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The most expensive “dry” exploratory well in the history of the oil industry: reasons of failure based on data of direct-prospecting methods application

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SUMMARY

The materials of additional testing of mobile direct-prospecting methods on the Alaska, Peru offshore are presented. Experimental studies have been carried out in order to demonstrate the operability, efficiency and potential capabilities of the developed methods during hydrocarbons (HC) accumulations searching. The studies performed on oil and gas drilling sites confirmed the feasibility of additional works conducting with using direct-prospecting methods when choosing sites for their laying. Within deep channels (volcanoes), filled with sedimentary rocks of 1-6 groups, signals (responses) are almost always recorded at the resonant frequencies of hydrocarbons (HC) and, in many cases, amber. Signals at the frequencies of oil, condensate and gas are also recorded quite often in volcanoes, filled with limestone. In volcanic complexes filled with sedimentary rocks of 8–10 groups (dolomites, marls, siliceous rocks), responses at frequencies of oil, condensate, and gas have never been recorded. In many areas of the survey, in the contours of responses from the HC recording, the existence of a 57 km boundary was confirmed, in the region of which the oil, condensate, gas and amber are synthesized from hydrogen and carbon migrating from below.

Introduction. To demonstrate the potential capabilities of the direct-prospecting technology developed, a survey of local sections (zones) of the location of drilled, drilling and design wells was repeatedly conducted. Some results of this kind of work are presented in (Yakymchuk and Korchagin, 2019). Research in this direction is deliberately continuing to establish possible causes of negative drilling results. This report presents the materials of experimental work at the drilling sites of the most expensive Mukluk well in the history of the world oil industry (Alaska offshore), as well as Marina-1 well (Peru offshore).

Methods of research. The experimental studies were carried out using the technology of integrated assessment of the oil and gas prospects of large search blocks and local areas, which includes methods of frequency-resonance processing of satellite images and photo images, as well as vertical sounding (scanning) of a cross-section in order to determine the depths and thicknesses of productive horizons and rocks in cross-section. The features of the technology used, as well as the results of its testing and practical application, are described in the articles and materials of the conferences, including (Yakymchuk et al., 2019; Yakymchuk and Korchagin, 2019).

Mukluk well on the Alaska offshore. Information on the most expensive "dry" Mukluk exploration well on the Alaskan offshore in the history of the oil industry is given in documents and articles (Arctic..; Engineering..; Sohio..; The most..; Thomas..).
A satellite image of the northern slope of Alaska is shown in Figure 1. A marker with the symbol M shows the position of the Mukluk well (point coordinates: 70.683342° N, 150.919968° W or 70°41'0".031 N, 150°55'11".885 W). Markers with the symbols K and P indicate points within the Kuparuk River and Pradkho Bay (Prudhoe Bay) oil fields. The coordinates of these points are borrowed from Wikipedia sites.
In the process of research, frequency-resonance processing of satellite images of local parts of the territory, the centers of which are marked with markers, was performed (Figures 2-4).

Figure 1 *Satellite image of the northern slope of Alaska. Markers indicate (from left to right) the centers of the following local processing areas: M) Mukluk wells; K) the Kuparuk River oil field; P) the Pradkho Bay (Prudhoe Bay) oil field.*

Mukluk well site. During frequency-resonance processing of a satellite image of the Mukluk well site (Figure 2), responses (signals) at frequencies of hydrocarbons (HC: oil, condensate and gas) were not recorded. No responses were also received from amber, oil shale, gas hydrates, ice, coal, anthracite, hydrogen, water, "dead" water, potassium magnesium salts, sodium chloride salts.
Responses from 9 and 10 groups of sedimentary rocks were recorded from the surface; no signals were received from all groups of igneous rocks.
On the surface of 50 km, responses were obtained from the lower part of the cross-section only from the 10th group of sedimentary rocks (siliceous rocks). By fixing the responses at various depths (50, 150, 250, 350, 450, 550, 470 km), the root of the channel (volcano), filled with rocks of the 10th group, was established at a depth of 470 km.

