

# ARCHAEOGEOPHYSICAL INVESTIGATION AT NEUSS-NORF, GERMANY

## Historical Background

The potential buried church is expected to be one of the oldest churches in the district of Neuss. The importance of Norf came from its location between the cities of Neuss and Cologne. The area was under the governance of the Roman Empire in the period between the 1st and 4th century. This period was followed by the Frankish period (5th to 9th century). Lots of finds confirm the archaeological importance of Norf in these periods. The church building is likely to have existed since 817. It was built in an east-west direction, with a massive stump tower in the west and has an expected size of 25 meters by 7 to 8 meters. The conflict between Catholic and Protestant potentates in 1585, led to considerable losses in Norf including the burning of the St. Andreas church. After that the church and other buildings in Norf were reconstructed but it is still unknown whether the church was reconstructed in the same place or in an adjacent place. Pieces of skeletons were reported in 1954/1955 during roadwork directly adjacent to the investigated site.

## Geophysical Techniques

A combination of magnetic gradiometry and electrical resistivity tomography (ERT) was employed to locate the remains of an old church form the 9th century in Neuss-Norf, Germany. The gradiometry survey was carried out along 27 parallel profiles oriented approximately E-W with a profile spacing of 1 m and a sampling spatial interval of 0.5 m along each profile. The vertical gradient of the magnetic field, with a fixed distance of 1.04 m between the sensors, was measured. The lower sensor was fixed at a height of 0.32 m from the ground surface. The magnetic data were transferred to the frequency domain using FFT then reduced to the magnetic pole.

The analytic signal and power spectrum techniques were applied to the obtained magnetic data. Moreover, ERT measurements were performed based on the results of the magnetic survey along 12 profiles utilizing the Wenner and Dipole-Dipole arrays with 0.5 m electrode spacing. The ERT data from both arrays were merged into one dataset to form a non-conventional mixed array. The ERT data were inverted into 2D resistivity models using robust (blocky) inversion technique, and then a 3D resistivity perspective was created. As a result, a map of the possible ancient building and other features at the surveyed archaeological site was constructed based on the results of the magnetic and ERT surveys.



Figure 1 Location map of the study area. The yellow rectangle represents the location of the archaeological site.

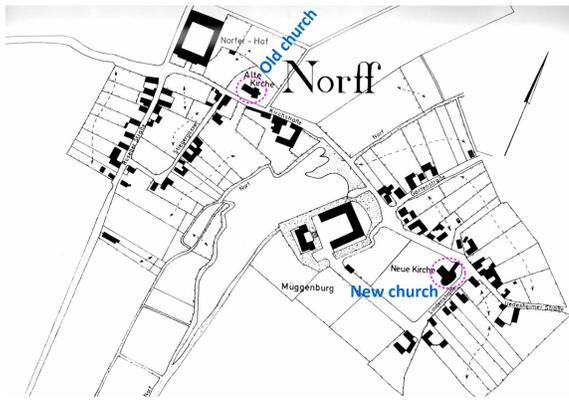


Figure 2 Ground plot of Norf based on the cadastral land register from 1812 showing the location of the old church.

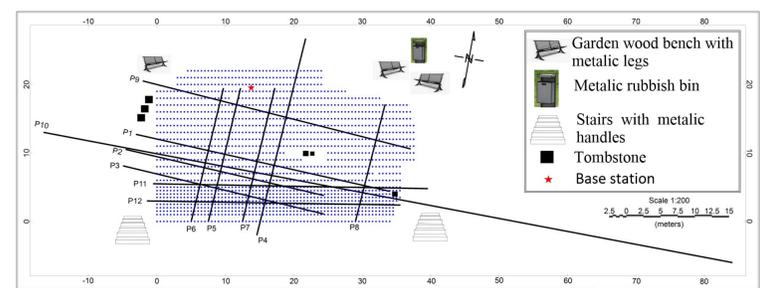


Figure 3 Scheme showing the local coordinate system for collecting magnetic and ERT data. Black lines represent the ERT profiles while blue dots represent the magnetic stations.

