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The iron-age burial mounds of Epe-Niersen, the netherlands: results from magnetometry in the range of ±1.0 nT

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The archaeological site of Epe-Niersen in the central Netherlands consists of a 6km long linear arrangement of barrows dating to the 3rd and 2nd Millennium BC (Bakker 1976; Bourgeois 2013). In total, no less than 50 burial mounds of this alignment are still preserved within the modern-day landscape. At the start of the 20th century the curator of prehistory at the National Museum of Antiquities in the Netherlands (*Rijksmuseum van Oudheden*) investigated several of these mounds and discovered peculiar burials and grave gifts in them (Bourgeois *et al.* 2009). The research at the time, however, focussed solely on the burial mounds and gave little attention to the surroundings of these monuments. What lies beyond these monuments? Can we find evidence for activities contemporaneous with the construction of these mounds?

The current day terrain-use and the extent of the alignment does not lend itself to classic (and destructive) excavation methods. Therefore, it was decided to do a magnetometer survey, connected to radar and seismic research conducted by the Faculty of Civil Engineering and Geosciences of the TU Delft.

For the magnetometer survey we used the Scintrex SM4G-Special Caesium magnetometer in a duo-sensor and total field configuration, which we carried ca. 30 cm above the uneven ground at a sampling rate of 25 x 50 cm. The application of this magnetometer with a sensitivity of ±10 pT in the uncompensated total field configuration allowed us the maximum utilisation of the magnetic anomalies (Fassbinder 2016). The total Earth's magnetic field at Epe-Nierson in June 2016 was ca. 49100.00 ±10 nT. The sandy and partly acid soils in the Netherlands constitute unfavourable geoarchaeological conditions for magnetometer prospecting (Kattenberg 2008). Considering this, the survey yielded surprisingly good results. Displaying the data in the narrow range of ±1 nT has the effect that even a tiny variation in sensor height above ground, unavoidable on an uneven surface, shows up as a "mistake" of the surveyor. Moreover, the area is densely crisscrossed by pathways from all time periods. Nonetheless we could clearly trace the archaeological features in the ground.

Apart from three known mounds the magnetogram shows two more burials, which also may have been small barrows, now erased. Additionally, within the

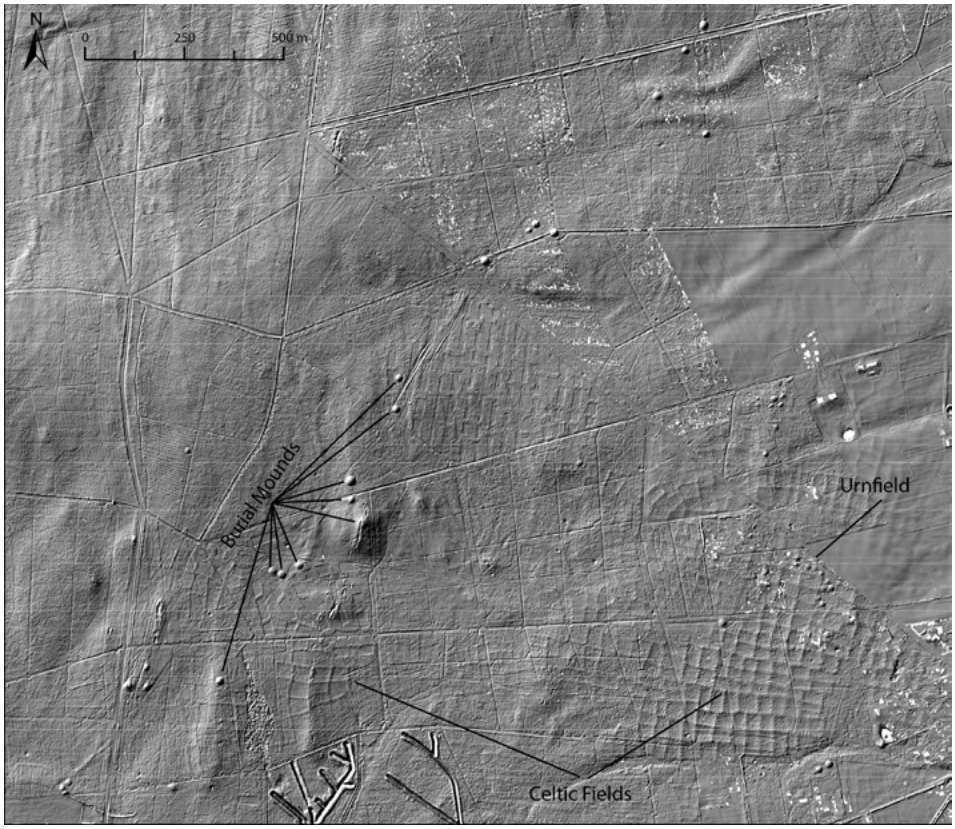

Figure 1: a hillshade-map of the Epe-Niersen barrow alignment, next to the barrows from the alignment a large field system dating to the Iron Age can also be seen (created from the *Actueel Hoogtebestand Nederland 2* or *AHN2*, www.ahn.nl).

