

GEOLOGICAL AND GEOPHYSICAL CONDITIONS FOR LOCALIZATION OF OIL AND GAS DEPOSITS AT THE SEVERNOE FIELD (WESTERN SIBERIA)

M.M. Bazylev

Scientific advisor - associate professor Yu.V. Kolmakov
National Research Tomsk Polytechnic University, Tomsk, Russia

The Severnoe oil and gas condensate field, located on the Northern border of the Tomsk region with the Khanty-Mansi Autonomous Okrug, is medium in reserves and unique in terms of geological structure complexity. The small field has a very large range of vertical oil and gas potential - more than 1.5 km, and its productive horizons mainly developed in different regions of the West Siberian petroleum province: Pokur suite – in northern part (the Urengoy region), the Lower Cretaceous – in the middle part (the Samotlor region), productive formations of Jurassic horizon – in southern part (Tomsk oblast). The ratio of horizontal and vertical dimensions of the Severnoe field is in conflict with statistical data for the Tomsk region (Kontorovich et al., 2001).

Identification of geological conditions of localization of oil and gas deposits in the Severnoe field is important in itself as a unique phenomenon, as well as in connection with the depletion of hydrocarbon reserves in the main production regions of Western Siberia and the search for deep-seated deposits on these well-developed areas as geological and geophysical characteristics of multilayer fields.

To solve this problem, the analysis of the results of geophysical studies of wells is made: within the Northern dome of the structure – 8 wells, in the Central part of the southern dome-1 well (311). Accepted requirements for the selection of wells for research: a full section from the Cenomanian to the Jurassic inclusive, from the PK1 horizons to the productive U1; a full range of geophysical log methods and available digital information; compact placement on the map. The numbers of the studied wells are conditional. Geological and geophysical parameters of the layers were used: general effective (porous permeable) thicknesses "H-total"; gas-saturated "Hg" and oil and gas saturated "Hog" thickness; hydrocarbon saturation index "Cog" fraction, thickness of the hydrocarbon seal "H seal". A qualitative and quantitative (mostly statistical) analysis of this information is made.

The results of the research are shown in the table and in Figure 1, 2, and briefly boil down to the following.

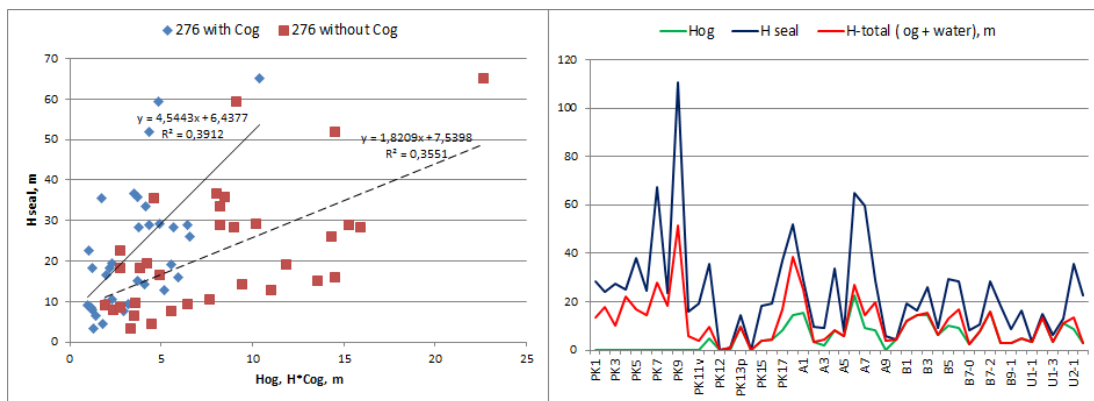


Fig.1 Results of research of geophysical logging data on the 76th well

- To assess the geological and geophysical conditions of localization of oil and gas deposits in the Severnoe field sufficient to use a simplified parameter of the productivity of the horizon, as for the borehole – gas-saturated oil and gas saturated thickness is used.

This conclusion is supported by the following data: a) similar changes in the Hog and H-total in the sections of most of the studied wells (Figure 1); b) improving the correlation between these parameters in the most productive wells and in the most productive intervals of sections (table); C) a slight improvement in the correlation ratio when taking into account the Cog-the value of the linear R-squared increased slightly from 0.3551 to 0.3912 (Figure 1).

Table

**Geological and geophysical information on the sections of the studied wells
(placed in the order of decreasing productivity - by Hog)**

Parametres / oil-wells	76	78	75	37	311	47	64	66	7
h total, m	562,65	500,7	477,7	598,6	549,9	478,7	551,6	597,7	537,7
Hog, m	268,8	183,8	162	144,8	121,4	79,3	55,1	46,8	21,8
True vertical depth of roof of PK1	873,26	654,3	699,5	402,2	440,9	431,2	431,7	403,2	429,5
U1: Hog * Cog, m	17,76	8,58	4,1	3,41	4,85	9,8	8,69	7,32	7,77
B01: Hog* Cog, m	4,74	5,62	5,46	2,9	0	0	0	0	0
Top layer with «Hog > 0»	PK11	PK8	PK9	PK1	PK1	PK1	PK1	PK1	A1

- There is a natural change in the studied parameters for the sections of the studied wells.

