

Frequency Domain Electro-Magnetic Method

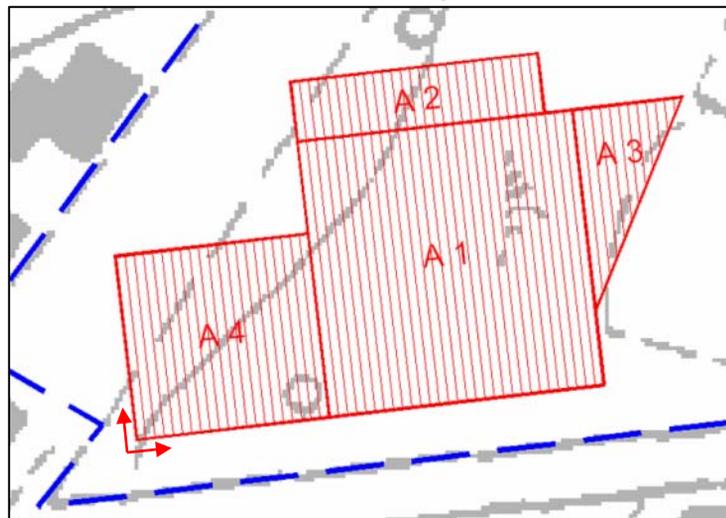
Frequency Domain Electro Magnetic induction (FDEM) involves generating an electromagnetic field (primary field) which induces current in the earth which in turn causes the subsurface to create a secondary magnetic field. By measuring this secondary magnetic field and the difference with the primary field, subsurface soil properties and the main features (buried objects) can be detected. This method measures the magnitude and phase of induced electromagnetic currents, which are related to the subsurface electrical conductivity. Electrical conductivity is different for rocks, and it is a function of the soil and rock matrix, percentage of saturation, and the conductivity of the pore fluids. EM instruments provide two measurements simultaneously, the electrical conductivity data and the in-phase component, which responds to magnetic susceptibility and metal.

FDEM has distinct advantages over many other techniques.

Because no contact with the ground is required, FDEM can cover a large area quickly and therefore with cost saving.

FD EM Survey

The survey area is divided in regular grid. The spacing between line is usually 1 or 2 m



Common applications of FDEM include the following:

- mapping buried wastes, metal drums, tanks, and metal utilities
- Evaluate the homogeneity of the clay liner of landfill bottom
- Evaluate the soil type for agricultural
- Detect archeological remnants

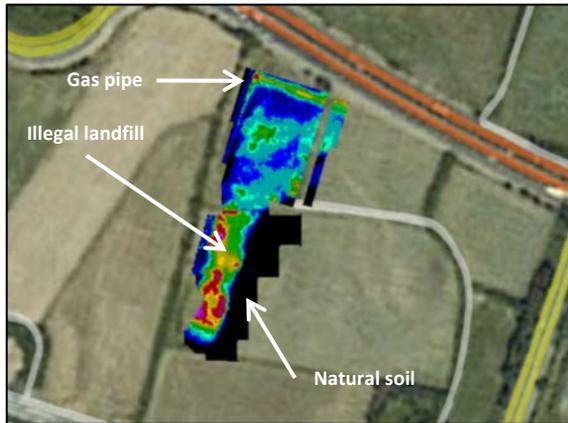
For FDEM (Frequency Domain Electro Magnetic) surveys we have chosen to use the Profiler instruments. This system can collect data from a number of different pre-programmed frequencies simultaneously.



FDEM SURVEY TO LOCATE ILLEGAL UNDERGROUND DUMPING

The maps of the geophysical parameters that are obtained by an electromagnetic survey can easily locate buried waste or contaminated areas. The magnetic susceptibility is particularly suitable for the detection of metals and helps a lot in the detection of buried drums or, for example, to recognize different waste type (in the example below, foundry wastes from ferrous foundries)

Detection and location of an illegal waste disposal - Brescia (ITALY)



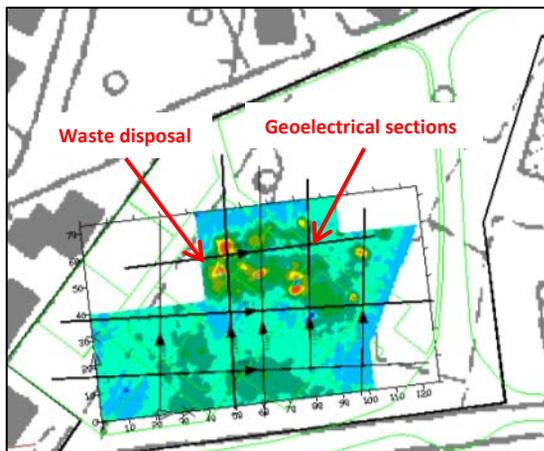
FDEM Survey
Electrical conductivity



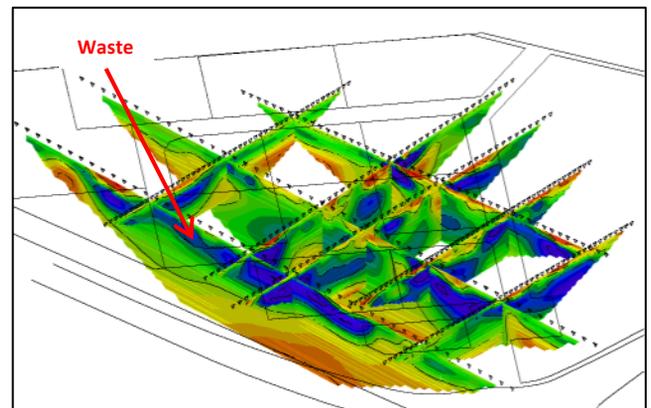
FDEM Survey
Magnetic susceptibility

For the investigation of contaminated sites, the FDEM survey is often combined with the geoelectrical methods. The combined use of two techniques of investigation allows a complete characterization of the waste body. The FDEM survey maps the lateral extension of the buried waste, while the geoelectrical lines provide more information about the depth, thickness and type of waste.

