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EXPERIENCE IN FORECASTING GEOLOGICAL STUDIES OF HYDROCARBONS ANOMALIES USING REMOTE RESONANCE TESTING EQUIPMENT OF THE GEOPHYSICAL COMPLEX "POISK"

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Institute of Nuclear Energy and Industry of the Federal State Budgetary Educational Institution of Higher Education, Northern State University.

Keywords: remote control equipment, nuclear-magnetic resonance, resonance tests, reference atoms, atomic spectra.

The experience of using the equipment of the deep subsoil probing complex is considered. Lands "Search" for remote search and delineation by direct method of areas hydrocarbon deposits at depths up to 6000 m. Using the equipment of the complex "Search" methods of identification, delineation and preliminary express assessment of the suitability for industrial development of identified deposits hydrocarbons by measuring the depths of hydrocarbons with remote equipment reservoirs, their porosity of rocks in them. Practical work confirms the possibility application of the developed remote search to identify types of hydrocarbons and characteristics of reservoir rocks before drilling. This provides an effective choice points for drilling productive exploration wells at depths of up to 6 km.

Key words: equipment of the remote resonance test complex, nuclear magnetic resonance, information and energy spectra, reference atoms, atomic spectra

Introduction. Low efficiency of geophysical methods for searching for hydrocarbons and the high cost of drilling exploration work, especially at great drilling depths, requires improving operational remote methods of geological exploration. Integration various geophysical, non-traditional and aerocosmogeological methods allows increase the probability of determining the boundaries of the contours of hidden deposits (up to 40-60%), which improves drilling efficiency [1]. However, obtaining remote search methods for the most important geological characteristics of reservoir rocks (type and porosity), useful hydrocarbon capacities horizons and effective areas of anomalies remains a challenging task, making it difficult making a decision to drill wells [2, 6]. Currently undergoing pilot testing several remote methods of geological exploration in Russia, Ukraine, Canada and other countries. Neither one of these geological exploration methods, as well as existing remote sensing methods Earth sensing from space cannot determine the porosity of reservoir rocks, useful reservoir capacities and effective areas of hydrocarbon (HC) anomalies.

Specialists from the Scientific Research Laboratory YAKHI SevSU have proposed a method for obtaining these characteristics using resonance test equipment of the geophysical complex "Poisk", which uses Remote sensing data and measurement results from mobile remote field equipment (weight up to 80 kg).

Methodology for using the remote geoholographic complex "Poisk" for detection and delineation of hydrocarbon deposits is described in detail in the articles [5,6,7].

The basis of the method for remote deep determination of oil areas and rock types oil-saturated reservoirs using field equipment of the Poisk complex lies application of microwave radiation generators of gigohertz frequency for resonant excitation atoms of substances in oil-permeable rocks and atoms of metals contained in various types of oil [1, 6, 9, 10]. Remote

identification (recognition) of oil and oil-permeable rocks in the subsurface Earth to depths of 6000 m with the help of the specified complex is carried out using resonance phenomena of substances when exposed to radio frequency radiation on atoms of elements

(NMR spectroscopy) that are part of a specific type of oil or various types of rocks. To send radio frequency resonant radiation to great depths, they are used generators of microwave radiation of gigohertz frequency with a rotational electromagnetic field in energy channel of radiation. Frequency frequencies are modulated to the operating frequency of the microwave generator resonance spectra of atoms of reference chemical elements (Ni, V, C, P, S, etc.) and information and energy spectra (integrated spectra) of oil samples and reservoir rocks of various porosities [1, 6, 10]. Resonance spectra (NMR spectra) of atoms metals included in the composition of the identified substances and selected as reference elements are recorded on NMR installations in the frequency range from 60 to 250 MHz. Resonant resonances are recorded directly from sample samples of various oil grades. information-energy spectra of substances (integral spectra) using high-frequency blocks of resonant test equipment included in the Poisk complex [1, 6, 7, 11, 12]. Information

and energy spectra of identified substances are transferred to working magnetic carriers ("working matrices"), and atomic spectra of metals - to "test" matrices and are used for resonant excitation of these substances in the bowels of the Earth (up to depths of 6 km) by exposure to modulated signals from a microwave generator [1, 2, 3, 11, 12]. A set of “reference” metals that make up various grades of oil was previously studied by Russian and Ukrainian scientists [9, 10]. To establish reference elements in oil, we used neutron activation method for determining the concentration of metals and non-metals in them. Elemental composition of samples and amplitudes of their integral spectral characteristics (information-measuring spectra) were recorded in the data bank of the stationary complex “Search” and were used as recognition features of hydrocarbons and reservoir rocks of varying porosity, occurring at depths of up to 6000 m [8, 13].

To configure equipment and confirm remote detection, identification varieties of oil ("light", "thick", "sealed") and reservoir rocks before starting field work in laboratory conditions, tests of stationary and portable equipment of the Poisk complex for selective registration of oil samples and rock samples (oil reservoirs) from different distances (25m and 50m). At the same time, by regulating sensitivity threshold of measuring equipment achieve selective identification each reference element or type of oil and rock samples located close to each other (to confirm the absence of mutual influence) [6].

Reasons for conducting research:

For several years, tests of the complex's equipment were carried out on well-known oil and gas fields in Crimea (Tatyaninskoye gas condensate field, 2006) [3] and at six known oil wells of the Vladislavskoye field (Crimea, 2007) [4]. Experimental studies have confirmed the high effectiveness of search work on delineation and measurement of hydrocarbon reservoir depths.

In 2009, an examination of the remote method of searching for oil and gas in the territory was carried out USA (Utah) with the involvement of an independent state arbiter in Utah. Five sites were identified, each with an area of 25 km2 (5x5 km). These areas were examined in detail over the course of five years. traditional exploration methods (seismic, electrical, magnetic, etc.) and All are assessed as promising for development. However, according to the drilling results, 2 oil fields in two areas, and a non-commercial gas field in one. At another site (No. 1), drilling was carried out at a depth of 2.5 km at that time. results examination of 10 sites using the equipment of the remote complex "Poisk" accurately coincided with the results of drilling, including in area No. 1 (upon completion of its drilling) [5].

In 2008, work was successfully completed in accordance with “Program 6” of the Ministry of Fuel and Energy Ukraine: "Remote study of natural gas and gas condensate accumulations in boundaries of the Novokonstantinovskoye uranium ore deposit" (code "Gas"). As a result work identified large accumulations of gas and gas condensate under Novokonstantinovskaya uranium ore zone, specific boundaries and approximate volumes have been determined accumulations of gas at depths of 2350–2450 m and gas condensate at depths of 2450–2550 m. It has been established that the flow of gas and gas condensate to uranium ore bodies occurs along a deep secant fault. Then work was carried out to confirm the accumulations hydrocarbons using traditional exploration methods (July 2009) and drilling. The data confirmed the presence of hydrocarbon deposits in the submeridional zones of intense crushing of rocks located below uranium ore bodies, which confirmed the high the effectiveness of detecting hydrocarbon anomalies in various geological structures.

Objects of study, research objectives and work methods. Forecast-geological The research was carried out at the request of commercial companies and investment companies in Crimea (examination of wells at the famous Tatyana gas condensate field), on Ukraine (study of gas accumulations in the mine field of the Zasyadko coal mine), in Russia (similar work at 6 coal mines of the Zarechnaya Management Company), in the USA (study of anomalies shale gas in pcs. Texas and the oil field in the state. Utah), in Indonesia (oil and gas block "Brantas" in 5 areas (S = 3,500 km2), of which 3 are on the shelf), in Australia (Cooper block REL-105 (Cooper), with an area of more than 1,100 km2), in Crimea (ordered by " Chernomorneftegaz", Russian Federation) on Povorotnoye field, 2014. At the first

stage, the work was carried out using remote sensing tools by deciphering satellite images using proprietary technology [1, 10, 11,

12]. At the same time, the types of hydrocarbon anomaly were identified (oil, gas, oil and gas), the boundaries of the anomaly contours, the approximate depths of occurrence hydrocarbon reservoirs in anomalies.

