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Express-technology for direct searching and prospecting of hydrocarbon accumulation by geoelectric methods

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Abstract:

The late publications testify that now the scientific institutions and service companies give the important attention to geoelectric and electromagnetic methods (EM) of prospecting and exploring of oil and gas fields. New EM methods are actively developed and the known ones are improved, the more wider application of these methods is observed during investigation for oil and gas, both onshore, and offshore, and the aspiration of the companies to purposeful integration of EM methods with seismic is marked also. There is the impression that the «breakthrough» technology for effective prospecting and exploring of hydrocarbon (HC) deposits can be created in the near future if not on the base of geoelectric methods only, but it is obligatory with their participation. In this paper the authors generalize the results of experimental application in 2001-2008 of some geoelectric methods for the oil and gas accumulations prospecting and exploring. These methods can form the effective geoelectric express-technology of “direct” prospecting for hydrocarbon.

The express-technology includes the methods of forming of short-pulsed electromagnetic field (FSPEF) and vertical electric-resonance sounding (VERS), compact and computerized equipment for field observations, software for measurement data registrations, processing and interpretation (FSPEF-VERS technology). These methods are based on studying the geoelectric parameter of the medium in the pulsed, not installed geoelectric fields, as well as the quasi-stationary electric field of the Earth and its spectral features over HC accumulations. An integrated application of these methods allow to find and map on the area the "deposit" type anomalies (DTA), to value the total thickness of anomalous polarized layer (APL) of the "oil", "gas", "water" type and etc, and to define their bedding depths. The realized possibility of conducting the areal surveys from moving car and airplane allows to examine the vast territory operatively.

The technology has had broad approbation on hydrocarbon deposits and perspective area in Ukraine, Republic of Kazakhstan and Russia during 2001-2008. Geoelectric investigations were conducted on 50 oil and gas fields. The "deposit" type anomalies were fixed by FSPEF survey on all (50!) fields. APL of "oil-and-gas layer" type was chosen by VERS sounding in cross-sections of all this oilfields. Geoelectric "deposit" type anomalies were also mapped by FSPEF survey within 50 perspectives for oil and gas structures and separate areas from 62 investigated.

The main distinctive feature of FSPEF-VERS methods consist in that they are based exclusively on non-classical principles of EM soundings. They are focused initially on structure studying of a near-surface layer of the charged particles, of polarization zones on borders of geological heterogeneities of a cross-section and of natural electromagnetic radiation of the Earth. Such non-classical approach has allowed creating: the compact small-sized measuring equipment, easy for transportation and convenient in service; an effective technique of operative carrying out the field measurements; the unique technology of the solving of a wide class of ecological, engineering-geological, hydro-geological and geologic-geophysical problems.

The general purpose of this paper is to attract attention of specialist-geoelectricians and geophysicists for the objective necessity of studying the natural electromagnetic radiation of the Earth (zones of polarisation, structure of near-surface layer of the charged particles, etc.) owing to that the further development of this direction promises broad opportunities for creation of effective innovative technologies of geoelectric investigation.

Introduction

Large-scale field measuring experiments on studying the structure of a near-surface layer of the charged particles (positive ions and electrons), and also of the polarisation zones on borders between the geological heterogeneities for the purpose of