarshamn. The peninsula of Simpevarp and the adjacent islands of Ävrö and Hålö are marked in the figure.

2 Objective and scope

The geological investigation of Quaternary deposits at Oskarshamn site investigation area started in May 2003 and will be finished at the end of 2004. The aim of this activity is to describe and characterize the formation, grain size composition, the chemical and physical properties, the distribution of the uppermost unconsolidated Quaternary deposits and, as far as possible, the thickness and stratigraphic condition of all deposits above the bedrock surface. Besides, this investigation shows the extension of areas with exposed bedrock.

The information gained from the investigation of Quaternary deposits will be useful for the hydrogeological modelling and for models of the Late Quaternary development.

The investigation area is shown in Figure 1-1. The information from the regional area will be carried out and adopted to the scale 1:50,000. Besides, the Quaternary geology within two small areas, the peninsula of Simpevarp with the adjacent islands of Ävrö and Hålö and the Laxemar subarea, will be investigated and carried out in a more detailed scale, 1:10,000.

This report contains field data carried out to scale 1:10,000 from the peninsula of Simpevarp and the islands of Ävrö and Hålö (see Figure 1-1). This area is about 5 square kilometres. The result appears from the map in Figure 5-1, which shows the extension of different Quaternary deposits and exposed bedrock. The field data also involve measurements of glacial striae, which show the directions of glacial movements, and thickness information about different Quaternary deposits, as for instance peat and clay.

The analysis results from grain size distribution and chemical and physical properties of the deposits from the area with detailed information in the vicinity of Simpevarp, will be presented together with analysis results from Laxemar subarea.

The Quaternary geology within the investigation area has earlier been mapped by the Geological Survey of Sweden /1/. This information is relatively old and has only been presented in a survey map in scale 1: 100,000.

A new map of the Quaternary deposits was presented in 1998 /2/. This map is only based upon interpretation of aerial photos and shows too much of areas with exposed bedrock.

3 Equipment

The used equipment in field follows the SKB method description (MD 131.001, SKB internal controlling document). A spade and two hand-driven probes were used for examination and determination. GPS and aerial infrared photos taken from a height of 2,300 m were used for orientation. A mirror compass was used to measure the directions of the glacial striae.

All field data have been digitally stored in a database in accordance with the SKB method description.

4 Execution

The work was performed according to the activity plan AP PS 400-03-022 (SKB internal controlling document) following the method description for mapping Quaternary deposits SKB MD 131.001 (SKB internal controlling document).

Firstly, aerial infrared photos, taken from a height of 2,300 m, was interpreted in a computer. Areas with exposed bedrock and different Quaternary deposits were marked. In most cases, the interpretation showed thin Quaternary deposits and large areas with exposed bedrock. Till is the most common deposit. Different types of fine-grained sediment and peat occur in the depressions and at inlets. Deposition of littoral sand, gravel and cobble field (shingle) has taken place near the coast.

The marked areas and all limits were checked and confirmed in the field. New and correct limits were drawn on field maps showing exposed bedrock and the distribution of different Quaternary deposits at a depth of 50 cm. Peat with a thickness less than 50 cm were also marked in field. At this work a spade and a simple hand driven probe was used. Besides, the information from detailed bedrock investigations has been taken into consideration.

The thickness of different peat layers, glacial clay and fine-grained sediments were determined to a depth of about 1.5 m by boring with a so-called Edelman-borr. In trenches thickness of different layers and stratigraphical data were measured.

4.1 Preparations

The GPS was controlled every day at a point with known position (6367749N, 1551366E). This control defined a precision better than ± 10 m.

4.2 Data handling

The locations of observation points (from mapping, stratigraphical observations and measurements of glacial striae) were determined with GPS. The dates of the observations were notified and they were all given PSM numbers. All point co-ordinates and dates were later stored in SICADA. The geological information connected to the PSM numbers was stored in a database for mapping Quaternary deposits at the Geological Survey of Sweden (Jorddagboken, version 5.4.3), and subsequently exported to SICADA.

The drawings of exposed bedrock and Quaternary deposits on the field maps (aerial photos) have been scanned and transformed into a database. This information has been delivered to SKB in Arc View shape on CD-ROM (SGU 08-618/2003). A second deliverance with a few and small additions is enclosed with this report.