During the period of field work (stage II) with mobile equipment installed on vehicles (or floating craft) measurements were taken to determine the following characteristics of the occurrence hydrocarbons in anomalies: -

contours of effective areas of anomalies, depths (up to 6000 m) of hydrocarbons reservoirs at measurement points on deep geological sections;

- useful reservoir capacities, types of hydrocarbon reservoir rocks and their approximate porosity (from 5% to 20%); -

contours of hydrocarbon traps (no more than 2 per anomaly); - gas

pressure in anomalies; Based

on these data, points for drilling wells were selected and predicted volumes of reserves in hydrocarbon anomalies.

Based on the report materials, the Customer checked the results of the work by comparing them with those available seismic data (if available) or conducted additional research using traditional geological exploration methods near the points selected for drilling. Then drilling work was carried out to uncover anomalies and a final assessment of the work results.

The main goals of the work were:

1) Determination of the type of hydrocarbon reservoir rocks and their porosity in the identified hydrocarbons anomalies;
2) Selection of points for drilling wells in hydrocarbon traps, providing guaranteed industrial production of wells.
3) Determination of the effective area of the hydrocarbon anomaly located in geological structure with the required porosity of reservoir rocks (>7%).

Work methodology: ÿ 1. Stage

I. Determination of hydrocarbon anomalies using remote sensing tools by decoding space photographs using stationary equipment using radiation-chemical technologies (visualization of the boundaries of anomaly contours). Choice promising anomalies for detailed examination. ÿ 2. Stage II. Field

work: a) clarifying the boundaries of anomaly contours and identifying effective areas; b) measuring the depths and thicknesses of hydrocarbon reservoirs at points located on geological sections; c) identification of reservoir rocks and determination of their porosity; e) determination of the boundaries of hydrocarbon traps; f) calculation of forecast hydrocarbon reserves; g) selection of points for drilling wells. ÿ 3. Confirmation of results using traditional geological exploration methods

nearby selected points for drilling wells, then drilling an exploratory well and evaluation of results.

Interpretation of space photographs was carried out using radiation-chemical technologies [1, 5, 6, 7, 13] by visualizing the boundaries (contours) of areas with hydrocarbon anomalies. These boundaries were clarified in the field using mobile equipment and GPS receivers and then plotted on a map of the search area. The the delineation method is similar to existing aerospace remote control methods earth sounding (ERS), however, the probability of identifying types of reservoir rocks and hydrocarbon anomalies using field equipment of the Poisk complex increases sharply (up to 95-97%) [5, 6, 11, 12,

13]. In field conditions, a modulated signal using a highly directional antenna from high-frequency block of the microwave generator through the energy or “ionization” channel is directed at a certain angle deep into the Earth for remote resonant disturbances of the atoms of the reference element or the entire identifiable substance lying on depths up to 6000m [1, 5, 6, 7, 11]. In this case, a weak high-frequency electromagnetic field characteristic of each type of oil and rocks. Each characteristic electromagnetic field is sequentially recorded by a sensitive a receiver device tuned to the resonant frequency of a specific reference atom element or integral spectrum of a substance (oil, reservoir rock), which provides them selective identification at different depths [1]. Reservoir depth measured by geometric calculations using the tangent of the antenna tilt angle and the measured leg, i.e. distance from the generator to the tip of the anomalies (Fig.-1, Fig.-2).

Results of the work. In all cases, as recognition features of varieties oil, the quantitative composition of reference metals in them was accepted, and for reliability to identify “sealed” oil or “non-commercial” anomaly, 4 additional parameters were used: a) absence of a gas cap in the oil-bearing reservoir; b) type oil reservoir rocks; c) the value of rock porosity; d) lack of movement dynamics formation fluids to the oil anomaly. The non-industrial gas anomaly was determined by type of rocks of gas-saturated reservoirs and their low porosity, as well as low pressure gas and significant capacity of the efficient collector. To

identify the types of rocks in oil-bearing reservoirs, the most frequently studied occurring rocks with increased oil and gas permeability - barrier reef, conglomerates, coarse- and fine-grained sandstones, fractured limestones, siltstones, pebble deposits and clastic crystalline rocks. Percentage of metals and specific (reference) elements in each rock vary significantly, which ensures their selective identification [1, 5, 6].

When identifying formations with mobile oil, the thickness of the gas cap ranged from 15 m up to 5 m (gas pressure in it is from 20.0 to 40.0 MPa). This was reliably recorded at points measurements near known wells in Mongolia, Bloch X South Torhom, USA (Utah, Orem), as well as at the oil site of Ukraine (Crimea), in Indonesia (Brantas block, at 3 wells) and in Australia (Cooper Block, well Piri-1) [3, 4, 6, 7]. Gas pressure in gas

anomalies and in gas caps of oil reservoirs was determined using using resonance testing equipment and recognition spectra of sample samples gas recorded on “test” matrices at different gas pressures in samples (test set ranged from 5.0 MPa to 60.0 MPa with a pressure range of 2.5 MPa).

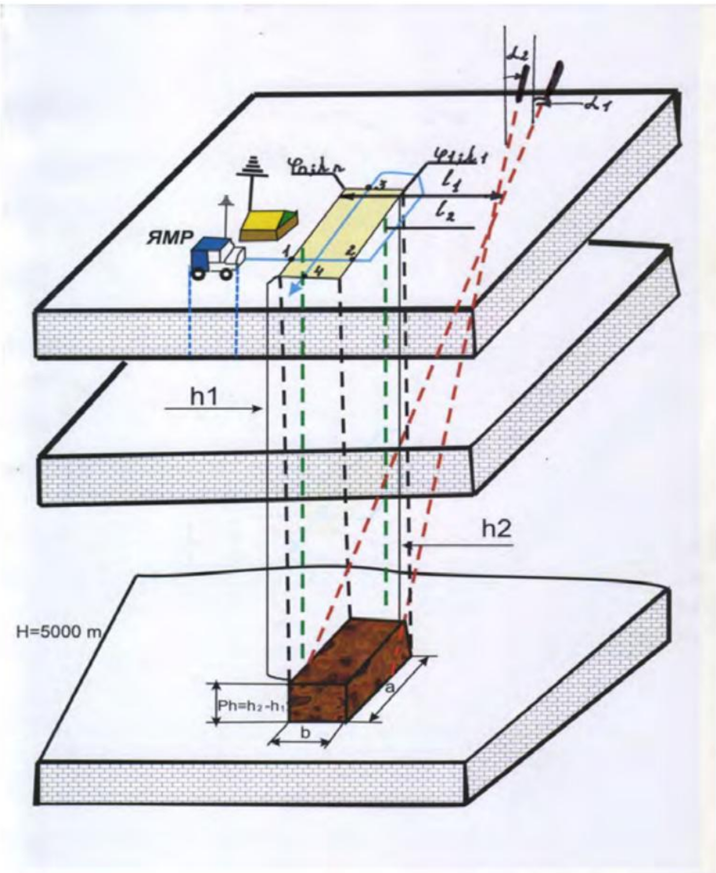

Fig.1. ***A method for delineating an area and determining the depths of horizons of oil manifestations using field resonance NMR equipment of the Poisk complex: l1t l2 - distance from the microwave generator to the far and near receiver lines; a, b - dimensions (area) of deposits; h1t h2 - depth of occurrence of the upper and lower parts of the deposits; Ph = h2-h1 - thickness of the deposit horizon***

l1, l2 –** distance from the microwave generator to the far and near receiver lines; ****a, b

– dimensions (area) of deposits; ***h1, h2**

– depth of occurrence of the upper and lower horizons of deposits; ****Ph=h2-***

h1 horizon **–** power of deposits; ***ÿ1, ÿ2**

– angle of inclination (°) of the microwave beam to the boundaries of the lower and upper horizons of the deposit.