## Results of Magnetic and ERT Surveys

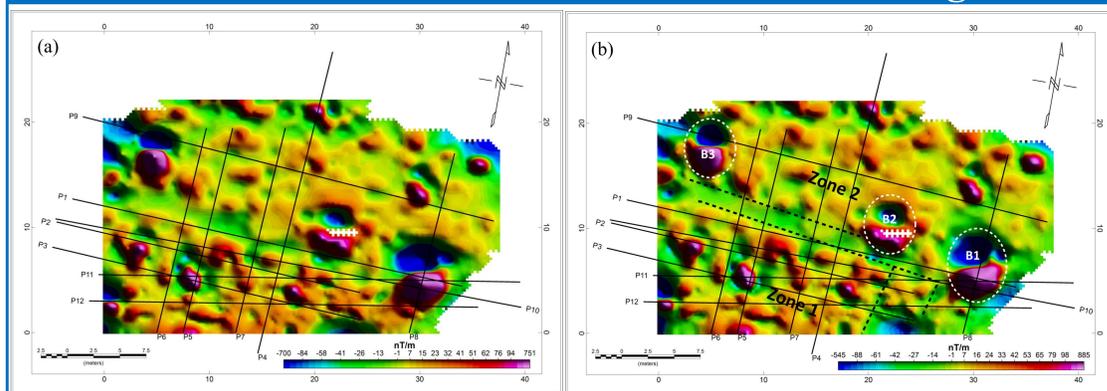


Figure 4 (a) Vertical gradient and (b) RTP vertical gradient magnetic maps of the archaeological site. Lines represent the location of ERT profiles. Dashed black lines show the interpreted possible boundaries of the potential old building inferred from the magnetic data.

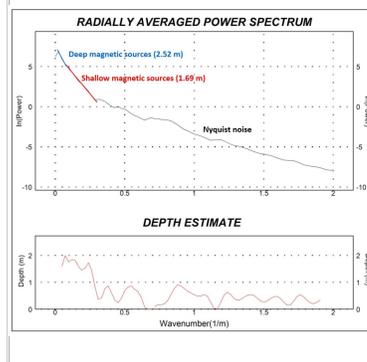


Figure 5 2D radially averaged power spectrum. Depths are calculated from the mid-point of the two sensors.

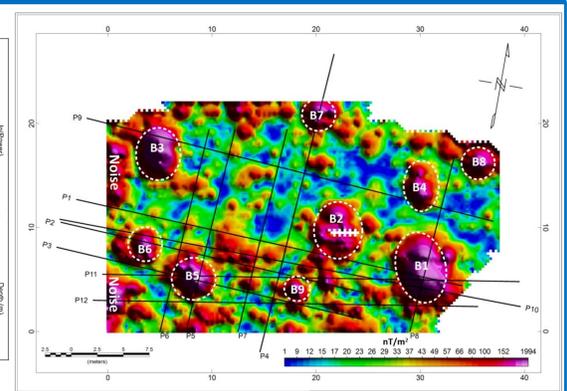


Figure 6 Analytical signal map of magnetic data at Norf archaeological site. Dashed white lines refer to interpreted causative magnetic sources.