Combined FDEM and ERT survey for investigation of an illegal waste disposal



FDEM Survey
Magnetic susceptibility



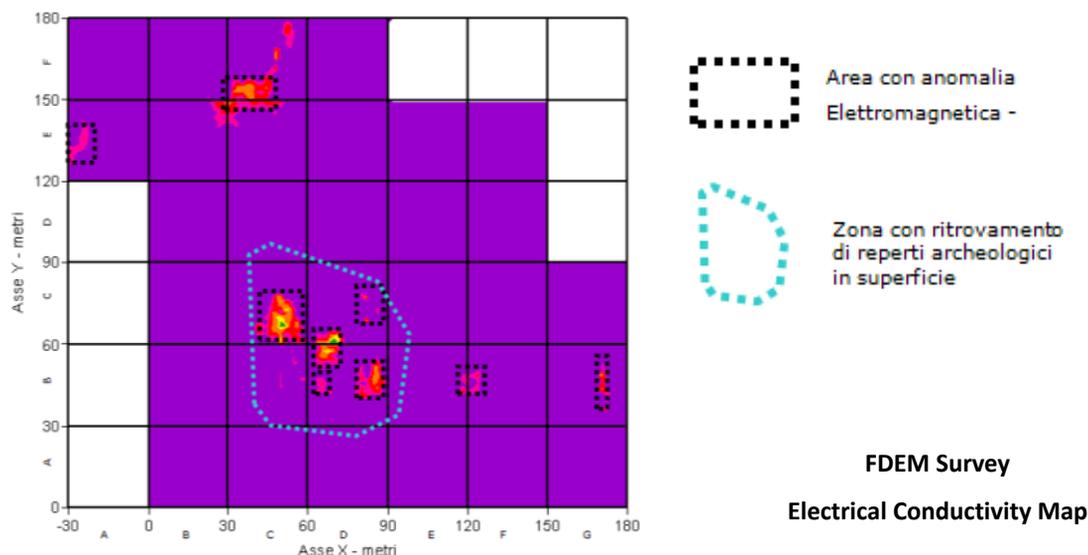
ERT lines
3D model

ARCHAEOLOGICAL EM SURVEY

The location of archaeological remains with the electromagnetic method is based on two principles: a) the change of electromagnetic properties to the ground, b) the geometric shape of the archaeological remains

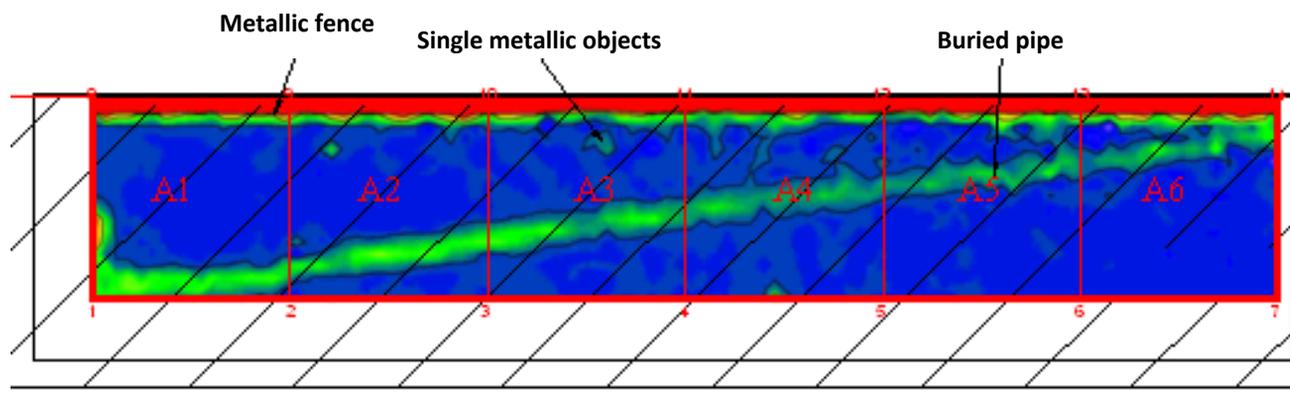
In general, foundations of buildings or remains of ancient buried walls have square or regular shapes

Rilievo elettromagnetico per la localizzazione di reperti archeologici – Fano (PU)



UNDERGROUND UTILITIES LOCATION

The underground pipes are an "anomaly" compared to the natural ground electromagnetic field (especially metal pipes and electrical wiring and for this reason - in areas with low electrical noise – can be an easy target. In addition, the elongated shape of pipes and cable helps in the recognition on the EM map



Indagine Elettromagnetica

Mappa della conducibilità elettrica apparente (quadrati A1-A6 con lato 40x40 m)