GEOPHYSICAL SURVEY AT VARIKKONIEMI, HÄMEENLINNA

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ABSTRACT

The article presents methods and preliminary results of a geophysical prospection at an ancient trading site in Hämeenlinna, Southern Finland. The survey began in 1988 and it supports archaeological investigations, which have been carried out at the settlement site since 1986. Geophysical surveys at archaeological sites have been carried out already many years in Scandinavia. This article is a contribution to the methodical discussion and also wishes to inform about the work, which has been done in Finland in this sector.

Introduction

In 1986 during trial excavations near the center of the town Hämeenlinna, Tavastland, a late Iron Age/ Early Medieval settlement site was discovered. Excavations in the following years brought to light a large trade center, the first known prehistoric urban settlement in Finland. The site is on a peninsula on the eastern border of the lake Vanajavesi, opposite to the castle of Häme. It covers an area of about 7 ha, of which 5.5 ha consists the actual research area. The site was surrounded by defence walls, and in the northern part there was a large artificial harbour basin. In the excavations from 1987 to 1989 (ca 400 m), carried out by the National Board of Antiquities, parts of the walls and remains of 23 buildings have been examined.

The site appeared to be a good testing area for several geophysical prospecting methods, which had not been used before on archaeological sites in Finland. On the other hand the documentation of most of the prehistoric remains at the site required research methods other than traditional archaeological ones; because within the existing 10-year field program at the most from 5 to 7% of the site could have been studied by traditional methods.

The research program has been developed together with the Helsinki University of Technology, which also carried out the electrical resistivity survey.

Magnetical measurements were carried out by Suomen Malmi Oy, and the ground radar survey by Imatran Voima Oy. Petrophysical studies, which support mainly the magnetical survey, will be done by the Geological Survey of Finland.

The electrical resistivity survey

(measurement and analysis by Jalle Tammenmaa/ Helsinki University of Technology)

The surveys were made with an Abem terrameter SAS 300 (photo 1). Two arrangements of current electrodes and measurement electrodes were used. In the northern part of the site, across the harbour basin we tried to get a stratigraphical model with the help of the Schlumberger configuration. Using a 10 meter electrode distance on an 80 meter measure line a depth of at least 15 meters was reached. A 5-layer model shows the following figure: A dry surface, B clay and fill material, C till, D clay and E bedrock (fig 1). It was not possible to discern between the fill material of the harbour basin, the clay sediment and the cultural layers.

In all other cases a dipol-dipol configuration was used. Series of measure lines crossing the site borders were used in order to locate the stone foundations of the defence walls. Most profiles show clear anomalies, in which the electrical resistivity increases 10 to 15 times. In two examples we see

Photo 1. Surveys made with an Abem terrmeter SAS 300.

cross-sections of stone foundations: in line 8 (fig 2) appears a two meter wide irregular anomaly, which reaches at the right border a depth of nearly 1 ½ m. The excavation revealed a 2 m wide stone foundation laying on a wooden supporting structure. The height of the stone setting is at the most 70 cm (photo 2). In line 4 (fig 3) several anomalies can be seen: a and b are caused by recent filling, e by tree roots, and f by a foundation of a railroad track. In the positions c and d there were no visible marks in the topography of the area. The anomaly c is about 3 m wide and up to 1,5 m deep, and the anomaly d 4.5 m wide and 2 m deep. In position c there is a 50-70 cm filling above the cultural layer, and in the depth of 90 cm a stone setting was uncovered, which is very dense in an area 3 m wide. There are also scattered stones on both sides of the stone structure up to the distance of 8 m (photo 3). According to the wood finds the stone setting has been a foundation of a wall which is dated by means of ^{14}C to the beginning of the Viking Age (Hel-2533 1210±90 BP). The structure in position d consists of several stone and gravel layers. A 3.5 m wide stone foundation is laying on a wooden supporting structure (photo 4). The stone foundation has later been widened to 5 m and filled up with gravel. It was used as a road in the beginning of the 20th century.

The stone foundation under the road is clearly younger than the dwelling site. Its actual purpose is not yet understood.