It is advisable to note **that within volcanic structures, filled with rocks of this type (siliceous), responses at HC frequencies have never been recorded.**

Figure 2 *Satellite image of the local site of the Mukluk well location.*

Figure 3 *Satellite image of the local area of the Kuparuk River oil field.*

Figure 4 *Satellite image of the local area of the Pradkho Bay (Prudhoe Bay) oil field.*

Kuparuk River Oil Field. When processing a satellite image of the local area of the field (Figure 3) from the surface, responses were recorded at the resonant frequencies of oil, condensate (very weak), gas (weak) and amber. Responses from oil shale, gas hydrates, ice, coal, anthracite, hydrogen, water, "dead" water, potassium magnesium salts, sodium chloride salts were not received.
Signals from 1 (weak), 2 (weak), 3, 4, 5 (weak), 6 (weak) and 10 groups of sedimentary rocks, as well as 1 (granites) and 11 (kimberlites) groups of igneous rocks were recorded. No responses from diamonds.
On the surfaces of 5, 6, 10 and 50 km, there were no responses from the lower part of the cross-section from 1-5 groups of sedimentary rocks. Signals from these groups of rocks were recorded on the surface of 5 km from the upper part of the cross-section. Responses from the 10th group of sedimentary rocks are recorded from the interval of 4-5 km to the interval of 20-21 km. Signals from the first group of igneous rocks were recorded from 20-21 km to 23-24 km. Responses from the 11th group of igneous rocks were traced in the interval 23-24 km - 195-196 km.
The survey site in Figure 3 is located outside the central part of the volcano, filled with sedimentary rocks. In volcanic complexes, filled with sedimentary rocks of groups 1-6, signals are almost always recorded at the frequencies of hydrocarbons (oil, gas, and condensate) and amber.
Pradkho Bay (Prudhoe Bay) Oil Field. During the satellite image processing of the local area of the field (Figure 4), responses were recorded from the surface at the resonant frequencies of oil, condensate and gas. Responses from amber, oil shale, gas hydrates, ice, coal, anthracite, hydrogen, water, "dead" water, potassium magnesium salts, sodium chloride salts were not received.
Responses from 7 and 10 groups of sedimentary rocks, as well as 1 and 11 groups of igneous rocks, were recorded from the surface. Responses from the 7th group of sedimentary rocks (carbonates, limestones) were recorded to depths of 4-5 km, the tenth group - in the range of 5-18 km.
Signals from the first group of igneous rocks were obtained from the interval of depths of 19–25 km, and the 11th group from the interval of 26–195 km.
The survey site in Figure 4 is located outside the central part of the volcano, filled with sedimentary rocks of the 7th group (carbonates, limestones). In volcanic complexes, filled with limestone, signals are almost always recorded at the frequencies of hydrocarbons (oil, gas, and condensate), there are no responses from amber within such channels (volcanoes).

Peru offshore. Document (Drilling..) provides information on the Marina-1 exploratory well, which is drilled within Block Z-38 (Figure 5) on the Peru offshore (Karoon..).
In this regard, the authors conducted experimental studies with the goal of an integrated assessment of the prospects for commercial fluid inflows (oil, gas) obtaining at a local well drilling site.
The position of the Marina-1 well within Block Z-38 is shown in the Figure 5. The coordinates of the well (points in Figure 6) are 3°36'56.988" S, 81°0'47.988" W - determined by the position of the drilling vessel.

First, we note that experimental studies on the site were carried out before completion of the well drilling.
At the first stage of the work, a frequency-resonance processing of a local area in the vicinity of the drilling point indicated in Figure 6 by rectangular outline was carried out.
From the surface during processing of this fragment of the image, the responses (signals) at the frequencies of oil, condensate and gas **were not recorded!** No signals were also received from amber, oil shale, gas hydrates, ice, water, "dead" water, coal, hydrogen, potassium-magnesium salt, sodium chloride, brown coal, anthracite.

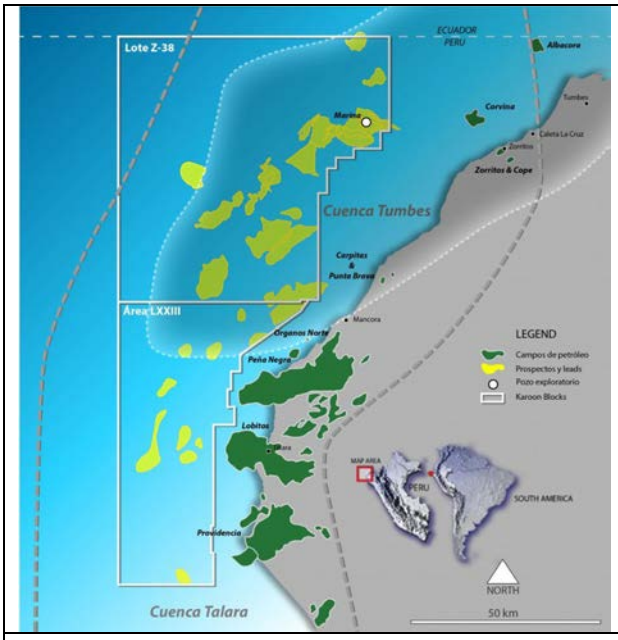

Figure 5 *Schematic map of the of Block Z-38 and Marina-1exploratory well location within the Tumbes Basin of Peru offshore.*