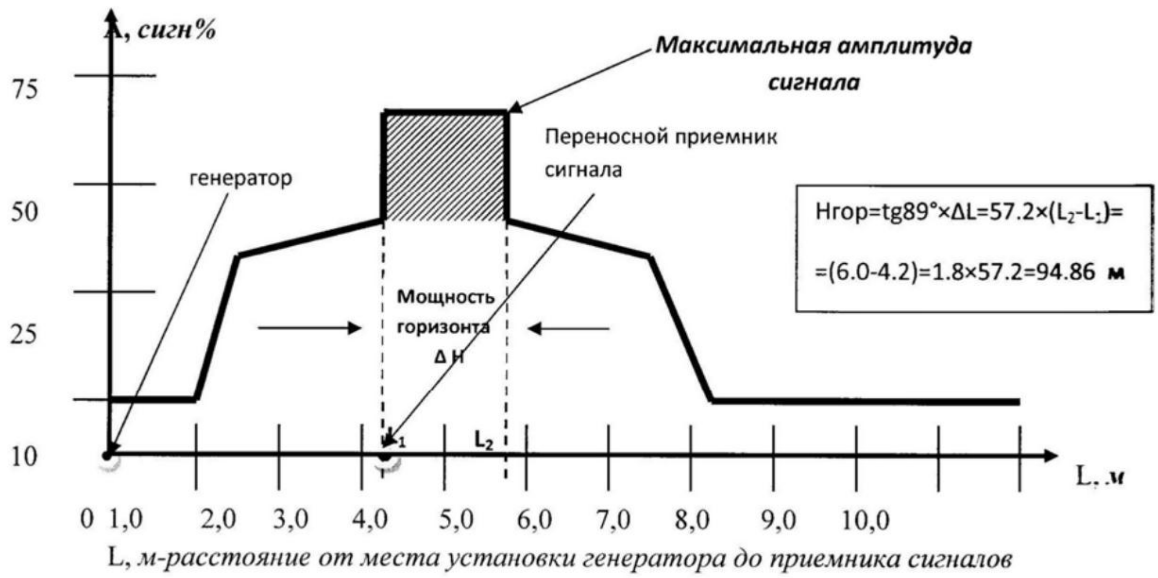

Fig.2. Change in the amplitude of the receiver signal during resonant excitation of the oil site at a depth of ~3760 m. L is the distance from the generator installation site to the signal receiver.

Remote registration by field equipment of the main types of oil-permeable rocks allows you to obtain primary data on the approximate values of the effective coefficients porosity of reservoir rocks necessary for rapid assessment of oil reserves, and for confirmation of guaranteed inflows in oil wells. Recommended points under drilling wells were selected in hydrocarbon traps.

The depths of useful horizons and their thickness were determined from earlier developed method [1, 6, 7] (Fig. 1). In this case, the signal from a highly directional antenna was heading towards the Earth at an angle of 1°. The depth was calculated based on the tangent of the angle and distance from the generator to the known boundaries of the anomaly contours. Maximum amplitude receiving signal was received over the area where the signal directly hit the anomaly (Fig.2).

Hydrocarbon traps were identified by a sharp change in the depths of occurrence and increase in reservoir thickness. Using this method, we worked out: a) construction depth profiles with a measurement step of 150-200 m; b) distance building techniques deep columns with detailed parameters of effective horizons at inclination angles 2° antenna, which made it possible to determine specific areas in the horizon reservoir with a movable (recoverable) oil (based on maximum signal amplitudes at a specific depth interval).

Thus, it is possible to construct depth profiles (2D) and depth cores at points selected for drilling wells. On the deep columns of the site (Fig. 3) the thickness of useful horizons with mobile oil (from which it is possible to obtain industrial inflows in wells), they are significantly less than the capacity of oil-saturated reservoir rocks.

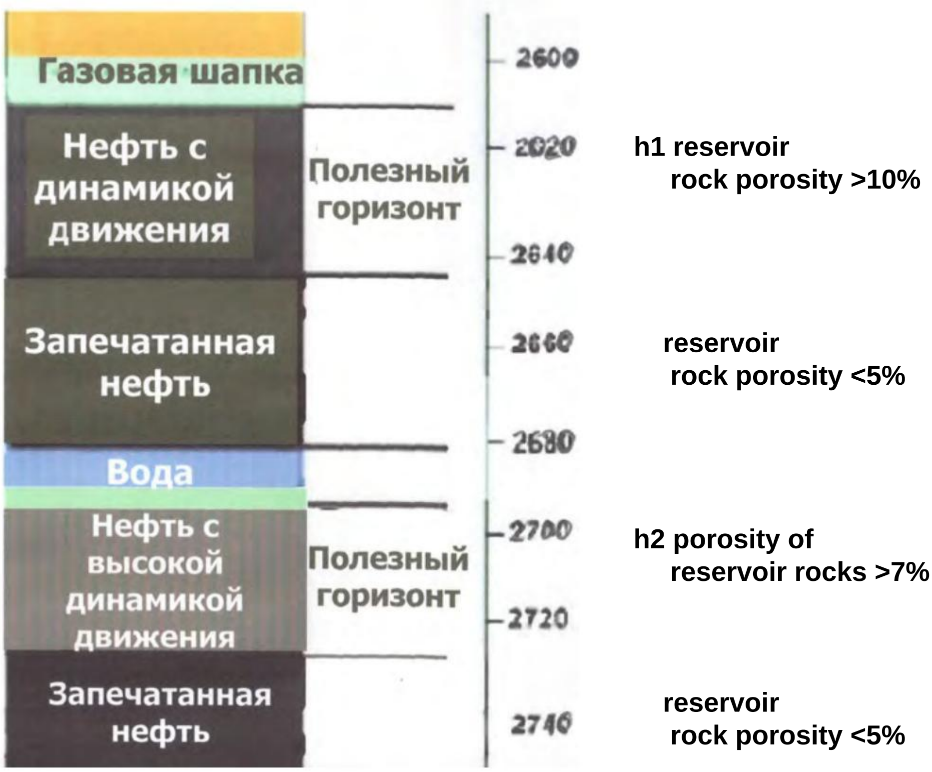

Fig.3. Deep column at the measurement point (Utah, USA). Total thickness of oil reservoirs H=h1+h2=70m; total thickness of oil-saturated rocks – 140 m

One of the important parameters for assessing inflows in oil wells is the dynamics migration of formation fluids to the oil reservoir and the path of their migration to and from the anomaly. The dynamics of hydrocarbon migration was determined by the amplitude of the receiver signal, the direction migration - through a series of measurements (6 times) at one point. In this case, the antenna of the device was installed at an angle of 15° and at each measurement rotated to an angle of 45°. It was assumed that the maximum amplitude of the resonant signal at the measurement point indicates migration hydrocarbons towards the operator, minimal - for migration from the operator, coinciding with the direction of the device antenna. Error in determining migration direction hydrocarbons can be ±15-20°. These data are important in determining “deconsolidated” (fractured) zones in rocks, which then makes it possible to search for oil lenses in these zones

An example of determining and taking into account hydrocarbon migration paths when selecting points for drilling wells at the Tatyana gas condensate field is shown in Fig. 4. It is clear that maximum inflows in gas wells and in wells with gas condensate can be get if the wells are within the boundaries of the corresponding “migration flows” fluids" (within the boundaries of porous reservoir rocks - medium-grained sandstone) This is confirmed by inflows in drilled wells [4]. It was then confirmed to everyone completed work.

Obviously, knowing the boundaries of porous reservoir rocks, you can correctly select points for drilling wells to tap a hydrocarbon deposit.