The ground radar survey

(Field work by Imatran Voima Oy, measurements and results controlled by Arto Koskiahde/Imatran Voima OY)

The survey was carried out with a Subsurface Interface Radar system, which consisted of a SIR 8000 H control unit, antenna boxes of 80 and 500 MHz, an analogue tape recorder and an ADTEK graphic recorder (photo 5). During the measurements the antenna was moved manually. It was connected to a measure wheel in order to control that the pulses were transmitted in exactly 10 cm distance along the measure line. The continuous printout was done in scales 1:100 and 1:50. The actual depths of the profiles have been controlled by results of the archaeological survey 1986-88. The stratigraphy of the site has been documented from a series of test pits covering the whole site in a 10 m net. The strates of the radargram were correlated with the layers of the test pits.

The ground radar survey consists of a series of single profiles at the site borders and the harbour basin and a test area in the center of the site, which is crossed by profiles in 2 m distance (photo 6). The aim was to get a stratigraphical model of the test area as well as to document anomalies within the states caused by artificial structures in the soil. During the measurement a 500 MHz antenna was used, which reached a depth of about 1.5 m. The scale of the profiles is 1:50. A contour map of the cultural layer is presented in figure 4. The contour lines represent changes higher than 1.5 NS (about 10 cm in the soil), which were observed in the 2nd and 3rd horizons of the radargrams. These horizons correspond with the surface and the bottom of the cultural layer. In the contour map there appears three different types of features:

- nearly rectangular, oval or round structures of 6-8 m diameter and a depth of 30 to 40 cm; 2 of the features were partly excavated, no 1 is the bottom of a pit house, at the place of no 2 were no clear structures, only a thin layer of dark coloured soil below the cultural layer.

- round structures of about 2 m diameter and a depth of 30 to 50 cm; three of them (no 3-5) were excavated, and they are pit hearths and pit ovens.

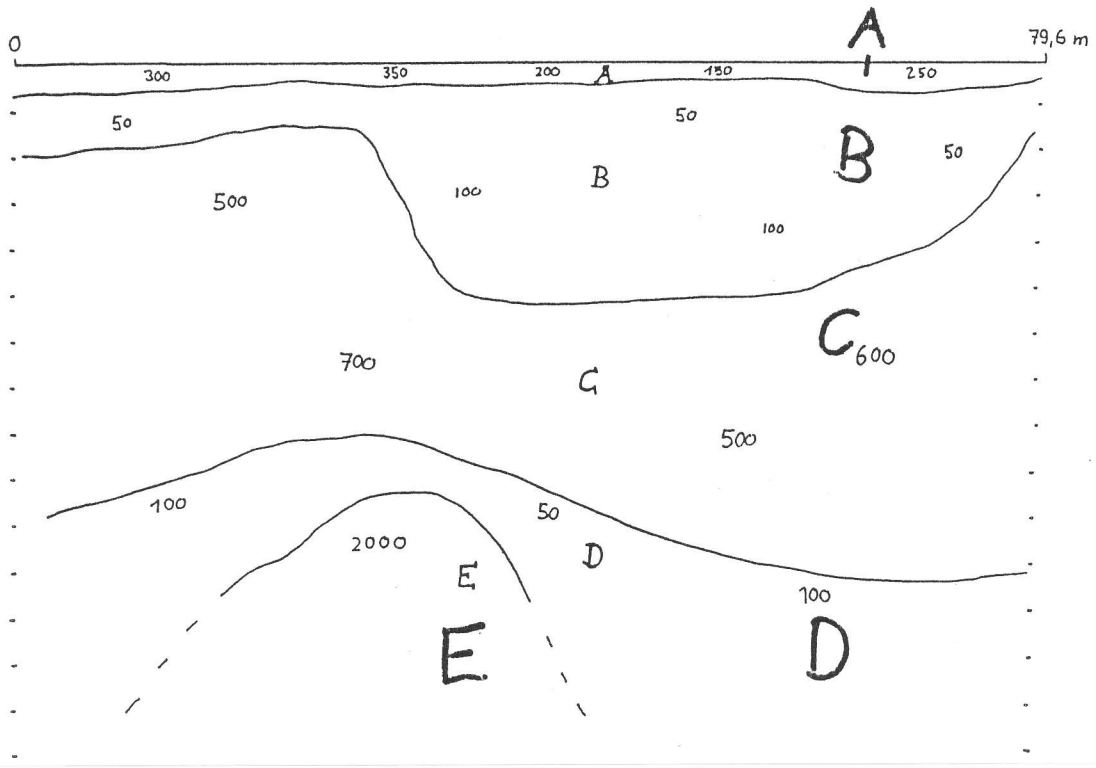

Fig 1. A: dry surface, B: clay and fill material, C: till, D: clay, E: bedrock.

