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Resistivity survey at Stora Uppåkra, Sweden

Torleif Dahlin

Multi-electrode resistivity imaging was carried out along three test lines at the archaeological site of Stora Uppåkra. The resulting sections reveal an upper zone of 1–2 metres depth that can be interpreted as strata affected by cultural activities, with discontinuities that are likely to have archaeological significance. The underlying horizons show a variation in resistivity that probably reflects geological variation.

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Introduction

Resistivity imaging was carried out along three test lines at the archaeological site Stora Uppåkra in southern Sweden. The objective was to assess the potential of resistivity surveying as a method of locating archaeological features such as for example building foundations at the site.

Method Description

The surveying was made as two-dimensional resistivity imaging, also called continuous vertical electrical sounding (CVES), which is presented as cross sections of the resistivity of the ground. The ABEM Lund Imaging System was used for the data acquisition, a computer controlled multi-electrode system. Four electrode cables with 21 take-outs each were laid out on a line using an electrode separation of 0.5 metre. The lines were extended using a roll-along technique (Dahlin 1993). Two different electrode arrays were tested in the surveying, the Wenner and dipole-dipole arrays. For the latter, the measurement protocol was designed for very shallow depth penetration and high resolution.

The data was processed using inverse numerical modelling (inversion), in which a finite difference model of the subsurface resistivities is automatically adjusted to mini-

mise the residuals between the model response and the measured data. The software Res2dinv was used for the inversion (Loke 1999).

The lines were chosen on basis of the lines suggested for test trenches by the team from Kiel University in their report on magnetic mapping and GPR. The lines are indicated on the map in fig. 1.

Results and Interpretation

The measured lines show a similar character in that they all have an upper sequence of around 1-2 metre depth, which is underlain by strata of varying resistivity.

Line 1

The inverted sections from Line 1-1 are shown in figs. 2a and 2b for the Wenner array and dipole-dipole arrays respectively. Both array types clearly show a sequence of layers with different character in the upper 1–1.5 metres, which can be interpreted as affected by human activities. Below this layer two different resistivity units are evident, with higher resistivities (71 Ωm and above) in the part of the section left of around 12 metres on the distance scale, and lower resistivities (63 Ωm and less) in the right part. This is interpreted as variation