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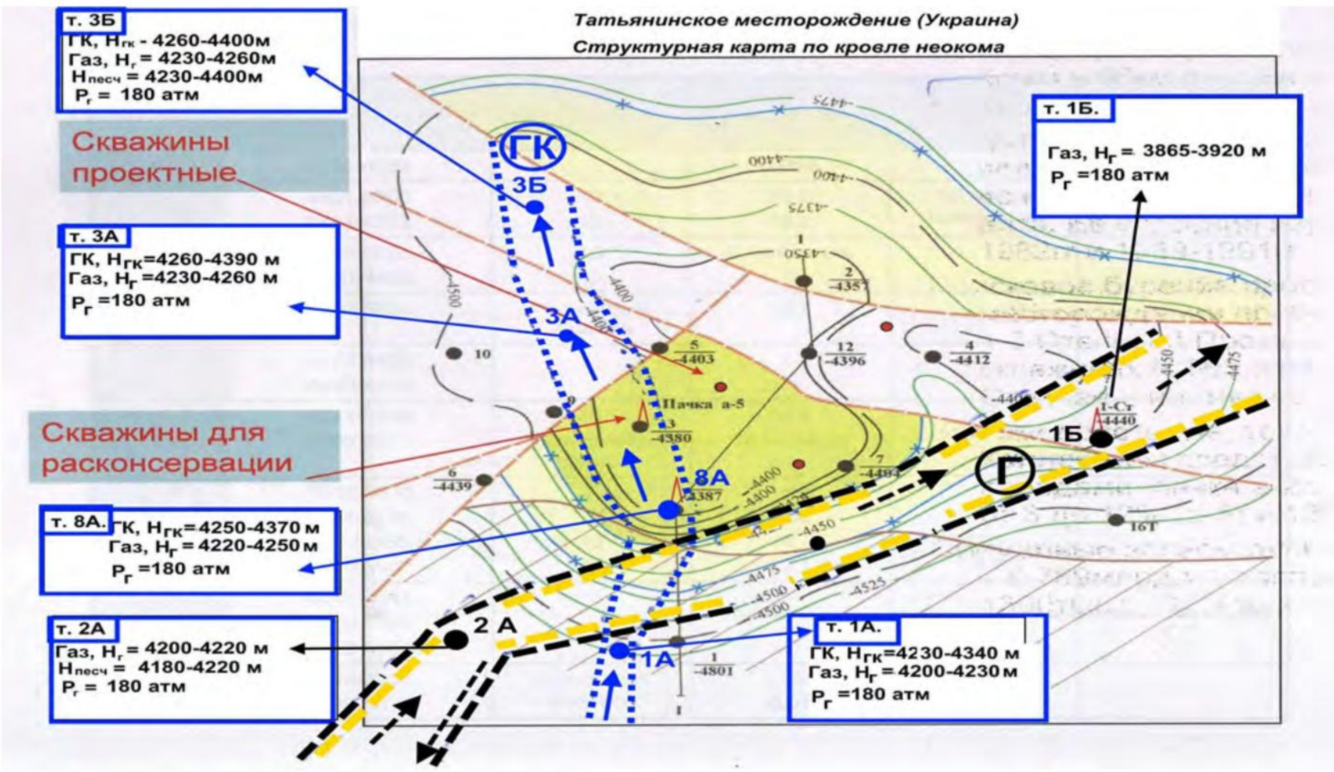
The obtained data of registration of all parameters using remote field equipment allows you to calculate (express assessment) the volumes of extracted reserves with an error of 30-40%, and also significantly increase drilling efficiency (95-9%).

An express assessment of the suitability of a deposit site for industrial development is carried out by calculating forecast reserves using known formulas. Data on hydrocarbon areas anomalies are taken from the map of the search area. In this case, only the effective area is taken into account an anomaly located in that part of the geological structure where the porosity of reservoir rocks is >7÷10%. This achieves a more realistic calculation of predicted hydrocarbon reserves in anomalies. The depth of productive horizons (oil layers) is determined by depth sections and depth columns of each horizon. Other corrections coefficients are averaged depending on what types of oil and gas bearing rocks identified in reservoirs. If geological data (cores) obtained from areas closest to the surveyed area, rapid assessment of reserves is greatly simplified deposits, as data on oil saturation of reservoirs becomes more reliable.



Conventional direction **of** migration : fluids.

Fig.4. Tatyaninskoye field

boundaries of porous reservoir rocks (>7÷10%)

industrial wells (1-Cr, 3-GK, 8F-GK)

The method of remote search using the equipment of the Poisk complex can be used in conjunction with geophysical and other methods of exploration and identification of oil-saturated reservoirs, for example, with geoelectric methods of "direct" searches [1, 6, 7] or seismic. The results of well examination at

the Tatyana gas condensate field are shown in Fig. 4. It has been proven that in the "trap" there are zones of increased porosity of reservoir rocks (in in the form of 2 "streams" at different depths). Wells that fall into these areas of increased migration gas - provide industrial gas inflows, and the rest are of no industrial importance.

Several works were carried out using the joint use of two complexes - remote equipment "Search" and geoelectric equipment of the Institute of Applied Problems of Ecology, Geophysics and Geochemistry (IPPEGG NAS of Ukraine) (Ukraine - gas, gas condensate (mine Novokonstantinovskaya); gas, oil - mine field of the coal mine named after. A.F. Zasyadko; Mongolia — oil, gas (block X South Torhom) [6, 7, Fig. 5].

The work performed showed great prospects for prospecting work during integration two remote search methods developed by the National Academy of Sciences of Ukraine, SNUYAEiP and traditional search [8].

When examining the mine field of the Zasyadko coal mine (Fig. 5), it was found that it is crossed from west to east by 3 geological "channel" faults with increased gas pressure in them and one from north to south [8].

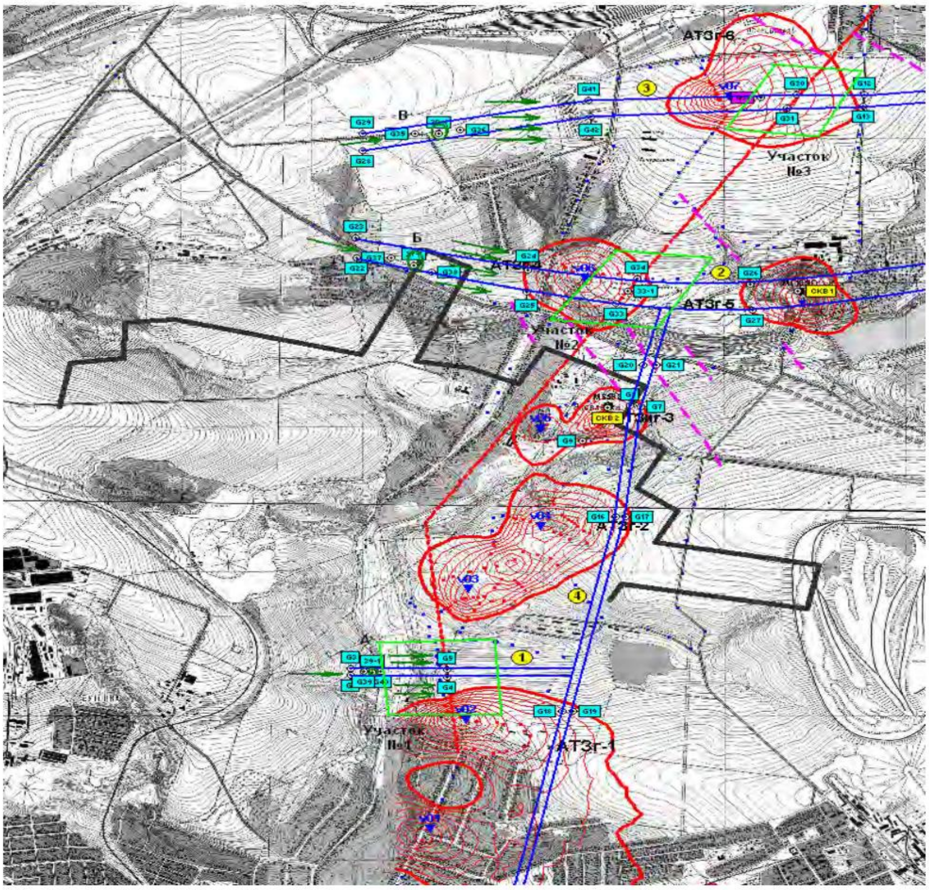


Fig.5. Contours of geoelectric anomalies of the ATZ and the boundaries of gas-permeable "channels" on topographic map of the mining allotment section of the A.F. Zasyadko coal mine [17].

