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DC Tensor Geoelectrics – Now Applicable to Archaeological Prospection!

The combination of geoelectrical mapping and sounding using modern multi-electrode resistivity meters can give dense information about underground structures and layers. Usually axial electrode arrays – e. g. Wenner or dipole-dipole – are applied. A crucial disadvantage of an axial configuration is the bad resolution of complex 3D structures. Improvement may be achieved by application of square arrays. But geophysicists shouldn't stop halfway.

Only considering specific resistivity r as a tensor (r_{ij}) results in a real improvement of the resolution of square array measurements. Tensor measurements and 3D inversion allow a determination of boundaries of complex 3D structures – resistive bodies like air-filled cavities or foundations as well as conductive ones like fillings of pits, cellars or water-filled cavities.

Examples for model estimations by FD algorithms and tomographic inversion of the specific resistivity tensor show the large possibilities of DC tensor geoelectrics compared with conventional electrode arrays. A field example – the investigation of a gallery digged into a loess layer – is given.

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Large Scale Geomagnetic Survey of an Early Neolithic Settlement in Lower Austria (5,250–4,950 B.C.)

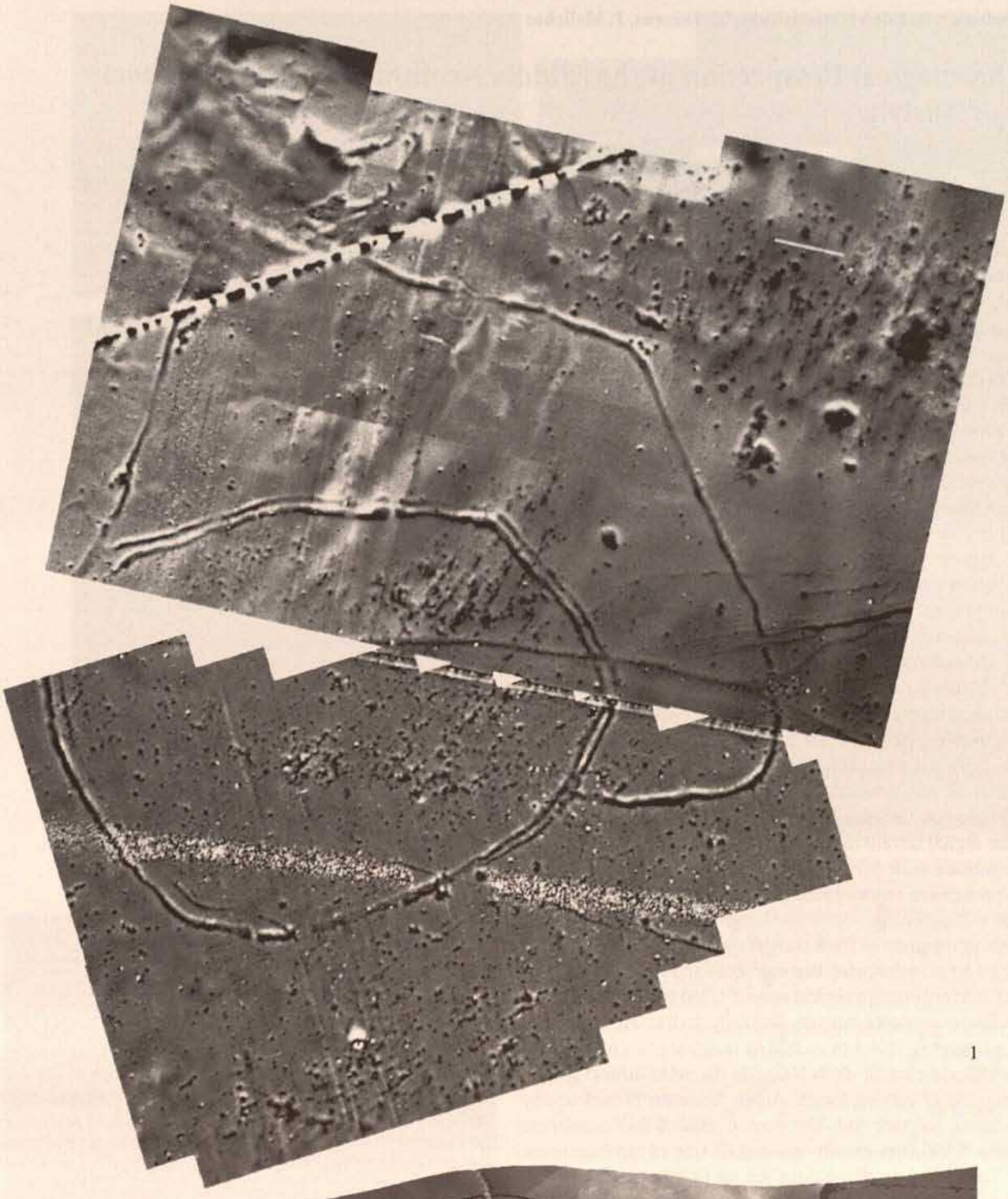
Asparn a. d. Zaya 50 km north of Vienna is a well known settlement from the Early Neolithic culture of Linearbandkeramik situated in loess soil with low susceptibility. The site was recovered by aerial archaeology and is already partly excavated by annual campaigns since over 15 years. The site covering 25 ha was magnetically prospected during the last years using cesiumgradiometers with 0.1 and 0.005 nT resolution. The latest surveys carried out with a multisensor caesium gradiometer in 0.5 x 0.125 m raster recovered typical remains of the Neolithic longhouses. Even the traces of single posts were resolved by the magnetics. The magnetic data (over 1.5 million readings) is visualised as digital image. For archaeological interpretation the data is resampled on 0.125 x 0.125 m raster and georeferenced using GIS software. The archaeological interpretation is done by thematic mapping and attributable description using the GIS ArcView.