5 Results

The investigated area, the peninsula of Simpevarp and the adjacent islands of Ävrö and Hålö with an area of about 5 square kilometres is located in the archipelago north of Oskarshamn. The area is relatively flat, dominated by exposed bedrock. About 47% of the investigated area is exposed bedrock (excluding areas mapped as artificial fill). In some places, there are distinct valleys, which partly are covered with different kinds of sediments. A distinct valley runs in SW–NE direction to the west of the power station from the small village Karlshamn at the Baltic Sea to the main road north of CLAB, a distance of about 800 m. Other marked valleys can be found on Ävrö.

Glaciers have polished the bedrock surface to a large extent. The number of striae localities is about 60. The striae can be found all over the area but they occur most frequently on the shore at the Baltic Sea. The dominating ice movement in the area was, according to the striae directions, from N40–50°W. All the striae localities show this direction and these striae reflect most probably the ice movement in the front zone during the ice recession. On the northernmost cape of Hålö, a somewhat more northerly striae direction has been observed. Probably, these striae reflect an older ice movement from N30°W.

Till is the dominating Quaternary deposit and covers about 43% of the investigated area. No moraine ridges or moraine hills have been observed neither at the interpretation of aerial infrared photos nor at the fieldwork. Therefore, the morphology of the till areas normally reflects the morphology of the bedrock surface. The till thickness is often between 0.5 and 3 m. In some places, as in the western part of Hålö, the till thickness might be somewhat more. This can only be revealed from excavations in the future.

In general, the boulder (and stone) frequency in the till surface is medium but areas with a high boulder frequency occur, especially on the peninsula of Simpevarp and on the western part of the island of Hålö. There are also a few small areas with a high frequency of large boulders. The internal frequency of boulders in the till is probably medium.

According to the composition of the matrix most of the till is sandy. Also coarse till, i.e. gravelly, is found in some trenches. This till type has been observed in trenches south of Skölkärret on Ävrö (6366808N, 1552525E) and 100 m east of the bridge at Lindströmmen (6367413N, 1552297E). It was impossible to separate these two till types in the field. Therefore, all till areas have been named sandy till in Figure 5-1.

The whole-investigated area is situated below the highest shoreline. As a consequence the till surface was re-worked by wave washing during the land-uplift. In exposed positions this has resulted in deposition of a thin cover of sand and gravel above the till. These deposits have been marked at the fieldwork. They often occur alongside the Baltic in the eastern part of Ävrö and in the southern part of the peninsula of Simpevarp.

Glacial clay has a rather limited distribution of the mapped area. Often, this fine-grained deposit occurs as a cover in many valleys and younger postglacial sediments often overlie it.

