Sobolev Institute of Geology and Mineralogy SB RAS (IGM SB RAS)
Trofimuk Institute of Petroleum Geology and Geophysics SB RAS (IPGG SB RAS)
Novosibirsk State University (NSU)

8th INTERNATIONAL SIBERIAN EARLY CAREER GEOSCIENTISTS CONFERENCE

13-24 June 2016

PROCEEDINGS OF THE CONFERENCE

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REVEALING CRITERIA FOR PETROLEUM POTENTIAL OF AN EASTERN SIBERIA FIELD (AS REPORTED BY TEM-DATA WITH THE USE OF GEOINFORMATIONAL TECHNOLOGIES)

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The transient electromagnetic sounding (TEM) method, which allows determining a section's electrophysical parameters in a wide range of depths, is successfully applied for searching Siberian hydrocarbon deposits [1]. However, not only field measurements are necessary during TEM-data interpretation, but also logging data with the description of the lithologic and stratigraphic complexes and their stratification depths, precise location of the TEM-points and borehole coordinates, geological and topographical maps, satellite images of the study area, and valid data on the topographical relief. To systematize and visualize all the available data, as well as to analyze interrelations between the objects in the area, one can optimally use geoinformational technologies [2].

In this work we consider a petroleum-bearing site in the Irkutsk region of Eastern Siberia, where areal detailed TEM-soundings with 600 x 600 m transmitting loops and 18 x 18 m receiving loops were executed. In total there were 2216 measurements, at that two receiving TEM-points were within each transmitting loop, whereas the rest ones (from 4 to 11 TEM-points) with different spacings were outside the loops.

During the field data processing with the ESRI ArcGIS package we created an operating schematic map with locations of the TEM-points, where the wells and areas of the same-type curves are marked (Fig. 1a). On the basis of the interpretation results, detailed geoelectrical sections for a number of the functional profiles were constructed, along with the maps of areal distribution of geoelectrical parameters, and three-dimensional visualizations (Fig. 1b). The interpretation was executed using the EMS software package [3]. One can notice that the obtained geoelectrical boundaries agree well with those corresponding to the borehole data. The fundament surface is characterized by local elevations and deflections. Some deflections are well correlated with the stream channels of the rivers flowing in the western part of the territory, and with the regional northeast-striking fault (according to geologic data) in its eastern part. The eighth geoelectrical horizon has the lowest resistivity values. There are pronounced anomalous low-resistivity zones in the site's western and central parts, clearly visible in the three-dimensional electric resistivity distribution model (Fig. 1b), including those dedicated to the productive wells. Accordant with the borehole data, all the productive strata distinguished in the Vendian-Cambrian complex (the lower part of the Usolskaya suite and the Motskaya suite) lie within the eighth geoelectrical layer overlying the fundament.

A comparison between the geophysical interpretation results and the provided geological data was made with the use of the ESRI ArcGIS package. The detailed structural maps of each productive horizon's top (by geology) [4] allowed us to calculate the depths to the tops at each TEM-point, and the longitudinal conductivity of the section's intervals containing each of the six productive horizons, and to draw the maps of the longitudinal conductivity distribution.

A comparison of the geological and geophysical data indicates that the high-conductivity zones in their areal distribution are essentially correlated with the contours of the prospective oil-bearing areas corresponding to the geological data.

Thus, considering the previous results obtained with the use of the TEM-sounding method, relying on the resistivity distribution in the regions of the wells with oil inflow, and involving the geological data, the anomalous low-resistivity (high-conductivity) zones can be regarded as hydrocarbon-perspective when they have the resistivity of 30-40 Om*m.

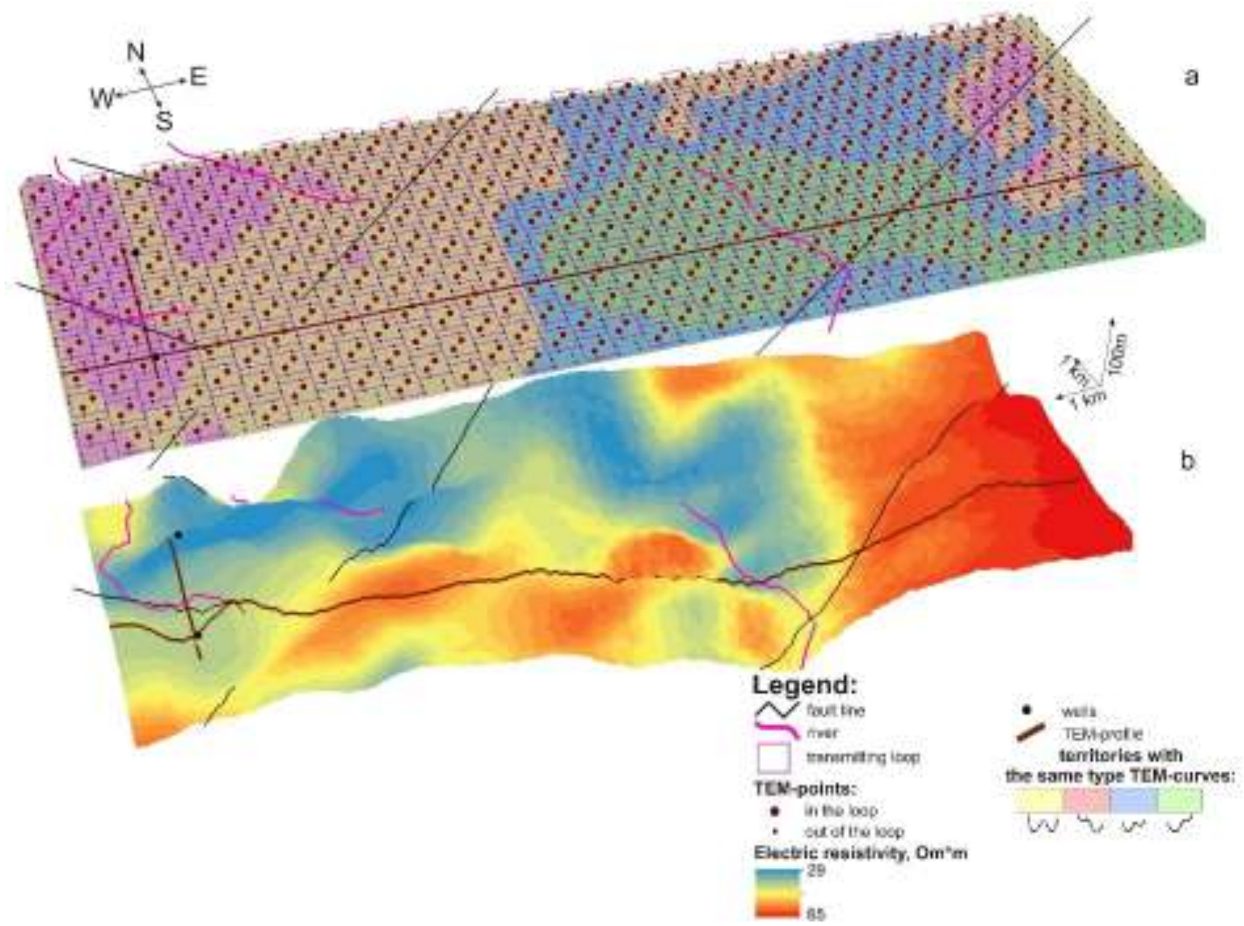

Fig. 1 – Location of the TEM-points (a); three-dimensional electric resistivity distribution in the eighth geoelectrical horizon, based on the TEM-data interpretation results (built for the horizon's top surface) (b)

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