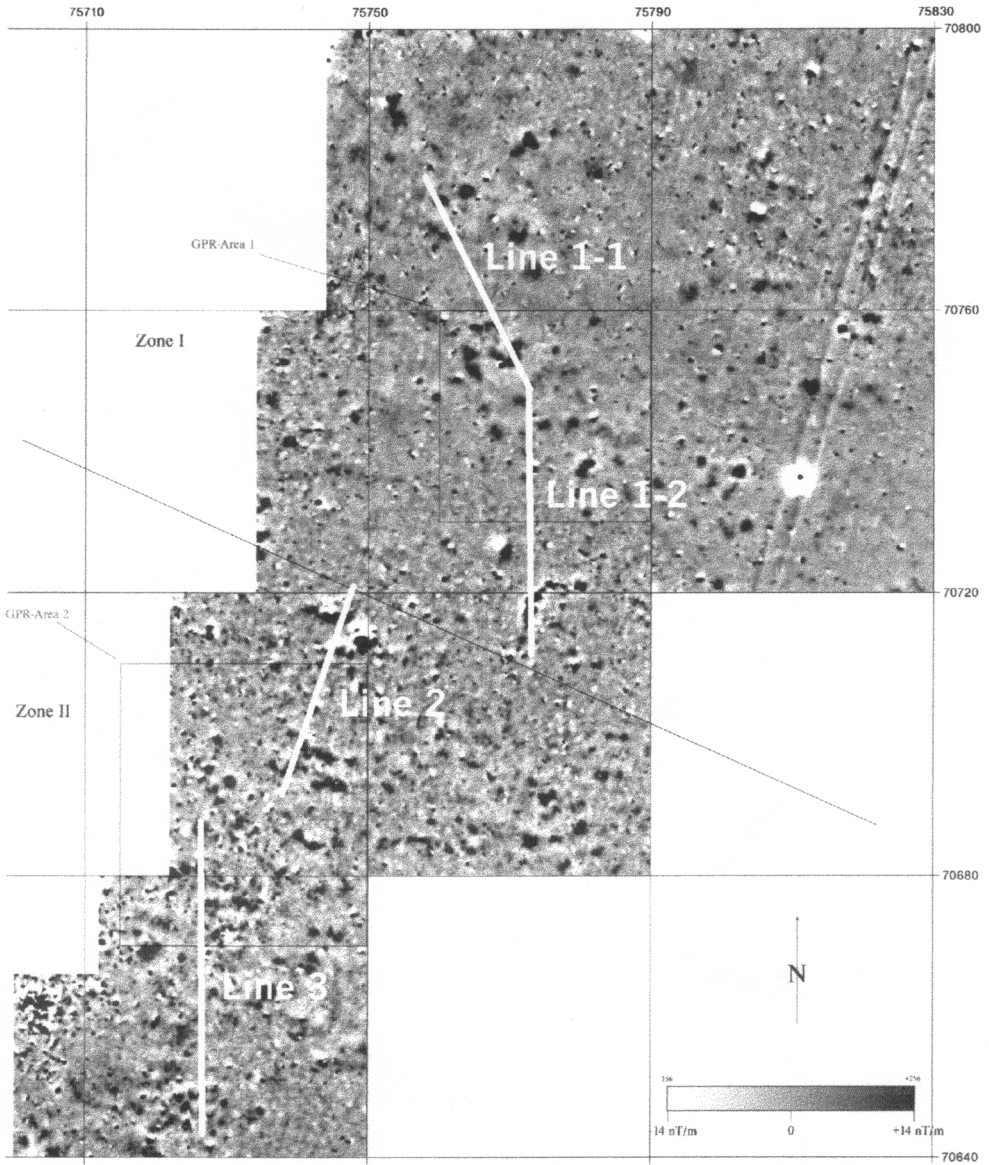
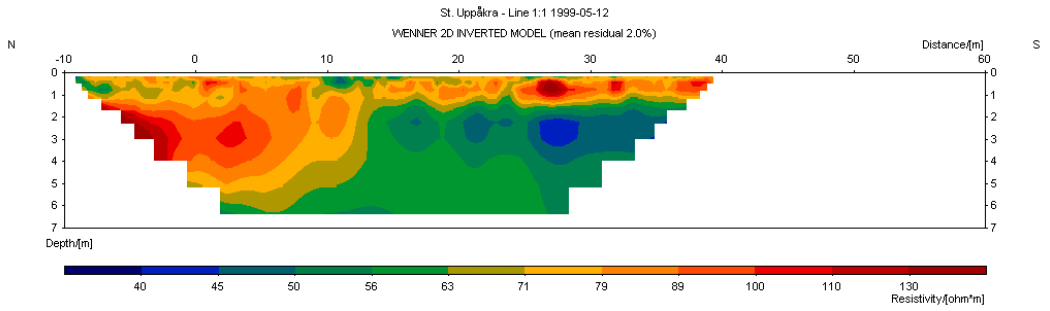


Fig. 1. Position of investigation lines superimposed on magnetic map. (Lorra *et al.* 1997)

a)



b)

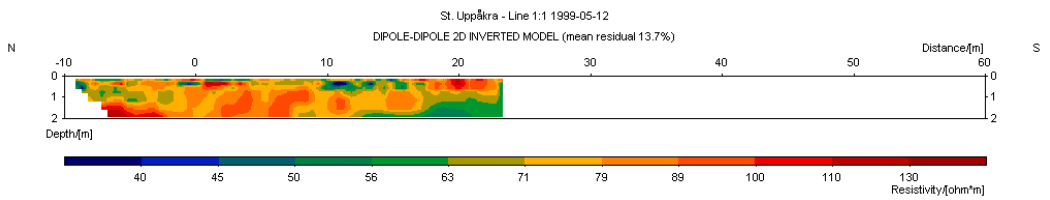
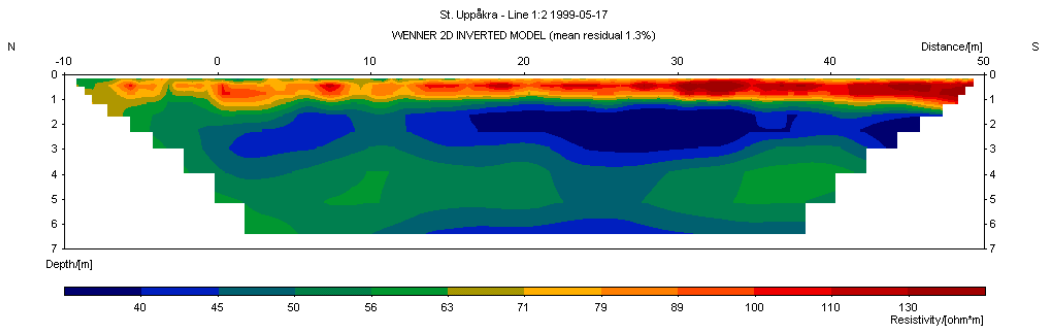