Vertical gas-permeable areas ("columns of rock decompression" vertically) were located outside the mine field (1÷1.5 km before its border) and were located on each of 3 faults ("channels"). Gas migration took place through all "channels" from west to east, which provided a certain gas pressure in each channel. The width of the

"channels" ranged from 40 to 80 m. Each "channel" had 4 gas-permeable horizons representing fractured medium-grained sandstone (porosity >12%), located in each channel at depths from 410 m to 1690 m. The thickness of the gas-bearing horizons ranged from 20 to 80 m, the excess gas pressure in the horizons (depending on the depths) ranged from 16 kgf/cm2 (upper horizon from 160 kgf/cm2 (lower horizon). Gas horizons were located under coal seams. The main source of high-pressure gas was located outside the mine field (5 km from it). Gas from it entered the mine field through 3 faults crossing the mine field. Moreover, the distribution of gas in the "channel" under the coal seams occurred from the lower horizon (1690 m) with high gas pressure (230 kgf/cm2) to the upper horizon (16 kgf/cm2) along a common gas-permeable vertical section of the "column" with depth 1690 m to depth 410 m (Fig. 6).

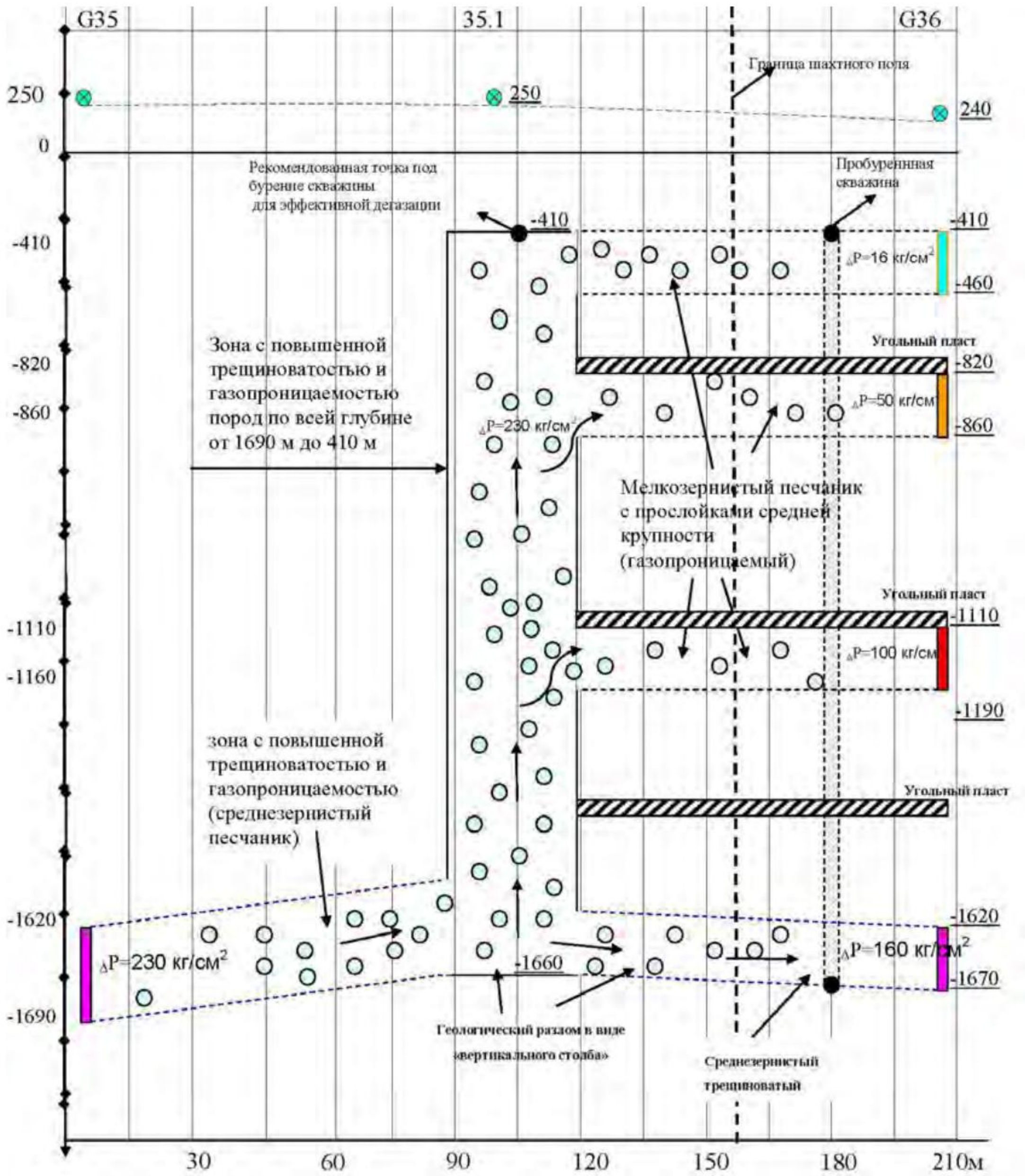


Fig.6. Depth section 035-036 of the gas-bearing channel in the mine field of a coal mine.

At a distance of ÿ5 km to the west of the mine field, a large gas-bearing deposit (diameter ÿ4 km) was identified with a gas pressure in it of 350 kgf/cm2, from which the "channels" of gas flow under the coal seams originated. As we approached the mine field, the gas pressure in the gas-bearing reservoirs decreased (throttled to 230 kg/cm2). An analysis of the sites of mine accidents with methane explosions (and deaths) showed that the explosions occurred during the development of coal seams above gas-bearing "channels" (faults) with high gas pressure in them (>50 kgf/cm2).

A well drilled in the northern gas "channel-1" in all 4 horizons confirmed the presence of inflows of natural hydrocarbon (and not "coal") gas with the corresponding gas pressures significantly higher (P4ў160 kgf/cm2) gas pressures in coal seams (usually 5-10 kgf/cm2). That. data from remote determination of the parameters of gas “channels” (collectors), their depth and gas pressure in them were confirmed.

Consequently, if you drill degassing wells directly in vertical gas-permeable “pillars” or “channels,” this will sharply reduce the overall pressure of gas approaching the mine field, which means the situation under the coal seams throughout the mine field will improve.