Figure 6 *Satellite images of the drilling site of the exploratory well Marina-1 (Block Z-38, Tumbes Basin) on the Peru offshore. The position of the well is indicated by a marker.*

Responses were recorded only from the 10th group of sedimentary rocks (siliceous rocks). Signals from all groups of igneous rocks are not fixed.
By fixing responses at various depths (50, 150, 250, 350, 450, 550, 470 km), the root of a channel (volcano), filled with siliceous rocks, was determined at a depth of 470 km.
Operative studies (measuring signals at HC frequencies) allow us to conclude that the probability of receiving commercial oil, condensate and gas inflows in the Marina-1 well after completion of its drilling is close to zero!
The experience of conducting this type of research indicates that the responses at the frequencies of hydrocarbons in volcanoes, filled with siliceous rocks, have never been received!
At the second stage of the work, an integrated assessment of the oil and gas prospects of a larger block was carried out - a satellite image in Figure 6.
When processing this image from the surface, responses were recorded from oil (very weak), condensate (stronger), gas (stronger), amber, oil shale. No signals were received from breccia of mudstone, gas hydrates, ice, coal, brown coal, anthracite, hydrogen, water, "dead" water, iron ore, diamonds, potassium magnesium salts, and sodium chloride salt.
Responses from 1 (weak), 2, 3, 4, 5, 7, and 10 groups of sedimentary rocks were recorded. No signals were received from all groups of igneous rocks.
Signals from the 2nd group of sedimentary rocks were recorded on the surface of 4 km, on the surface of 5 km there were no signals.
On the surface of 5 km, responses from 1–5 groups of sedimentary rocks were recorded from the upper part of the cross-section; no signals were received from 6–7 groups.

Responses from the 7th group of sedimentary rocks (limestones) were recorded from the lower part of the cross-section on the surfaces of 5, 7, 9, and 10 km, and signals were absent at depths of 11 and 12 km.
By fixing responses at various depths (50, 150, 250, 350, 450, 550, 470 km), the root of a channel (volcano), filled with siliceous rocks, was determined at a depth of 470 km.
Further studies within Block Z-38 have not been conducted.
Official information on the results of drilling the Marina-1 well appeared on the Internet sites in February 17, 2020 (Offshore..). **No industrial fluid inflows have been received in the well - the forecast based on the results of frequency resonance processing of a satellite image of the drilling site is confirmed by drilling.**

Some comments and conclusions. 1. In the absence of responses (intense) at the frequencies of oil, condensate and gas within the blocks (area) of the survey, further research does not make sense. In this regard, more detailed studies have not been conducted at the local sites of the Mukluk and Marina-1wells drilling.
2. The processing results replenish the statistical database of the main "reasons" for the lack of hydrocarbons in exploratory wells. In volcanic structures, filled with siliceous rocks, responses at hydrocarbon frequencies have never been recorded before.
3. To determine the central parts of channels (volcanoes), filled with sedimentary rocks of groups 1–6 (Kuparuk River field) and sedimentary rocks of 7 group (Pradkho Bay field), it is necessary to process satellite images of larger areas in the region of oil fields location.
The materials of the report, as well as the results of experimental studies in various regions, allow stating reasonably the following.
1. Within the deep channels (volcanoes), filled with sedimentary rocks of groups 1-6, signals (responses) are almost always recorded at the resonant frequencies of hydrocarbons. In very many cases, responses at the amber resonant frequencies are also recorded in the contours of such channels.
2. In volcanoes filled with the 7th group of sedimentary rocks (carbonates, limestones), signals at the frequencies of oil, condensate and gas are also recorded almost always. However, responses from amber in these volcanoes are not recorded.
3. In volcanic complexes filled with sedimentary rocks of the 8th group (dolomites), 9th group (marls) and 10th group (siliceous rocks), responses at the frequencies of oil, condensate and gas have never been recorded!
4. In the surveyed areas within which hydrocarbons were recorded, the existence of a 57 km boundary was confirmed, in the area of which the oil, condensate, gas and amber are synthesized from hydrogen and carbon migrating from below.

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