

## High resolution 3D magnetic survey: limitations and archaeological applications

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**Abstract:** In archaeological context, the use of magnetic prospection is a standard geophysical method to detect archaeological remains such as walls, hearts, kilns, ditches... Both methods could be used: magnetic susceptibility mapping with contact sensor and cartography of local distortions of the earth magnetic field. The high rate of measurement of magnetometer (fluxgate gradiometer or optically pumped magnetometer) allow to cover large surface in a short time (more than one ha by day). Geolocation of measurements is generally obtained by transfer of time to distance between two spatial reference positions at each extremity of a line which is covered with walking regulary following a grid, or with GPS determination. If the dimension of the archaeological remains researched is bellow a metric scale so the error on geolocation of measurements become too high compare to the objet. In such a case, magnetic susceptibility cartography can be realized with an adapted mesh. But, the low penetration depth of the sensors not allow to investigate the stratigraphy bellow few centimeters and moreover the realization of a survey is time consuming.

Keeping the advantage of magnetometer need to obtain a geolocation of the measures concomitantly. This could be obtain by tracking with a total station of a laser reflector fixed on the magnetometer sensor. The precision of the localization depend mainly on the rate of measurement. With comparable rate between the magnetometer and the total station used, the error on the position can be estimated less than a centimeter, which allow to explore anomalies of decimeter size.

At this scale, the small spatial extension of the anomaly generated and the effect of microtopography require a 3D exploration of the local magnetic field distortion. In order to obtain a homogeneous cover of the space, the magnetometer sensors are fixed at the end of a telescopic boom pole and fixed on a tripod. Some surveys realized in prehistoric cave and during the excavation of a Roman shipwreck are presented.

**Keywords:** Archaeometry, Magnetic survey, 3D, decimetric resolution