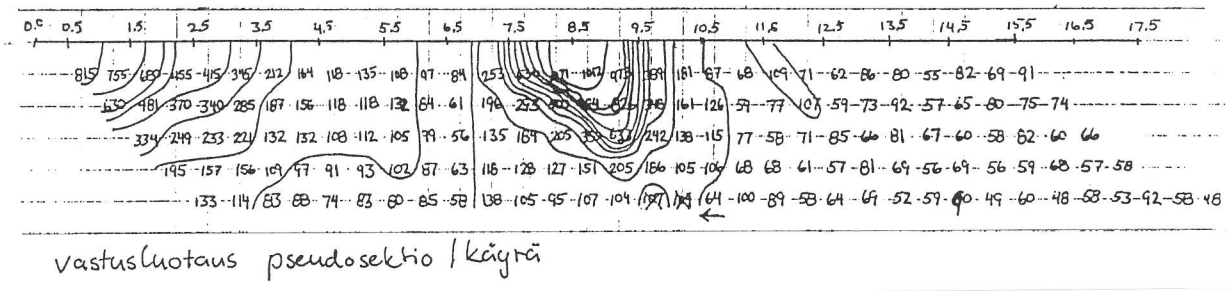

Fig 2. A cross section of a stone foundation, with a two meter wide irregular anomaly.

- a 10 m wide structure, crossing the area at the right border in N-S direction. Its bottom is about 50 cm under the cultural layer, and it rises clearly higher than the surface of the cultural layer. It may be a part of a wall foundation or a road. This part of the area has not yet been excavated.

According to these results it seems to be possible to map artificial structures, which are wider than 1 m and cause vertical surface deformations of at least 20 cm between the soil layers. To this group belong pit houses, pit hearths, and wall foundations. Excavated foundations of wattle and timber houses as well as small stone settings and large finds could be correlated with anomalies in the ground radar profiles,

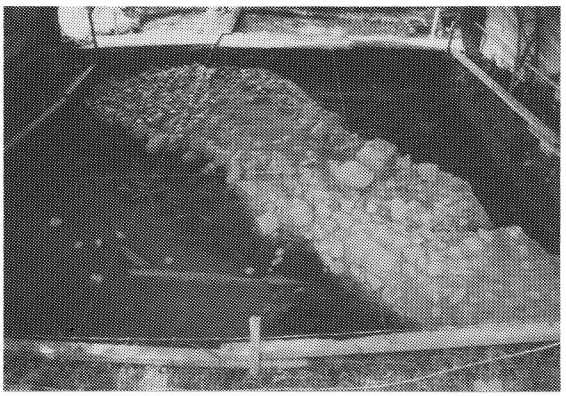

Photo 2. A 2 m wide stone foundation laying on a wooden supporting structure.