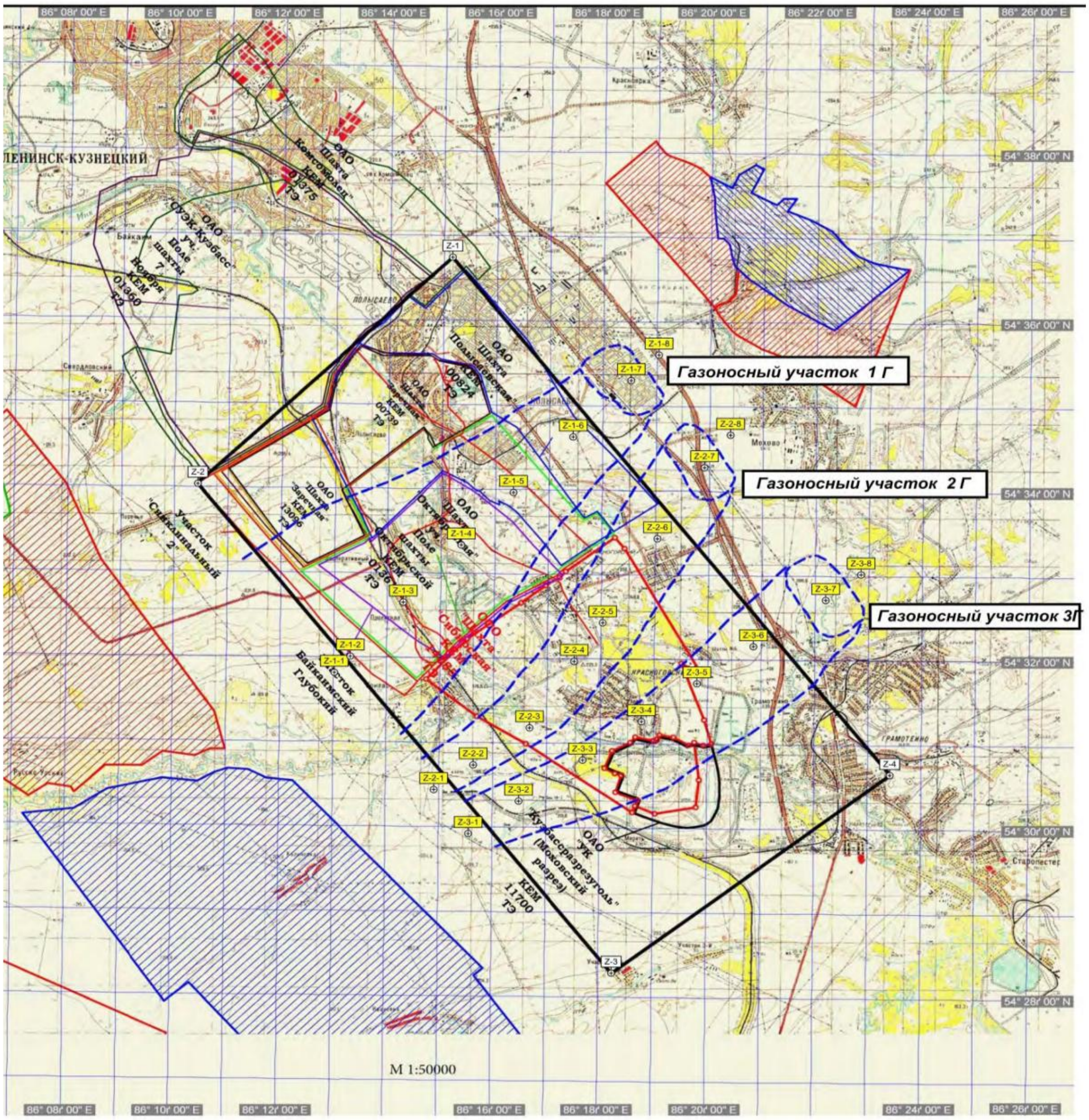


Fig.7. Boundaries of identified gas anomalies in the territory of mining allotments of the Polysaevskaya, Zarechnaya, Oktyabrskaya and Sibirskaya coal mines (S=99 km2).

It is advantageous to use gas from such a well with an industrial inflow and a pressure of 160 kg/cm2 for the technical needs of the city, rather than degass it into the OS. A similar picture was revealed at several Russian mines (Fig. 7, Fig. 8). Recommendations were given for drilling degassing wells in gas-bearing “reservoirs” with high gas pressure, which can significantly reduce the gas hazard throughout the entire mine field. Similar work performed at 5 coal mines in Russia

confirmed a similar situation in the presence of several “channels” of gas supply with high gas pressure > 350 kg/cm2 under coal seams from sources located at great depths and located outside the mine fields.

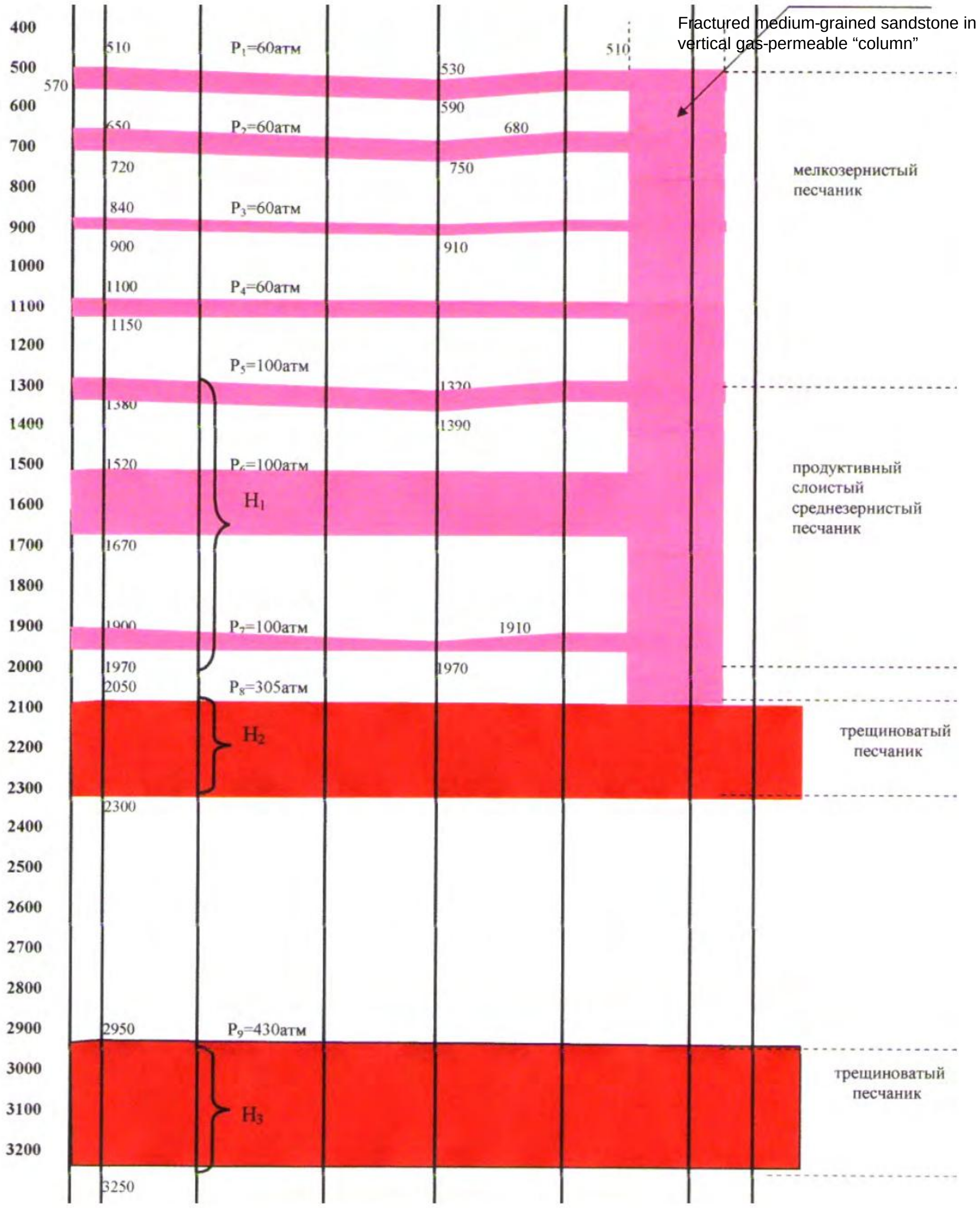


Fig.8. Depth profile of gas section No. 1G in the mine field (Zarechnaya mine, Russia).

High gas pressures under coal seams were recorded at depths of ÿ500 m. Accumulations of gas with high pressure (>50 kg/cm2) pose a great danger when carrying out mining operations, because when opening coal seams near such accumulations there is an instant release of large volumes of gas mixture into the air-oxygen environment drift, which leads to a volumetric explosion with great destructive force.

The work carried out during the examination of 5 sections of the Brantas block (Indonesia) confirmed that hydrocarbon anomalies may not occupy the entire area of the promising geological structure (which is well identified by seismic), but only that part of it, in in which reservoir rocks have high porosity (>10÷12%). This was confirmed by 16 unsuccessful (empty) drilling wells previously completed by the Customer in hydrocarbon fields traps (according to seismic data) and 3 successful drilling wells (2 oil and one gas), made in anomalies with reservoir rocks with a porosity of 15-25%. This allowed for based on measurement results using field equipment of a remote complex

“Search”, obtain new data on the selection of points for drilling wells on land and shelf, and also calculate predicted oil and gas reserves (Fig. 9).