Effective total thicknesses (in fact, reservoir thicknesses) increase on average from the deepest horizon up, which is explained by a drop in pressure as the depth decreases. In the range U1 – PK13 (the uppermost of the horizons with proven industrial oil and gas potential), the Hog changes in accordance with the undulating change in the effective total thicknesses. At the same time, there is a tendency to reduce the differences between the values of both parameters by depth (Figure 1, table)

The change in the phase composition and power of the hydrocarbon seal: a) in all wells, except for well 76, the horizon U1 is exclusively oil; b) in well 76 U1 is the gas reservoir is like the hydrocarbon seal of the oil reservoirs U2; the same gas hydrocarbon seal takes place in the upper layer of the horizon B.

The effect of the hydrocarbon seal on reservoir productivity: a) the change of the hydrocarbon seam height is consistent with changes in total and oil-and-gas-saturated thicknesses (Figure 1); b) low R-square values in the "reservoir productivity – hydrocarbon seam height" pair are most likely associated with the presence of low-power high-quality hydrocarbon seal, for example, the Bazhenov formation [1]; in the well 76, a similar situation also occurs for the upper (gas) layers of the PK13 and B01 horizons. All these data indicate abnormally high formation pressures (AHFP) in productive wells. According to A. A. Nejdánov, U. A. Zagorsky, and others [2] the presence of AHFP on a significant vertical stratigraphic interval is a sign of oil content of deep horizons in the North of Western Siberia, such as Urengoy, Yamburg, and others.

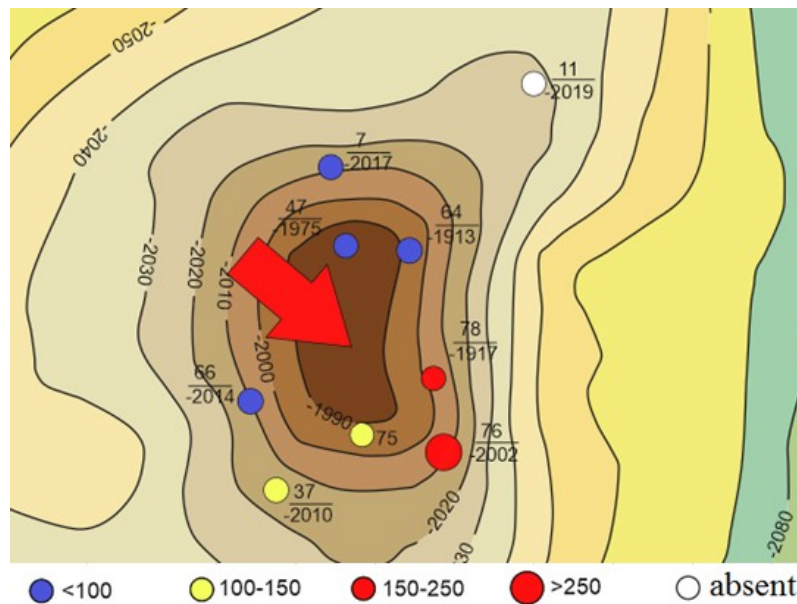


Fig. 2 Position of the studied wells on the structural map.

The Northern dome, reflector OG IIa (the bottom of the Bazhenov formation)

(the map shows the wells numbers, depth of crossing the Jurassic, the intervals of total Hog, m)

- Wells of different productivity are naturally located relative to the centers of the dome structures of the Severnoe field (Figure 2).

In the center of the dome structure well 2 is located, which is not productive in all positions (even in the Jurassic), with changed geophysical parameters of the Bazhenov formation [1]. Productivity of the wells increases from the center of the structure in the South-East direction, to the most productive well 76 (arrow on the map). There are no productive wells in the opposite direction.

Moving away from the center of the structure in different directions gives a different effect on the productivity of the wells as a whole and its individual horizons. In the North-East direction (the structure as a whole is wedged out), there is a sharp decrease in the productivity interval (from 47 and 64 to 7) and the productivity of the well as a whole (11 – an empty well). In the South-West direction (to the southern dome, well 311), the decrease in productivity is slower (66, 37). It is characteristic that in all the mentioned wells, except 7, the topmost horizon PK1 is oil – bearing, and the intermediate horizons up to U1 are empty (table). When exposing the U1 horizon, this is a good sign of the well's depth forecast.

The revealed regularities allow to assume as the main reason and the uniqueness of the Severnoe oil and gas condensate field, and spatial (by depth and in plan) changes its petroleum potential - proximity to the Urengoy-Koltogorsky graben-rift at the latitude of the Severnoe field sharply changes its stretch from submeridional on the North-East.

References

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