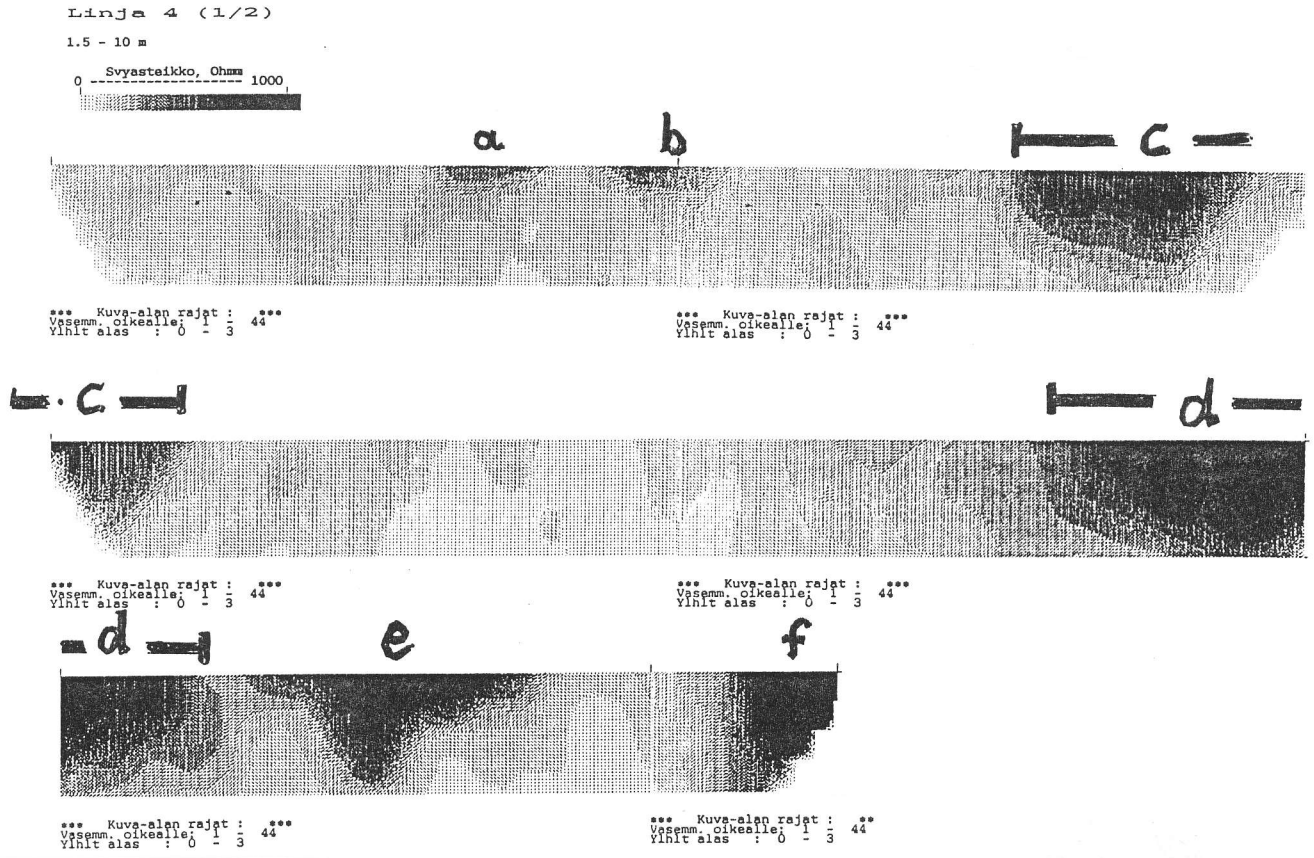

Fig 3. Line 4 where several anomalies can be seen, caused by different reasons.

but it is not possible to identify these structures in the radargram without the excavation results. The vertical disturbances, caused by these anomalies, are so small, that they are not visible in the contour map. Experiments with a higher density of contour lines did not lead to useful results. The reason for this is probably the large amount of recent disturbances at the site.

The magnetical survey

(Field work and analysis by Arto Julkunen/Suomen Malmi Oy)

The survey was carried out with a Scintrex IGS-2/MP-3 double probe proton magnetometer, the sensitivity of which is 0.1 nT (photo 7). The distance between the probes was 1 m. The lower probe was 0.5 m above ground surface, and the hither one 1.5 m. The total magnetical field intensity and the gradient of the magnetical field were measured with this vertical gradient configuration. The distance between the measure lines was 1 m, and between the measure points 0.5 m. The magnetical prospection covers at the moment an area of 3500 m in the center of the settlement site. The aim is to

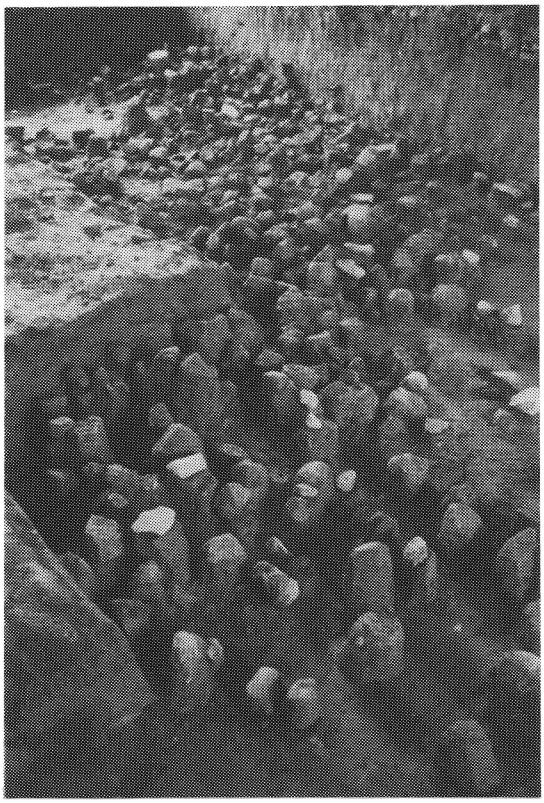

Photo 3. Scattered stones seen on both sides of the stone setting.

