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Automatic magnetic mapping of the *oppidum* of Boviolles (Meuse, France)

T. DECHEZLEPRÊTRE*, M. DABAS** and K. GRUEL*

Key words: Magnetic survey, *Oppidum*, Rural settlement, Aristocracy.

The *oppidum* of Boviolles is one of the most important Gallic fortifications included in the East of Gallia PCR (Collective Research Program): “*Nasium*, from *oppidum* to Gallo-Roman town” with the financial support of the Conseil general de la Meuse Council and French Ministry of Culture. The presence of both a Gallic fortification (main occupation between 2nd and 1st century BC) and a Gallo-Roman town makes this site important for understanding urbanisation processes (Dechezleprêtre *et al.*, 2007; Dechezleprêtre, 2008).

The surface of the *oppidum* – more than 60 ha – required the use of several surveying techniques like field walking, geophysics and archaeological trenching. The magnetic survey was undertaken over 40 ha (spacing between profiles 50 cm, acquisition frequency 50Hz). The surveys were done manually and the first trials of AMP (Automatic Magnetic Surveying using a quad-bike) were done with success in 2006 using sensors from Foerster interfaced with a dGPS and homemade GIS software (Geocarta SA). This system enabled the survey of more than 10 ha a day, whereas manual surveys give less than 1 ha per day (including topography).

The AMP system (Fig. 1) designed by GEOCARTA SA comprises a non-magnetic cart which can support up to five magnetic sensors, low-noise vertical fluxgate sensors specifically designed by Bartington for this application, an electronic system for acquisition and filtering the analog output signals of the sensors, a dGPS for the acquisition in real-time

Figure 1: System AMP in action.

(no post-processing) of positioning data and finally of software for real-time acquisition of these data. The software is part of a homemade GIS already used for the acquisition of continuous electrical data (ARP© system). The acquisition rate along the profile is 80Hz. Considering an average speed of acquisition of 4 m/s, the sampling interval is 5 cm along the profiles. The distance between sensors is 50 cm. Distance between profiles is 2.5 m. The navigation is computer-aided: the operator has to follow lines which are drawn on the screen parallel to each other and spaced 2.5 m apart. At the same time, the output of the five sensors is displayed in real-time for quality check.

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Processing of the data is standard: synchronisation of magnetic and positioning data, removal of mean value over each profile and for each sensor, 1D removal of outliers and 2D gridding by spline function.

The geophysical maps prove that the entire surface was occupied and that specific high concentration areas exist (Fig. 2). The magnetic anomalies recorded represent different kinds: punctual, linear and diffuse. The most important is a linear anomaly which corresponds to a ditch running for 1200 m, which does not actually divide the plateau, but rather isolates the highest part of the *oppidum*. Other anomalies can also be seen and correspond to small ditches which limit dwelling blocks oriented along the different pathways which cross this Gallic agglomeration. As for the punctual anomalies, they correspond to caves, excavated workshops, extraction and rejection pits and wells. Archaeological excavations have enabled the identification of diffuse anomalies. They correspond mainly to layers with a high concentration of archaeological artifacts (Fig. 3).

In conclusion, the use of geophysical maps has brought information not only about the internal structure of this site, but has also provided elements to understand the level of conservation of the remains.

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Figure 2: Magnetic survey of the site (Terra Nova 2007).

Figure 3 (see color plate): Aerial photo superposed with interpretation.