UDC 53.097

APPLICATION OF RADIO IMPULSE TO GEOELECTRICAL EXPLORATION OF A HYDROCARBONIC DEPOSIT

ANASTASIYA KUNKO, KARINA IVANOVA
Polotsk State University, Belarus

Geoelectrical exploration method of a hydrocarbonic deposit by means of radio impulse emission is suggested. This method allows to pinpoint overall boundaries and depth of a geological deposit with greater accuracy. Two examples of the method have been described in this paper.

The methods of the hydrocarbonic deposit geoelectrical exploration have some drawbacks: its low accuracy is caused by the high level of interference in the range of used frequencies; limitation the distance between the receiver and the transmitter associated with the final sensitivity and transmitter power; large size antennas; low depth of measurement; low resolving ability; inaccurate detection of anomalies of the electric field of the hydrocarbon deposits.

The object is achieved by the use of radio signals. The investigated profile at the site of possible deposits location is scanned by radio signals following each other in a frequency range of 50 to 100 kHz, with high-frequency component in the range from 20 to 35 MHz and the low frequency envelope in the range of 1 to 5 MHz. Reflected signals are received, the electric field intensity is measured and the lag time of the reflected signals at each point in the scan, and then the location of boundaries and depth deposits are determined on the basis of the measurements.

When probing the signals [1] in layer with "d" thickness three signals are sent to the receiver: straight, the upper signal reflected from the upper boundary of the layer, and the lower the signal reflected from the lower boundary of the layer, as well as signals from intermediate boundaries between the top and the bottom. Geoelectrical exploration method is used to determine the boundaries and depth of hydrocarbon deposits. Periodic sequence of probing radio signals use allows measuring the time delay of the reflected radio signals relative to the emitted and measuring the depth of hydrocarbon deposits. The boundary is defined by the abnormal increase in the electric field intensity of the reflected signal radiopulse.

The selection of high-frequency component «f_1» in the range of 20–35 MHz is due to the required amount of attenuation radiopulse signal for measuring the depth of hydrocarbon deposits and achievement acceptable antenna size for probing deposits. The frequency f_2 = (1–5) MHz due to the achievement of high resolution identifying deposits. The value of f_3 = (50-100) kHz defines the range of unambiguous measurement of the depth of hydrocarbon deposits.

Example of the method. As the receiving and transmitting are used vibro antennas of 4.07 meter. The spacing L = 2 m. The height H = 0.5 m. The speed of propagation electromagnetic wave $v = 7.5 \cdot 10^7$ meters per second.

Example 1.

The profile of an electromagnetic wave was scanned at a fixed frequency f_1 = 25 MHz in the low-frequency envelope f_2 = 5 MHz repetition rate radio signal f_3 = 100 kHz. The reflected signal was received and electric field intensity of the reflected signal was measured to the test points of measurement profile. The reference point was chosen against which the distance along the investigated profile was measured. The measuring points were selected with the discrete 10 m. along a straight line passing through the reference point and the anticipated border. In anomalous values of the electric field intensity of the reflected signal is determined by the border of hydrocarbon deposits. At the same time the delay time t_3 of the reflected signal was measured relatively to the emitted and, according to the formula (1), the depth of hydrocarbon deposit was measured:

$$d = \frac{\nu t_3}{2}, \quad (1)$$

where ν – speed of electromagnetic waves propagation,

t_3 – the reflected signal time delay relative to the emitted radiopulse.

Example 2.

The process was performed as in Example 1, and f_1 = 20 MHz at 1 MHz and the $f_2 = f_3$ = 100 kHz.

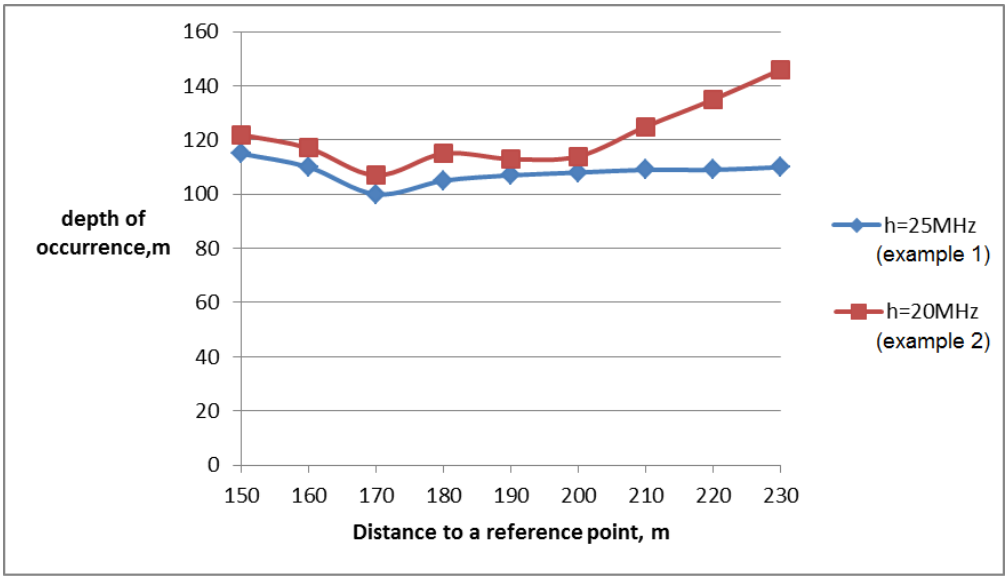

Fig. 1. The graphs of the depth of hydrocarbon deposits on the distance from a reference point, as examples 1 and 2

It can be seen from graphs in Figure 1 that the value of the field strength of the reflected signal radiopulse increases on the border of the deposit (reference point 170) at a depth of about 100 m., at a frequency of 25 MHz and at a depth of 107 m. at a frequency of 20 MHz, which allows you to determine the boundaries of hydrocarbon deposits with the added dimension of depth.

The advantages of the method in comparison with existing analogues are:

– Improving the accuracy of determining the boundaries of the deposit, by receiving radio signals reflected from deposits;

– The possibility of measuring the depth of 100–150 m;

– Increasing the resolution of the positioning of deposits, at the expense of used radial pulse.

REFERENCES

1. Финкельштейн, М.И. Применение радиолокационного подповерхностного зондирования в инженерной геологии / М.И. Финкельштейн, В.А. Кутев, В.П. Золоторёв. – М. : Недра. – 1986. – С. 42.