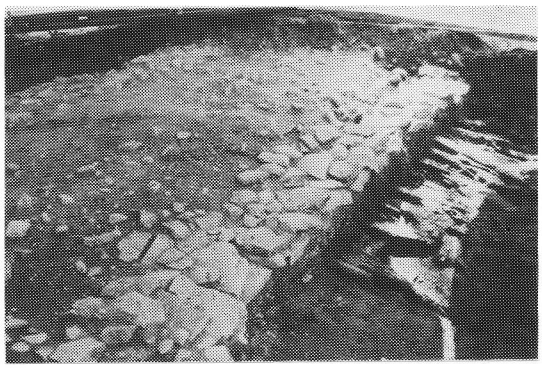

Photo 4. A 3.5 m wide stone foundation laying on a wooden supporting structure.

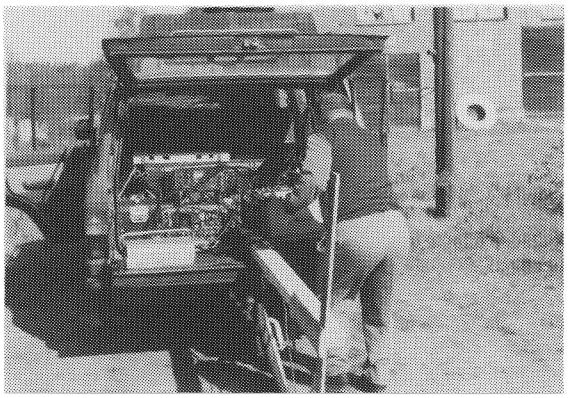

Photo 5. A Subsurface Interface Radar system.

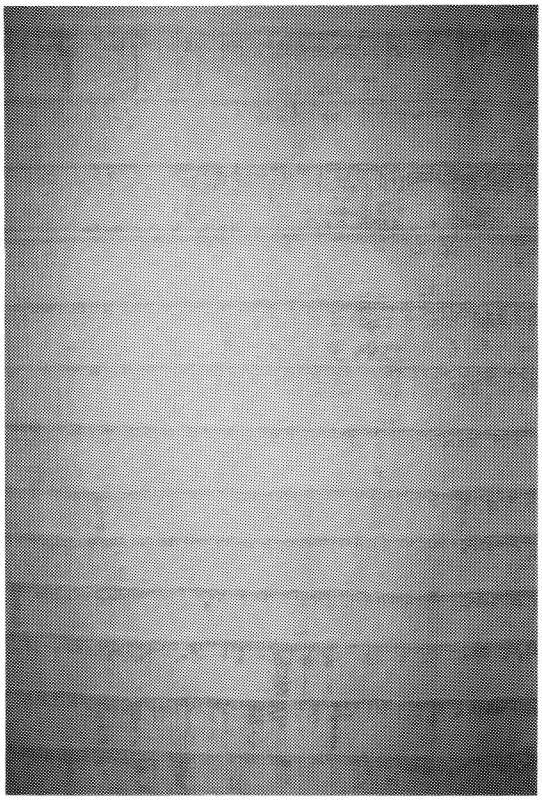

Photo 6. The ground radar survey consists of a series of single profiles at the site borders and the harbour basin and a test area in the center of the site.

document the magnetical anomalies caused by building remains, hearths and waste pits.

The magnetical gradient map from the years 1988-/1989 is presented in figure 5. The center and the right part of the map show large and intensive anomalies which ere caused by recent structures. In the right part there are groups of smaller anomalies.

Photo 7. A Scintrex IGS-2/MP-3 double proton magnetometer.

According to excavation results several anomalies could be correlated with pit hearths, concentrations of clay daub and in two cases even with post holes. Nevertheless it is not possible to identify different types of structures. In order to get better results in future, the density of measure points will be increased. Also it is necessary to remove recent iron garbage before the measurements with the help of a metal detector, because the strong anomalies caused by the garbage, cover in large areas the anomalies we are searching.

