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## A new method of geoelectrical prospecting by vertical electric current soundings

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### Abstract

Some advantages and problems of a new geoelectrical prospecting method, vertical electric current soundings (VECS) are discussed. This method is based on using a new source, circular electric dipole (CED). The source is installed in the following way. One of the transmitter poles is grounded in the central point. The other pole is uniformly grounded around with a radius determined by the depth of investigation desired. It can be defined as a noninductive source. The most interesting CED properties in the low frequency regime are as follows. CED has no magnetic field of its own. It is a pure galvanic source, which differs from a loop (a pure inductive source) and from a line, which is both galvanic and inductive (a 'line' here means a cable or insulated wire grounded at its end points). The normal magnetic field on the earth's surface (and above it) of a horizontally layered medium is absent (within the quasi-static approximation), and only a radial electric component exists. A CED field is at right angles to the loop field and has azimuthal symmetry. The CED field is always governed by a vertical medium structure (at the latter transient stage as well) rather than by the total longitudinal conductivity. An interesting result was obtained: in marine electrical prospecting a sea water layer will not play such a crucial role when a CED is used as in applying a loop or a line. In a medium with non-conducting basement the decay of the CED field is exponential. The transient process is more fast than in the case of a loop or a line. The CED can be also considered as a ground analogue of another known source, a vertical electric line. Besides, the CED is a pure galvanic source that does not excite a long-term transient field. Thus it seems to be a new useful means to study IP processes. The mathematical apparatus is represented in the frequency and time domain. The authors consider the results of the initial field tests.

*Keywords:* electrical prospecting; transient; circular electric dipole; vertical electric current soundings

### 1. Introduction

The proposed electrical prospecting method is principally based on using a qualitatively new controlled source, a circular electric dipole (CED) (Mogilatov, 1992).

Efficiency of a method for electric prospecting depends on several components. The choice of electromagnetic field source may be the key factor. A correct choice of source creates an optimal space-time structure for the electromagnetic field that best interacts with target objects, providing real physical preconditions for solving the problem at hand.

We propose the new source as an alternative to the classical sources, a loop and a horizontal electri-

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