Fig. 2. Inverted depth sections for Line 1-1, a) Wenner array b) dipole-dipole array.

a)



b)

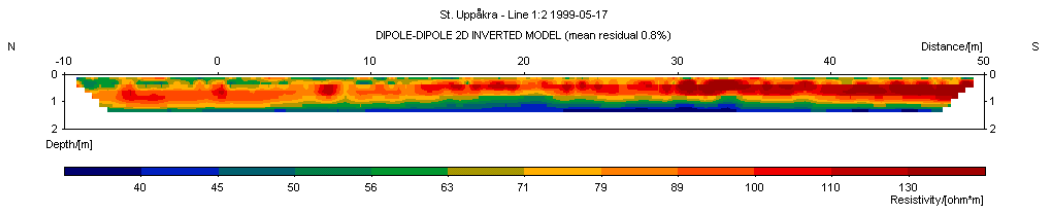


Fig. 3. Inverted depth sections for Line 1-2, a) Wenner array b) dipole-dipole array.

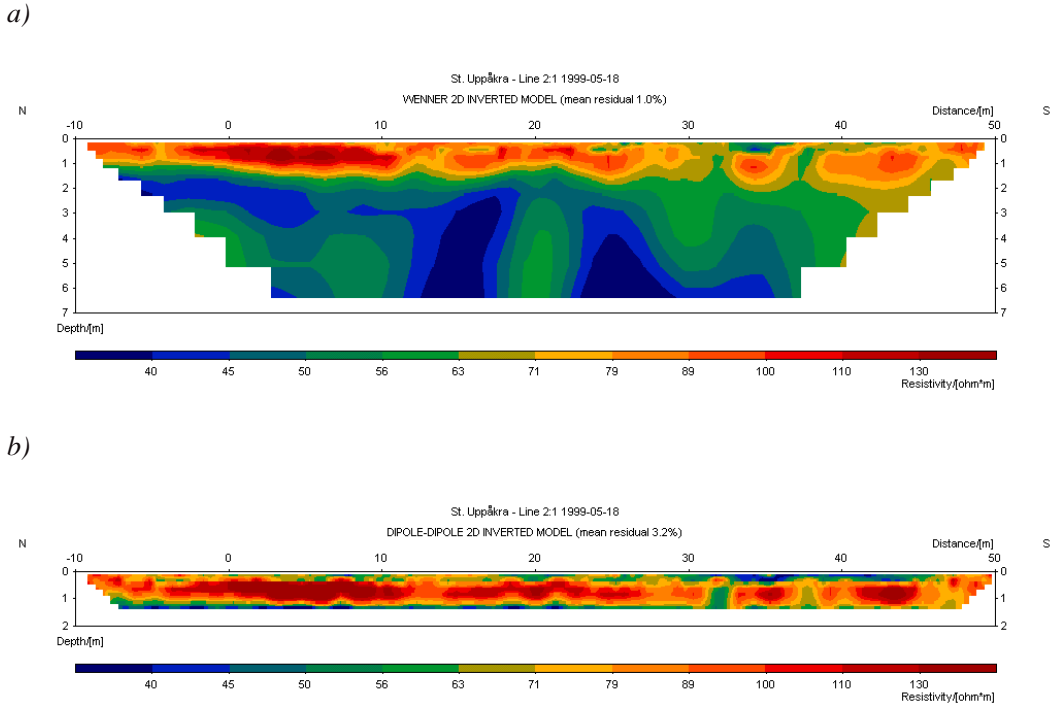


Fig. 4. Inverted depth sections for Line 2, a) Wenner array b) dipole-dipole array.