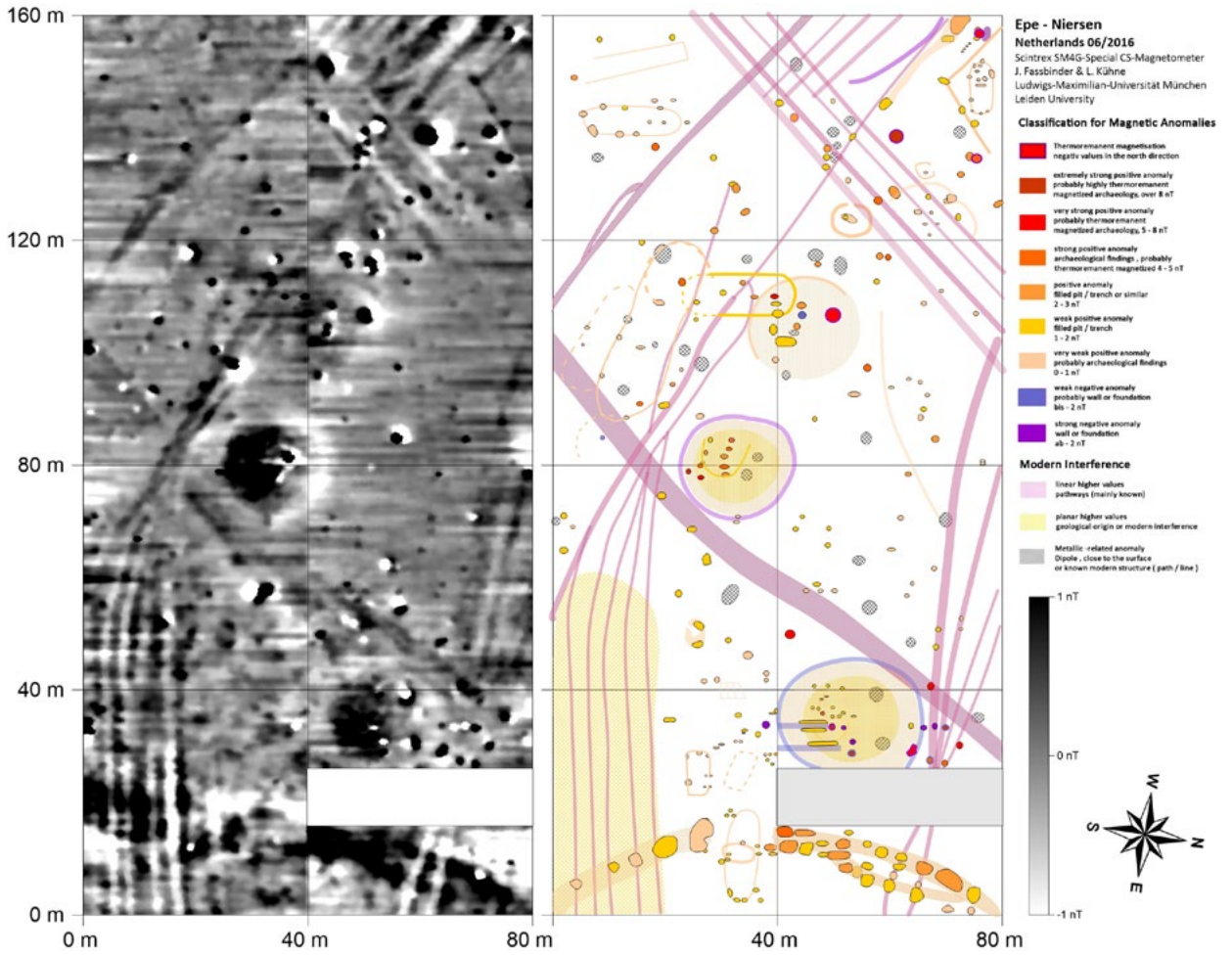

Figure 2: Magnetic map of survey area 1. Smartmag SM4G-Special caesium-magnetometer, sensitivity ±10 pT, duo-sensor configuration, sampling rate 25 x 50 cm, interpolated to 25 x 25 cm.

known mounds we found a half-round structure in the range of 1 - 2 nT. Through archaeological fieldwork and core drilling this feature was later verified as an earlier construction phase of the barrow. The soil samples in this part differ clearly from the remaining mound.

We also detected thermoremanent magnetization in the range of ±5 - 8 nT. This value is nearly the strongest in our measurements corresponding to archaeology, and was probably caused by high temperature impact, which we interpret here as intentionally burned stones inside and outside the mounds. Such pits containing burned stones are known from contemporaneous burial sites in the wider region.