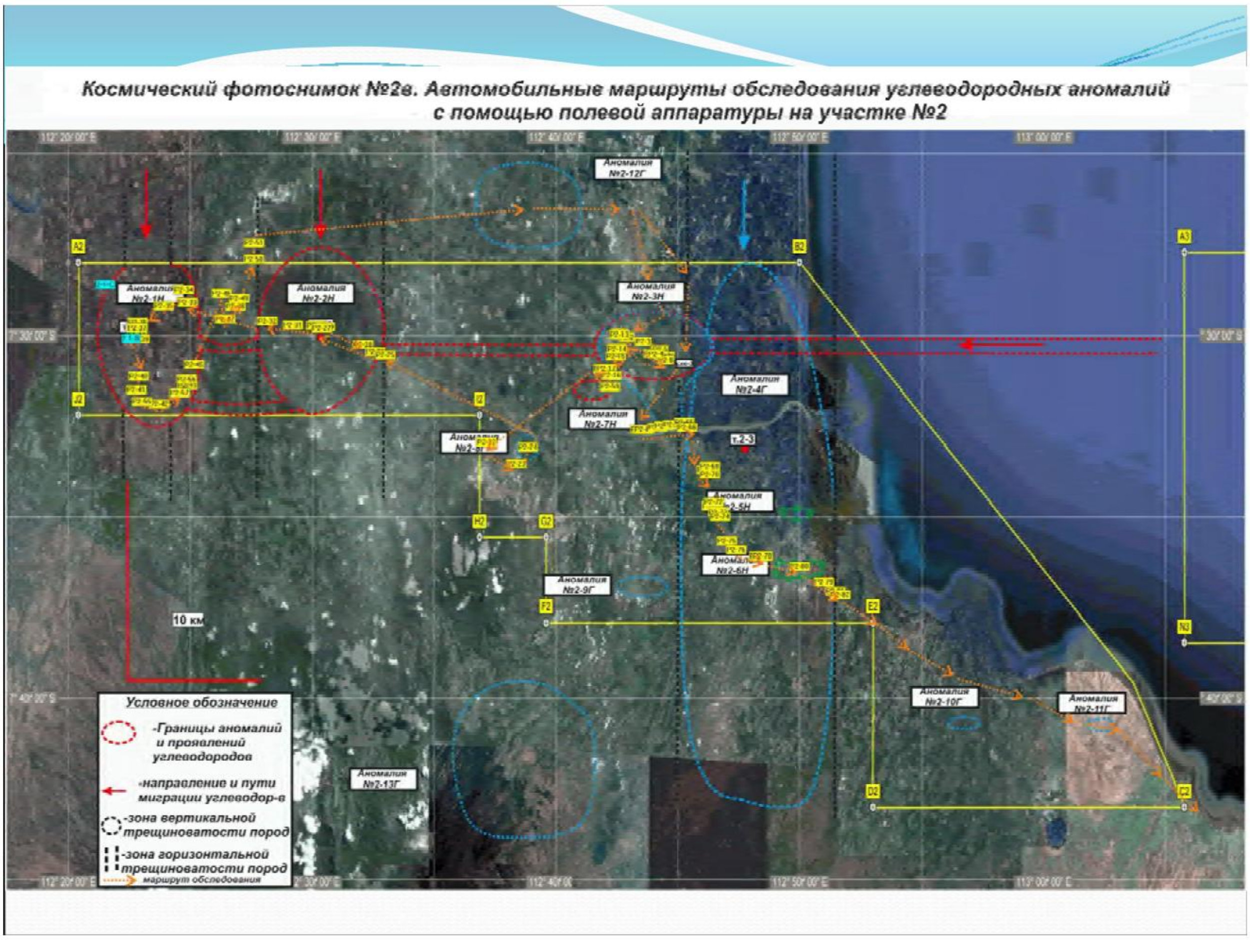


Fig.9. Satellite photograph with automobile routes for examining hydrocarbon anomalies using field equipment

Work on studying the features of shale gas occurrence in area (>120 km2) in the state of Texas (USA).

This study showed that shale gas accumulation occurs only along porous (fault) zones and has gas migration to shale from large gas fields with high gas pressure. (Fig. 10). The results of the work were confirmed by drilling a well in the identified anomaly, which discovered a gas deposit at a depth of 3.5 km with a gas pressure of 620 kg/cm2 (~65 MPa) at point 1.

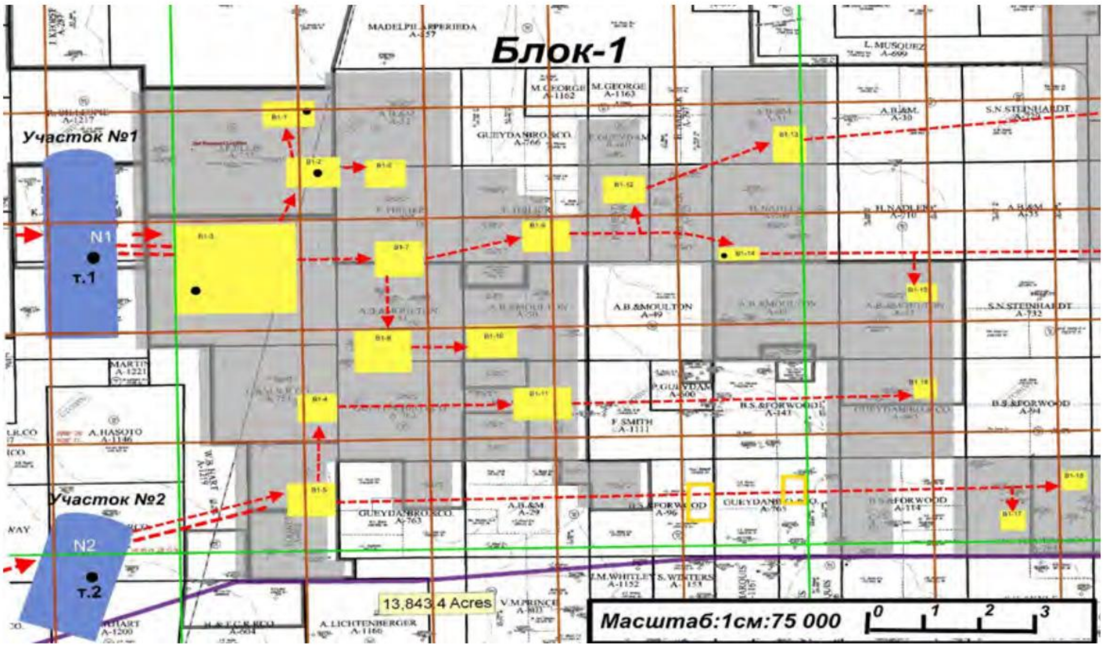


Fig. 10. Boundaries of identified oil and gas anomalies in the shale section of block No. 1, Texas (USA)

The work performed in 2013 using remote equipment “Poisk” at the Cooper PEL-105 site (Australia) to study the site and the oil and gas trap (identified by seismic results) allowed us to suggest that the identified oil and gas anomaly and trap are unpromising for industrial development, i.e. To. reservoir rocks in 3 horizons (2 gas and one oil) have low porosity (5-7%). It was proposed to the Customer to abandon the planned drilling of the Piri-1 well. However, the Customer drilled the Piri-1 well at a point selected based on seismic results (in a hydrocarbon trap), where geologists predicted high volumes of oil and gas reserves. Drilling results confirmed the low porosity of the reservoir rocks (~7%), which does not allow obtaining commercial volumes of oil and gas. The well was closed, the Customer suffered financial losses of ~ 10 million US dollars (Fig. 11).