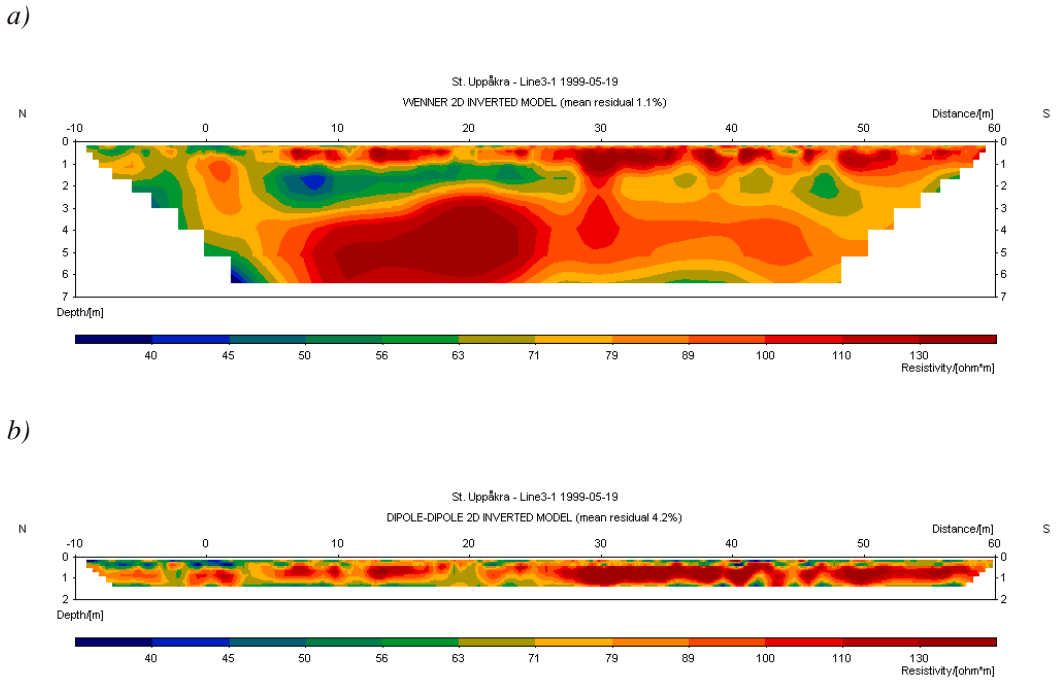


Fig. 5. Inverted depth sections for Line 3, a) Wenner array b) dipole-dipole array.

in the natural soils, which can be for example sandy soils to the left and silty-clayey soils to the right.

The inverted sections from Line 1-2 are shown in figs. 3a and 3b for the different arrays respectively. The upper layers of different character, which can be interpreted as being affected by human activities, stand out distinctly. Below this three different resistivity layers are visible, from top to bottom with lower resistivities ($<50 \Omega\text{m}$), and higher resistivities ($>50 \Omega\text{m}$ and less) and lower resistivities ($<50 \Omega\text{m}$). This can be interpreted as relatively fine-grained layers with differences in clay and silt content.

Line 2

The inverted sections from Line 2 are shown in figs. 4a and 4b for the two array types. The upper layer sequence, which can be interpreted as being affected by human activities, stand out distinctly here as well and increases in thickness towards the right of the section (south). Notable features in the upper sequence appear at around 32 metres and 38 metres for both array types. Below this, the three resistivity layers from Line 1-2 are visible in the left end of the diagram, but the regular appearance break up into vertical discontinuities in the middle part of the diagram.

Line 3

The inverted sections from Line 3 are shown in figs. 5a and 5b for the two array types. The upper layer sequence is clearly visible, except maybe in the left part of the Wenner section (south). In the lower part, there appears to be a vertical discontinuity around 0 metres in the section. To the right of this point two resistivity layers can be clearly distinguished, first lower resistivities ($<71 \Omega\text{m}$) and below this higher resistivities ($>79 \Omega\text{m}$). This can be interpreted as a fine-grained layer (e.g. silt and some clay) overlying a coarse-grained layer (e.g. sand). In the right half of the diagram a low resistivities layer is indicated ($<71 \Omega\text{m}$).

Discussion and Conclusions

The results show that there is good a potential in resistivity imaging for mapping structures of archaeological significance at Stora Uppåkra. The technique should preferably be applied so that a surface cover is achieved in order that the data can be presented as maps, or even depth slices at different depths below the surface. This is in line with recommendations for geophysical survey in archaeological applications published by the English Heritage Society (David 1995), where resistivity area mapping is suggested as a primary method.

A major advantage of the method is that it is non-destructive, in contrast to excavation that is fully destructive. By using resistivity imaging, and other geophysical techniques, as pre-investigations the subsequent excavation can be concentrated to the most relevant areas so as to optimise the investigation. Parts of the area may also be left unexcavated for future generations.

The upper 1-2 metre is interpreted as the layer affected by human activities, as these differ clearly in character from the underlying strata and the depths are in accordance with the excavations at the site. Discontinuities within this upper layer are interpreted as being of archaeological significance, and may be caused by e.g. building foundations. Smaller single objects are not expected to be detectable by the method when applied at this scale, as the resolution is not sufficient for that.

The variations in the lower strata are interpreted as variation in properties in the underlying natural soils. This may be, for example, zones of sandy and clayey soils.

Acknowledgements

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