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Archaeomagnetic Object Dating at Conditions of Shape Magnetic Anisotrophy

Classical archaeomagnetic investigations based on laboratory analysis of oriented samples are under discussion now (Abrahamsen, 1986). The focus of discussion is shape magnetic anisotropy effect. The shape anisotropy causes magnetisation vectors refraction of homogeneous object. Archaeomagnetic refraction is mainly formed by TRM vectors. Refraction of TRM probably causes the significant error of archaeomagnetic investigation results. Development of methods for refraction error correction is actual (Abrahamsen, Koppelt, Voss, 1997).

Evaluation of archaeomagnetic errors due to the refraction was done on mathematical models of a pottery kiln. The kiln was found during magnetic prospecting done in Crimea (Ukraine) in 1988. Magnetic structure of the kiln was has been worked out on the base of an algorithm which includes two parts. The first part of the magnetic structure, determined by the TRM vectors is modeling. This magnetic structure is formed by an ancient geomagnetic field when the temperature of the object is near to blocking temperature (Radhakrishnamurty, Likhite, 1969). At the second part, final magnetic structure of the object due to by modern geomagnetic condition is calculated. Calculations were done by a computer. Programme, "DEGMAG" (Ermokhine, Glazounov, 1989). Mathematical modeling results allow one to conclude that the scattering of the TRM vector directions of kilns is connected not only with well known reasons, but also with demagnetisation effect of these objects. That conclusion has practical interest as it allows for contributed corrections to the procedure of the archaeomagnetic research. The places of selection of the oriented samples of kilns should be chosen taking into account the results of the object magnetic structure modeling.

Additional investigations of the model show that the vector of the total magnetic moment of the object is practically parallel to the ancient geomagnetic field vector. This fact is reasonable to use for archaeomagnetic object dating at the condition of shape magnetic anisotropy. Methods of the magnetic moment vector determination are well known in theory of inverse magnetic problems. Algorithms based on methods of approximation and spectral analysis for the inverse problems solution were done. For the algorithms realization information about geometry of the object, distribution of magnetic susceptibility and factor Q of kiln has to be known. This information is available after archaeological excavations of the kiln. Examples of a practical test of the spectral method for medieval isometric pottery kiln dating is presented (Glazounov, 1985).

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High-Resolution GPR Surveys for Archaeological Prospections Data Acquisition and Elaboration Techniques

Recent developments in 3D high-resolution multi-image processing and contouring as opposite to destructive testing have greatly contributed to improve the quality of geophysical information in archaeological reconnaissance surveying.

Ground Penetrating Radar (GPR) offers very high-resolution sounding capability with detection of features of the order of a few tens of millimetres thickness at ranges of several metres.

In this work, the results of high-resolution GPR surveys carried out in two archaeological sites characterised by different geological environmental conditions are presented. The two archaeological sites are: Roman Villa – Cazzanello (Tarquinia, Viterbo – Italy), and Forum Novum – Vescovio (Stimigliano, Rieti – Italy).

The Ground Penetrating Radar profiles were carried out using an SIR System 10 A$^+$ (GSSI), equipped with different antennas, operating at 300 and 500 MHz. For the first site, GPR profiles were collected in an area with dimensions 140 m x 60 m; in the second site two different area with dimensions 60 m x 80 m and 40 m x 80 m were investigated. In all areas the interval between adjacent profiles was 0.5 m.

To enhance the interpretation of the GPR data, radar signal processing and time-slice representation are worked out. The results obtained on shallowly buried structures indicate that the floor plans of the buildings can be clearly identified from time slice analysis.