

## Simultaneous Interpretation of Electromagnetic and Magnetic Data Using Linear Filtering

Magnetic (M hereafter) and electromagnetic (EM hereafter) methods are two different but complementary ways to study soil magnetic properties which intervene in pedogenesis and anthropogenic processes by measuring respectively any types of magnetisation and magnetic susceptibility (in frequency domain).

Recent studies established a linear relation in Fourier domain between M and EM data. This method allows one to deduce induced magnetisation from EM data by using linear filter. The Fourier transformation of the induced magnetisation is obtained by the direct product of the Fourier transformation of magnetic susceptibility by the ratio of the Fourier transformation of the impulse M response on the Fourier transformation of the impulse EM response generated by a magnetic dipole. The tests re-

alised on synthetic data allowed one to prove the efficiency of this filter and to evaluate the influence of the different parameters. It has been established that the depth of the dipole has a very limited influence on the filter and can be approximated by a single magnetic dipole.

The linear filter has been thus tested on field data from different archaeological sites: a pottery workshop from Iron Age (Verdun sur le Doubs, France) and a metallurgic workshop from medieval period (Melles, France). The results show a good correlation between filtered EM data and magnetic data. The result will essentially depend of the estimation of the depth of the magnetic source. The filter must thus be tested with a single dipole at different depth to be sure to obtain the best result.

G. Bossuet, P. Barral, C. Petit, C. Camerlynck, M. Dabas

## Diachronic Interpretation in Magnetic Prospection. The archaeological Sites of Ribemont-sur-Ancre (Somme, France) and Authumes (Saône-et-Loire, France)

Over two archaeological sites, magnetic prospections were carried out with gradiometer equipment. For each site, several geophysical responses corresponding to different historical time scales are superimposed. The need for a diachronic interpretation arises to separate the different structures and replace them into the proper time window. This can be achieved by the confrontation with all available historical sources and archaeological features.

The archaeological site of Ribemont-sur-Ancre (Somme) has an extension of 70 hectares. Studied for 30 years, this major site known as a reference for Celtic civilisation, is nowadays reinterpreted as a Celtic trophy from the second half of the 3<sup>rd</sup> c B.C., superposed with a pre-augustean sanctuary. Since its discovery in 1960, a lot of missions of aerial prospecting (Agache 1960, 1964, 1970, 1978) and archaeological excavations have taken place. If the spatial distribution of remains is well known – a large temple, a worship enclosure, baths, a theatre and insulae-, many questions are still unsolved :

- some structures identified on aerial photographs are very faint and not yet controlled by archaeological soundings,
- over large areas well documented by an extended aerial data cover, no marks are visible despite many artefacts on the ground surface,

– the opportunity of using the magnetic method in a magnetically polluted environment (presence of numerous iron objects and other related structures dating from the first world war). However, magnetic prospection has enabled the detection of new structures: Celtic ditches, a craftwork area, etc. Confrontation of magnetic data to old field boundaries and vertical aerial photographs taken by the Royal Air Force during the first world war allows us to interpret the origin of the different anomalies in terms of historical periods over 2,000 years.

The archaeological site of Authumes (Saône et Loire) is located on a mound over the Doubs valley. Surface findings span over an area of approximately 700 x 300 m. They extend from the 3<sup>rd</sup> c B.C. until 4<sup>th</sup> c. A.D. Concentrations of artefacts from one period seem to be well concentrated over different areas. However, no marks appears on the available aerial photographs. In order to gain information in a very short time to convince political authorities, the magnetic prospection was required: a surface of 3 ha was surveyed within two days. The map shows a palimpsest of superimposed structures probably associated with the different states of occupation of this site. Further excavations and geophysical surveys should confirm the time superposition of the discordant structures and the possible relationships between them.