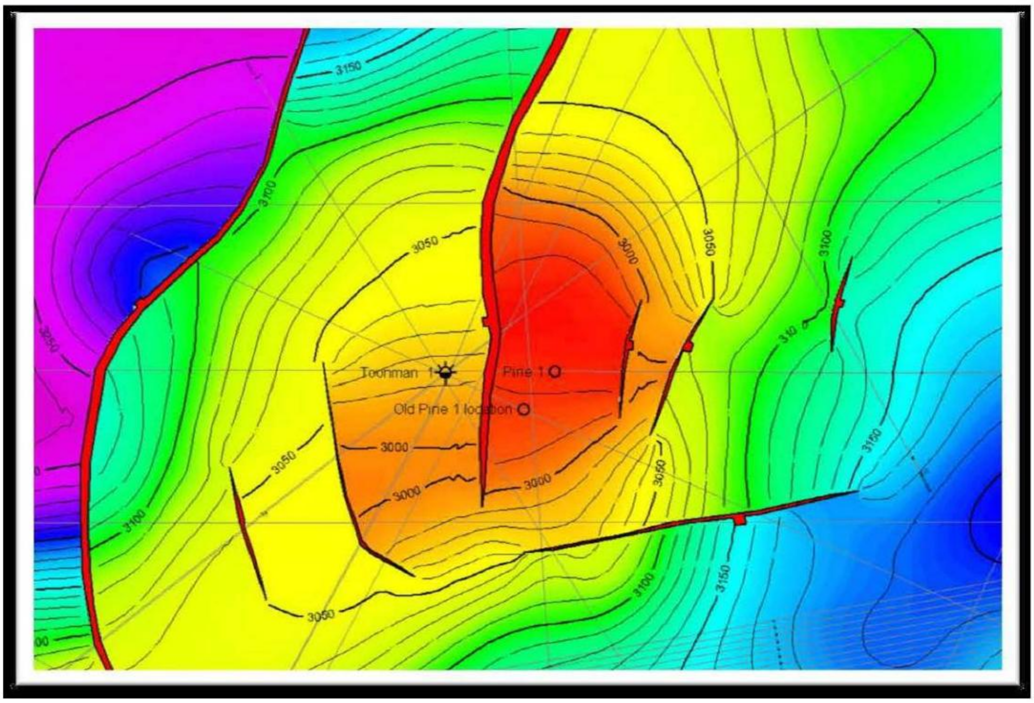


Fig. 11. Oil and gas anomaly in the Pel 105 area indicating the Pirie-1 well (Australia).

Similar work testing the effectiveness of the equipment of the Poisk complex during the study of a site with an area of 160 km2 in Utah (USA, 2013) made it possible to change the Customer’s decision on the choice of drilling points for 2 wells in oil anomalies with low porosity of reservoir rocks (Fig. 12). New drilling points are recommended in oil traps, which are additionally confirmed by seismic profiles, and also in which the porosity of reservoir rocks (>15%) was measured by field equipment of the remote complex “Poisk” (Fig. 13). The listed studies of hydrocarbon anomalies confirm the high effectiveness of

geological forecasting work using remote sensing tools and field equipment of the Poisk remote resonance test complex.

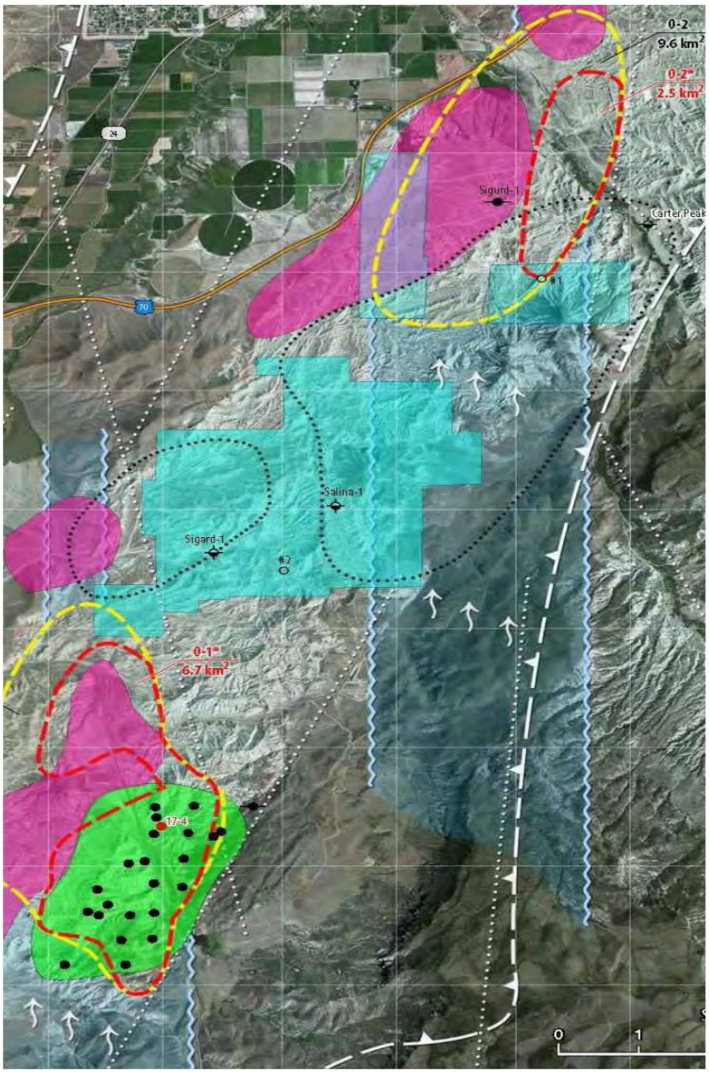


Fig. 12. Boundaries of effective areas of oil anomalies with drilled wells (Covenant, Utah, USA).

Рис. 1. Разрез складчатого пояса по линии северо-запад – юго-восток

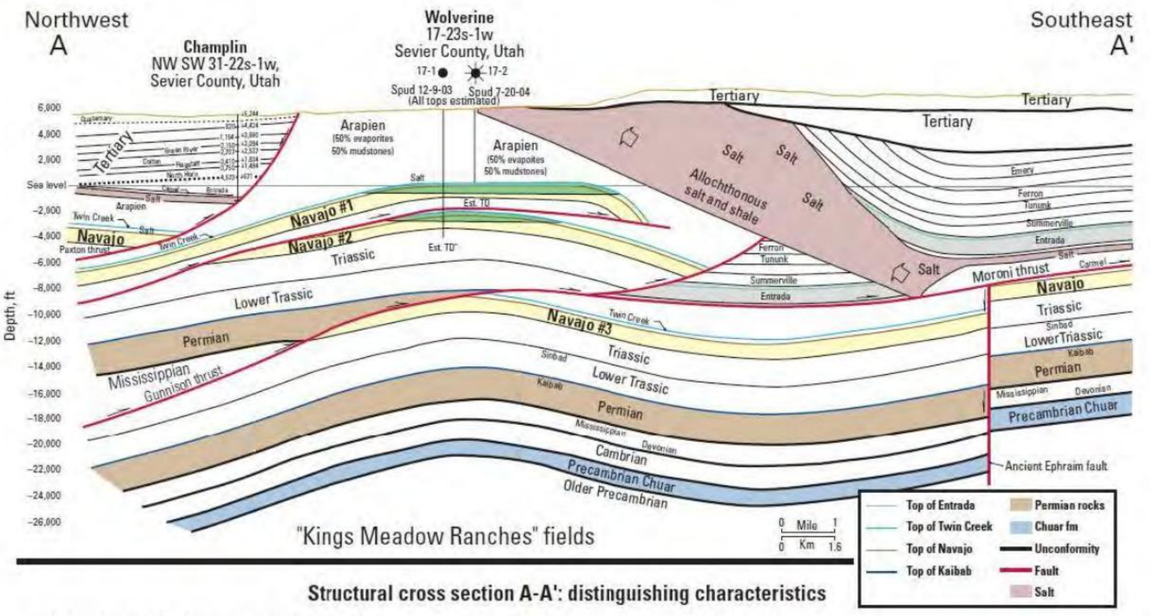


Fig. 13. Geological section of the southern oil anomaly with drilling points at Covenant Field, Utah.

Conclusions.

1. Experienced and practical search work carried out using field equipment remote complex "Poisk", confirm its high effectiveness for remote identification, delineation and obtaining primary geological and geophysical characteristics of reservoirs necessary for rapid assessment of suitability for industrial development of identified hydrocarbon deposits or selection of points for placement of drilling wells with a guaranteed influx of hydrocarbons.
2. The ability to determine important geological characteristics with field equipment occurrence of hydrocarbon horizons (depth, thickness, gas pressure, temperature, direction of fluid migration, type of reservoir rocks and their porosity) is significant facilitates decision-making on further detailed studies of identified areas using traditional geophysical methods, as well as to select points for drilling exploratory wells. 3.

Integration of aerospace, traditional and non-traditional search methods hydrocarbons can significantly reduce the financial risks of exploratory drilling operations, especially at great depths, which creates commercial attractiveness oil and gas exploration.

4. The results of studies of gas accumulations under coal seams allow us to determine additional measures to ensure gas safety of mines that exclude volumetric explosions.

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