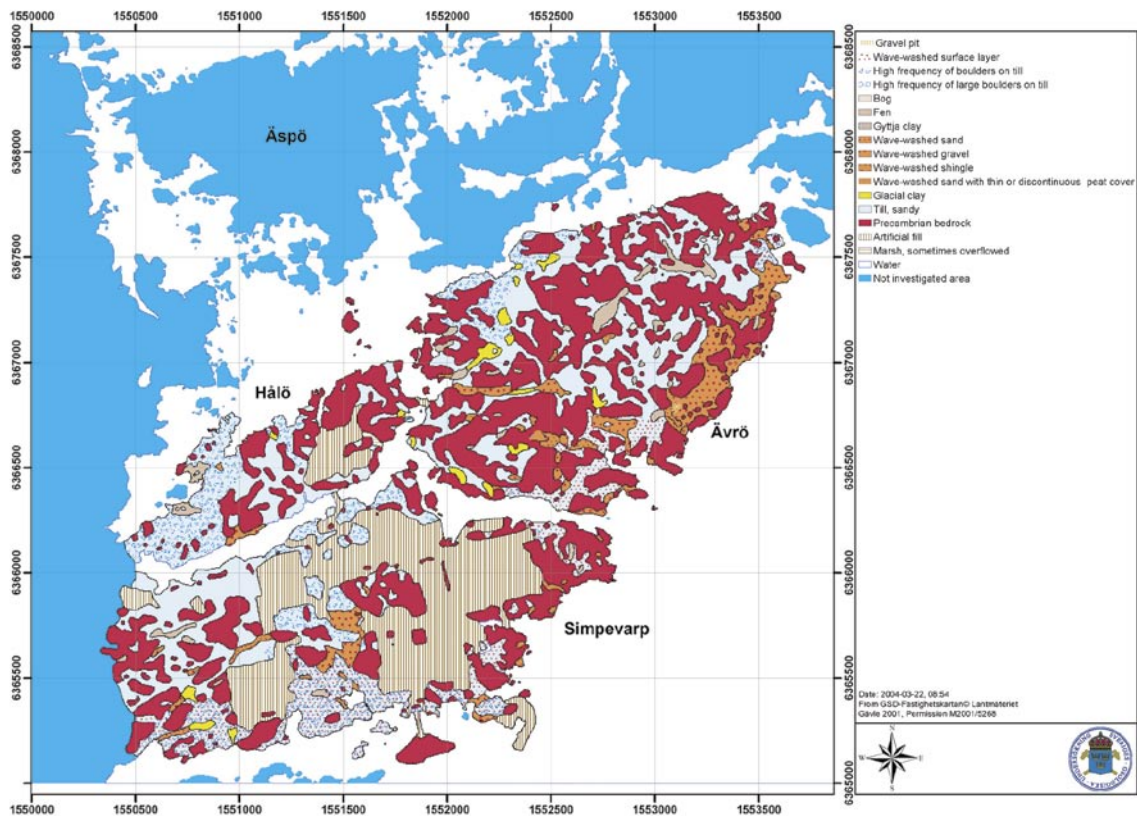


Figure 5-1. A map of the Quaternary deposits and exposed bedrock.

The clay is normally brownish. The thickness of the clay is somewhat unknown. Drillings show often about 1 m of glacial clay but in some places the thickness is more. Three drillings on the island of Ävrö and one on the Simpevarp peninsula show more than 1.5 m of glacial clay. The drilling on Simpevarp was done in the Ornehålskärret (6365445N, 1550761E) in the above-mentioned distinct valley to the west of the power station.

As mentioned before, the till surface has been re-worked by wave washing during the land uplift. In exposed positions this has resulted in deposition of littoral deposits. These deposits cover about 7% of the investigated area and have been distinguished into sand, gravel and cobbles. The coarse remains of wave washed till form many small cobble fields at the Baltic. A well-developed cobble field can be seen north of Korsbergen on Ävrö. It has a length of about 200 m.

Flat areas and small beach ridges consisting of gravel occur in many places in the investigated area, most frequently in the coast zone in the north-eastern part of Ävrö. Gravel exploitation has taken place in a small pit (6366784N, 1553092E) about 200 m south-west of Korsbergen. The thickness of the gravel in the pit is more than 3 m. Littoral sand has a rather small extension. It occurs in depressions, where it often covers glacial clay.

The mires are divided in two types: bogs and fens. A coherent cover of *Sphagnum*-species characterizes the bogs. They are few, small, not raised and occur only in the northern part of Ävrö. The thickness of the bog peat (*Sphagnum* peat) is limited to about 0.5 m. It covers,

according to some drillings, fen peat and gyttja. The fens are characterized by sedges of different species, reed, moisture-seeking herbs etc. The fens are small and are situated in depressions in the landscape. The largest fen in the investigated area is Örnkärren/Stora mossen. The peat thickness in this fen is about 1 m according to two drillings. This is probably a normal thickness of fen peat in the neighbourhood of the Baltic Sea.

It was impossible to determine the Quaternary deposits in connection with the power station. The ground has been changed by human activity to make stable conditions for buildings, roads etc. Therefore, all these areas have been mapped as artificial fill. On Hålö, there is a large area with artificial fill, the origin of which is bedrock material from the Äspö tunnel.

6 References

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- /2/ **Bergman T, Johansson R, Lindén A-H, Lindgren J, Rudmark L, Wahlgren C-H, Isaksson H, Lindroos H, 1998.** Förstudie Oskarshamn. Jordarter, bergarter och deformationszoner. R-98-55, Svensk Kärnbränslehantering AB.