The archaeological analysis of the geomagnetic evidence shows at least three main periods of occupation. Two of them were fortified by ditches 4–6 m width and up to 3 m deep. Several entrances inside the fortification are visible in the magnetogramm. The ditches form an oval central ditch system with an outer and an inner ditch which partly run in parallel and a trapezoidal enclosure appended in the north. Due to the high resolution of the magnetic data it was possible to interpret several typical longhouses of the Early Neolithic inside the plenty of pits of various size. The analysis of the orientation of the houses found by magnetics confirmed at least two periods. The settlement slightly moved from the bottom to the top of the hill. The excavation results showed the fortified settlements are the youngest. The occupation of the site dramatically finished 4,950 B.C. by a massacre as the remains of the killed inhabitants were found at the bottom of the ditches.

Occasionally an earlier settlement from the germanic period (200 – 400 A.D.) was detected at the lowest terrace of the river Zaya. The magnetic pattern of that settlement is clearly different from the Neolithic one. Several typical grubenhouses could be detected. The site of Asparn a.d. Zaya is already heavily eroded due to modern agricultural use as could be shown by aerial photographs, susceptibility profiles, the magnetic evidence and the excavation results. For the documentation of the rapid erosion process a partial remeasurement is planned after ten years.

Fig. 1. Magnetogram of the Early Neolithic settlement of Asparn a. d. Zaya; caesium gradiometer, area approx. 25 ha, raster 0.5 x 0.25 m and 0.5 x 0.125 m, dynamic range [-5.0,5.0] nT

Fig. 2. 3D visualisation of the digital terrain model of Asparn a. d. Zaya combined with the archaeological interpretation of the magnetic prospection data



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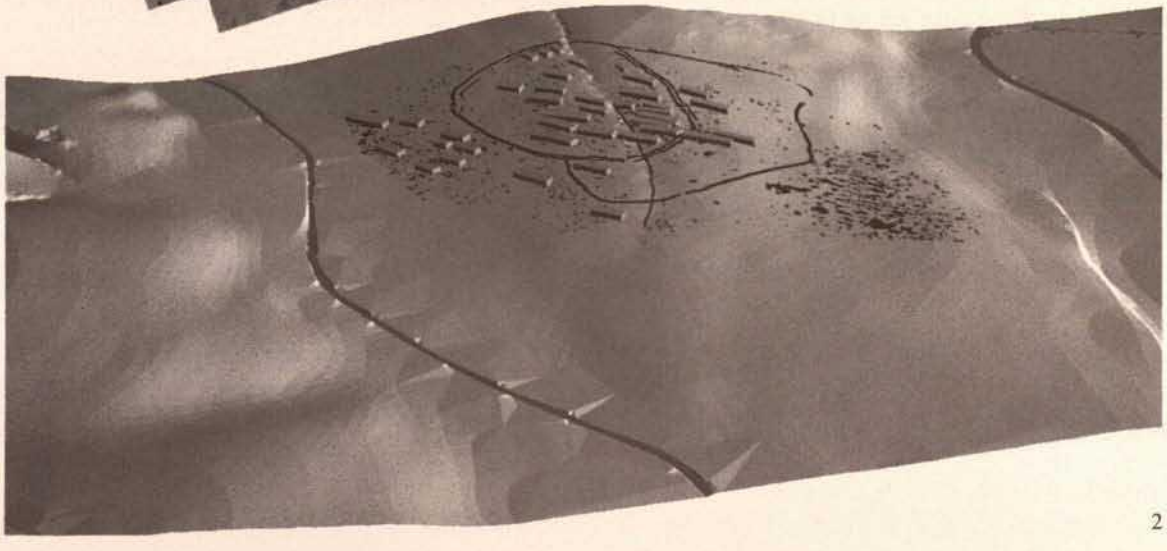

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