The main reason to undertake geophysical measurements at these sites, however, was to find out if there were any other structures, such as settlements or ritual places, adjacent to the mounds, similar to those found at the foot of Scythian Kurgans in Russia (Fassbinder *et al.* 2016). Indeed, we found up to ten ground plans of houses from different time periods. While they were almost all below 1 nT, they can still be detected in the magnetic image, if you look closely in the data. One of these ground plans is located beneath a topographically visible mound. We conclude that it must be older than 4000 years and hence belongs to the Neolithic period. Further investigations like trench excavation are planned to verify the results and provide us with more reliable dating of the ground map of the house and further structures.

Interestingly, in the eastern part of the surveyed terrain a possible circular pit-row showed up. Unfortunately, that part is heavily disturbed by the pathways leading through it, so we will have to wait for the excavation results to see if it is worth continuing our survey towards the east.

Another measurement was undertaken a few hundred metres to the southeast at a mound which belongs to the same burial alignment. The mound is notably higher than the previous ones and located next to a modern road. This may explain why we see a slightly higher range in the magnetometer data, but still no magnetic anomalies caused by archaeology above ±5.0 nT. The two linear structures running through the mound from north to south were already visible in the LiDAR data and correspond to

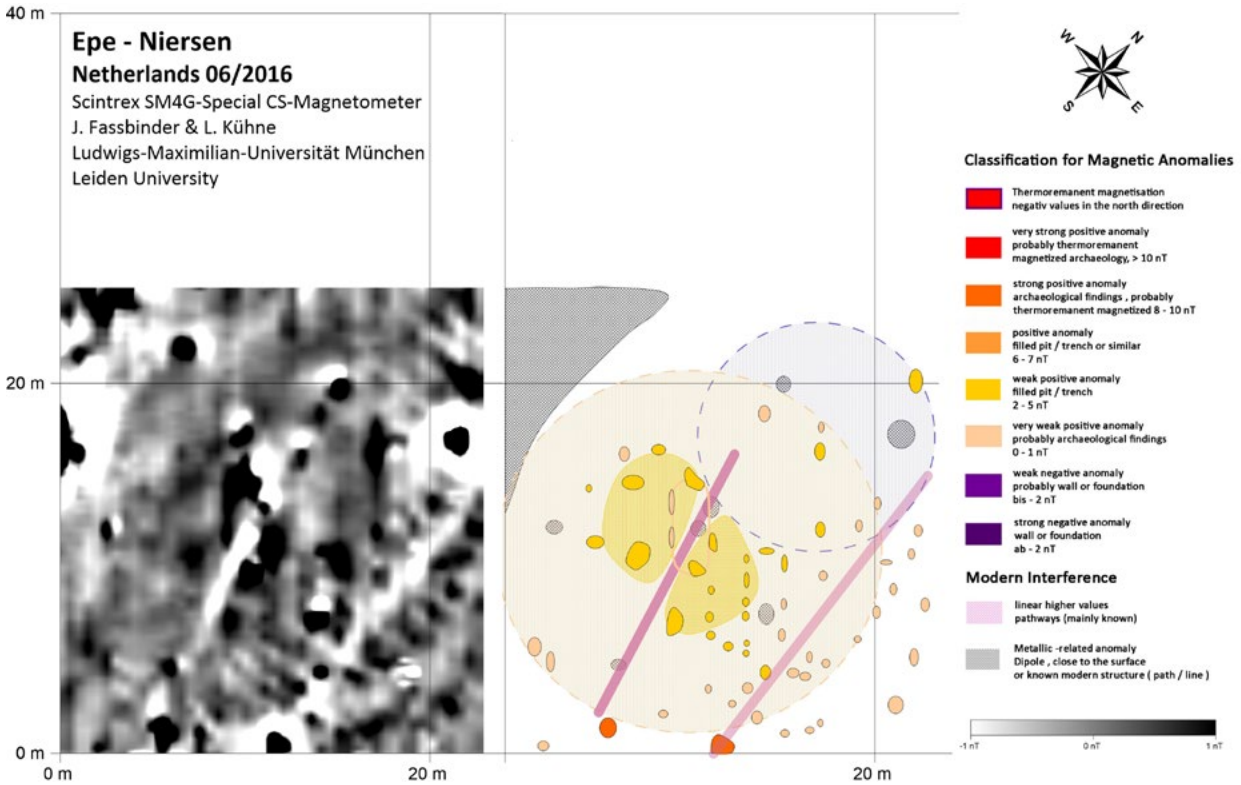

Figure 3: Magnetic map of survey area 2. Smartmag SM4G-Special caesium-magnetometer, sensitivity ±10 pT, duo-sensor configuration, sampling rate 25 x 50 cm, interpolated to 25 x 25 cm, total field fused by high-pass-filtered magnetogram.

pathways probably dating to the medieval period. Apart from some pits and pit alignments we can recognise a burial in the centre that seems to be surrounded by a palisaded ditch, a feature known from other mounds (Bourgeois 2013).

What was not recognised before is that the mound is in fact composed of two distinct phases, suggesting that here as well, the large barrow actually consists of multiple construction phases.

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