The geophysical survey at Varikkoniemi gives already after two years promising results. In some cases we got very clear answers to our posed questions, but several unsolved problems show, that the archaeological team as well as the team of geophysicists connected with the project have to collect more experience with this matter, before any kind of "reliable" geophysical map of the unexcavated settlement area can be presented.

HÄMEENLINNA VARIKKONIEMI
Sheet 2131 09
Ground radar survey (1988/1989)
Contour map
Grid 2 · 0.1 m
Scale 1:200 10 m
H.-P. Schulz, 17.10.1989

Contours 0 ± 1.5 NS
0- level = 5 NS (≙ 0.3 m)
green = features above cultural layer
blue = features in/below cultural layer

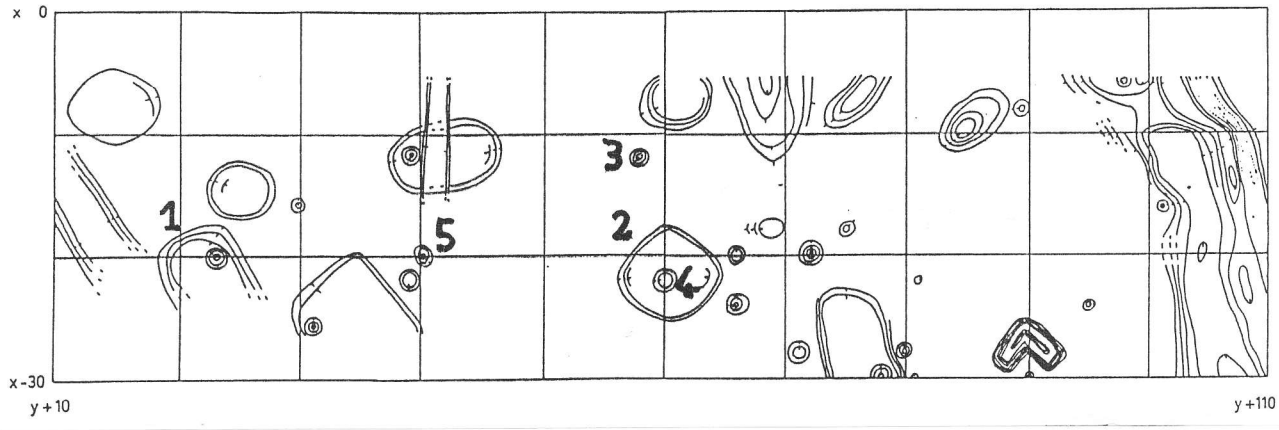

Fig 4. Contour map of the cultural layer.

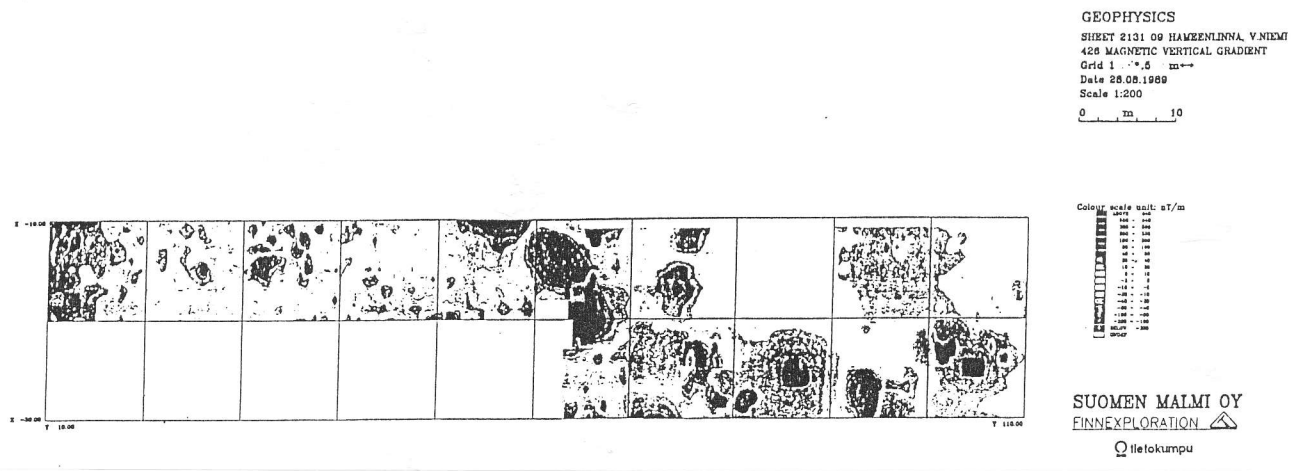

Fig 5. Magnetical gradient map from the years 1988-1989.

