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ROV advanced magnetic survey for revealing archaeological targets and estimating medium magnetization

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Magnetic survey is one of most applied geophysical method for searching and localization of any objects with contrast magnetic properties (for instance, in Israel detailed magneric survey has been succesfully applied at more than 60 archaeological sites (Eppelbaum, 2010, 2011; Eppelbaum et al., 2011, 2010)). However, land magnetic survey at comparatively large archaeological sites (with observation grids 0.5 x 0.5 or 1 x 1 m) may occupy 5-10 days. At the same time the new Remote Operation Vehicle (ROV) generation – small and maneuvering vehicles – can fly at levels of few (and even one) meters over the earth's surface (flowing the relief forms or straight). Such ROV with precise magnetic field measurements (with a frequency of 20-25 observations per second) may be performed during 10-30 minutes, moreover at different levels over the earth's surface. Such geophysical investigations should have an extremely low exploitation cost. Finally, measurements of geophysical fields at different observation levels could provide new unique geophysical-archaeological information (Eppelbaum, 2005; Eppelbaum and Mishne, 2011).

The developed interpretation methodology for magnetic anomalies advanced analysis (Khesin et al., 1996; Eppelbaum et al., 2001; Eppelbaum et al., 2011) may be successfully applied for ROV magnetic survey for delineation of archaeological objects and estimation averaged magnetization of geological medium. This methodology includes: (1) non-conventional procedure for elimination of secondary effect of magnetic temporary variations, (2) calculation of rugged relief influence by the use of a correlation method, (3) estimation of medium magnetization, (4) application of various informational and wavelet algorithms for revealing low anomalous effects against the strong noise background, (5) advanced procedures for magnetic anomalies quantitative analysis (they are applicable in conditions of rugged relief, inclined magnetization, and an unknown level of the total magnetic field for the models of thin bed, thick bed and horizontal circular cylinder; some of these procedures demand performing measurements at two levels over the earth's surface), (6) advanced 3D magnetic-gravity modeling for complex media, and (7) development of 3D physical-archaeological (or magnetic-archaeological) model of the studied area. ROV observations also permit to realize a multimodel approach to magnetic data analysis (Eppelbaum, 2005). Results of performed 3D modeling confirm an effectiveness of the proposed ROV low-altitude survey.

Khesin's methodology (Khesin et al., 2006) for estimation of upper geological section magnetization consists of land magnetic observations along a profile disposing under inclined relief with the consequent data processing (this method cannot be applied at flat topography). The improved modification of this approach is based on combination of straight and inclined ROV observations that will help to obtain parameters of the medium magnetization with areas of flat terrain relief.

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