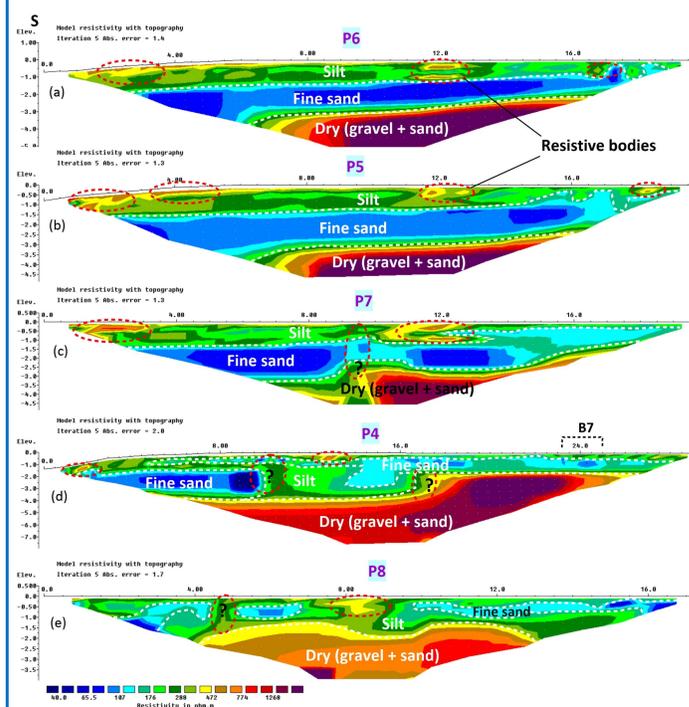


Figure 7 2D resistivity inverted models along profiles (a) P6, (b) P5, (c) P7, (d) P4 and (e) P8 using robust inversion. Red dotted lines refer to resistive structures.

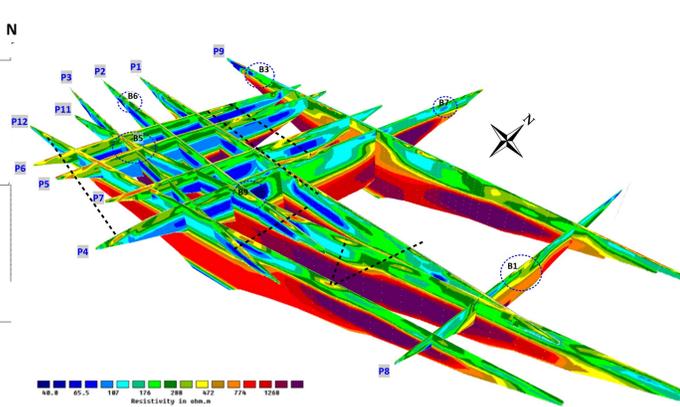


Figure 8 3D resistivity fence diagram of archaeological site in Norf. Significant resistive structures are connected by dashed lines. Selected magnetic anomalies are also presented.

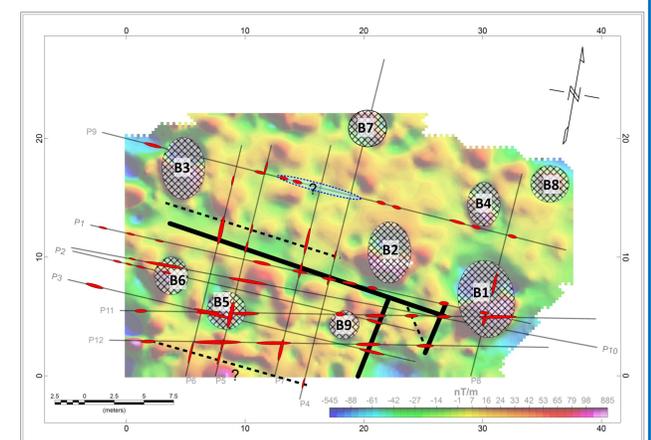


Figure 9 The hypothetical final map of the possible ancient buildings and features at the Norf archaeological site inferred from the magnetic and ERT results.

## Conclusions

The combined interpretation of the magnetic and ERT showed that the archaeological structures are close to the ground surface with a maximum depth of up to 2 m. We successfully detected anomalous zones that could be associated with the walls of at least one ancient church-building in addition to several possible archaeological structures in the survey area. A considerable agreement between the results of both methods was observed. Highly magnetic sources that could be associated with metallic objects were detected. An archaeological map of the possible location of the old church and the assumed surrounding features was constructed. Finally, some promising places were suggested in order to start an archaeological excavation in the site based on the findings of our research.