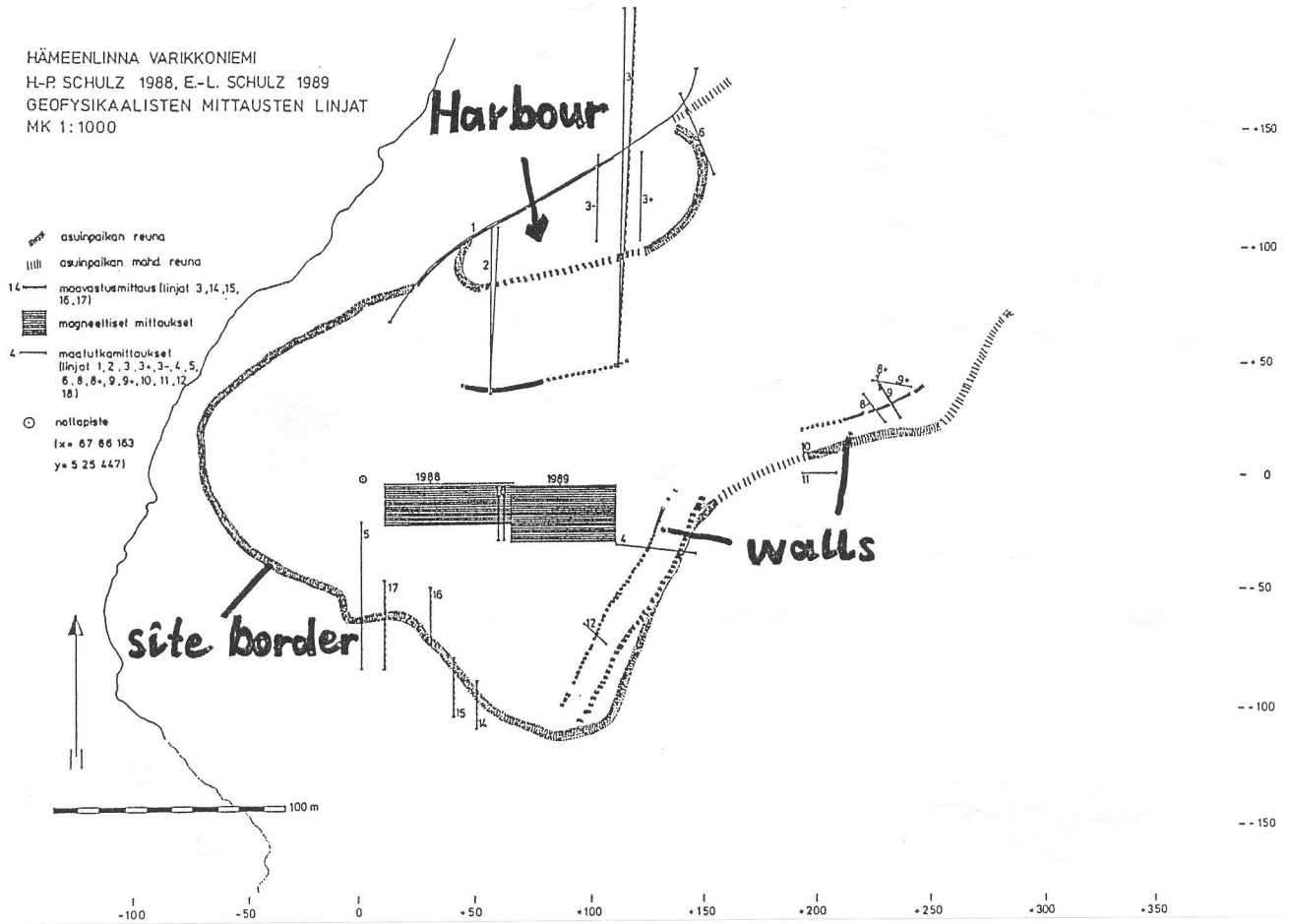

Fig 6. Excavation area.

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