

Oil and gas presence perspectives of weathering layer reservoir of Nurol'ka mega-basin according to data of geothermics

T. Luneva¹, G. Lobova², A. Fomin³

^{1, 2} Department of Geophysics, Institute of Natural Resources, National Research Tomsk Polytechnic University, 30 Lenin Ave., Tomsk, 634050, Russia

³Head of the laboratory of geochemistry of oil and gas, Institute of oil and gas geology and geophysics of A.A. Trofimuk SB RAS, building 3, Academician Koptyuge Ave., Novosibirsk, 630090, Russia

E-mail: tanyao@sibmail.com, lobovaga@tpu.ru, fominan@ipgg.sbras.ru

Abstract. Oil perspective areas of the Nurol'ka mega-basin (south-east of Western Siberia) through the M formation (Permian-Triassic weathering crust) on the basis of the results application of geothermometry were identified. Accumulating power distribution and quality of the M formation collectors were taken into account. The priority area for research are weathering layer reservoirs and its development that cover the South beads of Kulan-Igayskaya and Tamradskaya basins and its insulation joint were proposed. Glukhov's oil field that is located in this area approve its high prospectivity.

1. Introduction

Expansion of the resource base of hydrocarbons in the oil-field regions of Tomsk (in south-east of Western Siberia (figure 1) is possible to use the deep stratigraphic levels, including reservoirs, formed in the lower Jurassic and in the weathering crust of Nurol'ka mega-basin and its framing structures [1].

The investigated reservoir of the weathering crust (M formation) is related to the pre-Jurassic of petroleum-bearing complex. Direct signs of oil saturation in the weathering crust in Rechnoe, Urmanskaya and other areas confirmed the potential of this stratigraphic level [2].

The zoning area in the resources compaction of primary accumulated of Togur's oils for reservoir of weathering crust were conducted in the given paper. According to the results that were early achieved of geothermal regime reconstruction of oil source - Lower Jurassic Togur' suite and intense release of oil generation were conducted as well [1].

2. Characteristic of oil and gas area perspectives

Dispersed organic matter (DOM) of oil-producing of Togur suites within Nurol'ka mega-basin is a typical lake, sapropelitic-humic type, with the index C_{org} to 5% [3]. Spread of the Togur suite in the study area is limited to reduced forms of topography (figure 2a) and has thickness more than 100 m [2].



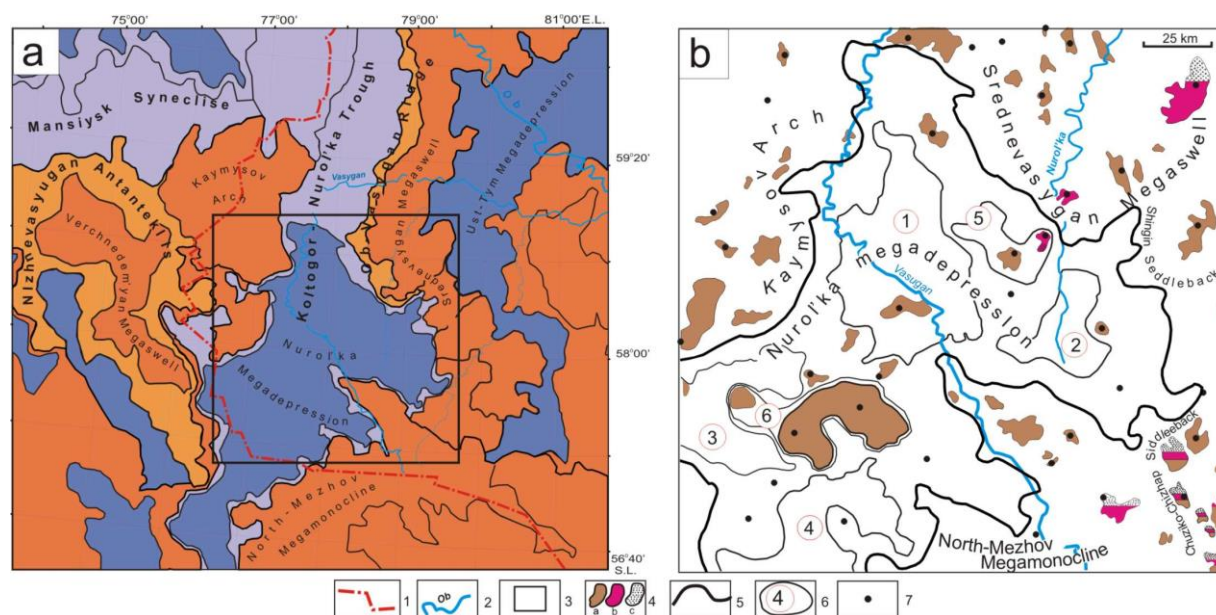


Figure 1. General tectonic scheme (a) and scheme of petroleum potential (b) of Nuroł'ka mega-basin (based on [2]). To figure (a): 1 – the south-western border of Tomsk region; 2 – the main rivers; 3 – arial limits of area zoning. To figure (b): 4 – oil fields: a) oil, b) condensate, c) gas; 5 – the boundary of Nuroł'ka mega-basin; 6 – structure of III order and its number; 7 – wellsite of paleotemperature modeling [1]. Structures of III order: 1 – Kulan-Igay basin; 2 – Tamrad basin; 3 – Axial diflection; 4 – Tamyan diflection; 5 – Festival swell; 6 – Igol-Talov domal upwarping

It is noticed that there is an uneven arial spreading of the sediments of weathering crusts within the research area. The maximum thickness is 120 m in the central and south-western parts of the territory. Pinching-out the sediments of weathering crust is confined to the joint zones of Nuroł'ka mega-depression and its framing structures (figure 2a).

The way out on the surface of polyfacies basement rocks (figure 2b) predetermines the formation of a variety of profiles of weathering crusts, which, in its turn, in various degrees have reservoir properties. Granitoid, granodiorite and rhyolitic magma bodies that have been spread here, being exposed to supergene processes and create the preconditions for the reservoir formation with good filtration-capacitive properties (FCP). Thus, the exit zones of clay-siliceous and igneous rocks of acid composition on the surface of the basement are zones of enhanced proliferation of collectors.

Lower Jurassic, Levin local and / or regional Kiterbyut clay rocks are the cap for reservoir of weathering crust. The local Laida and / or Leontiev clay formation of Middle Jurassic plays the role of cap in the case when the Lower Jurassic strata wedge out.

3. Research Methodology

Simulation of the thermal history of Togur suite formation made with the use of computer technology of paleotemperature modeling [4, 5, 6]. Twenty-three representative wells located in the zone of Togur deposition were selected for paleotemperature modeling. Design procedure of paleotemperatures, mapping centers of generation of oil and the distribution map of the calculated values of the resources of the generated Togur oils density are given in [7]. The resource estimate of density is performed in conventional units, that appears to be valid for the subsequent areal zoning [8].

The map of distribution of settlement density of resources of Togur oils (figure 3a) was built for pre-zoning of weathering crust reservoir. This map was built by multiplication the values of the density of the generated resources of Togur oils [1, 7] and values of bark thickness of weathered sediments (figure 2a), taken from the nodes of a regular grid.

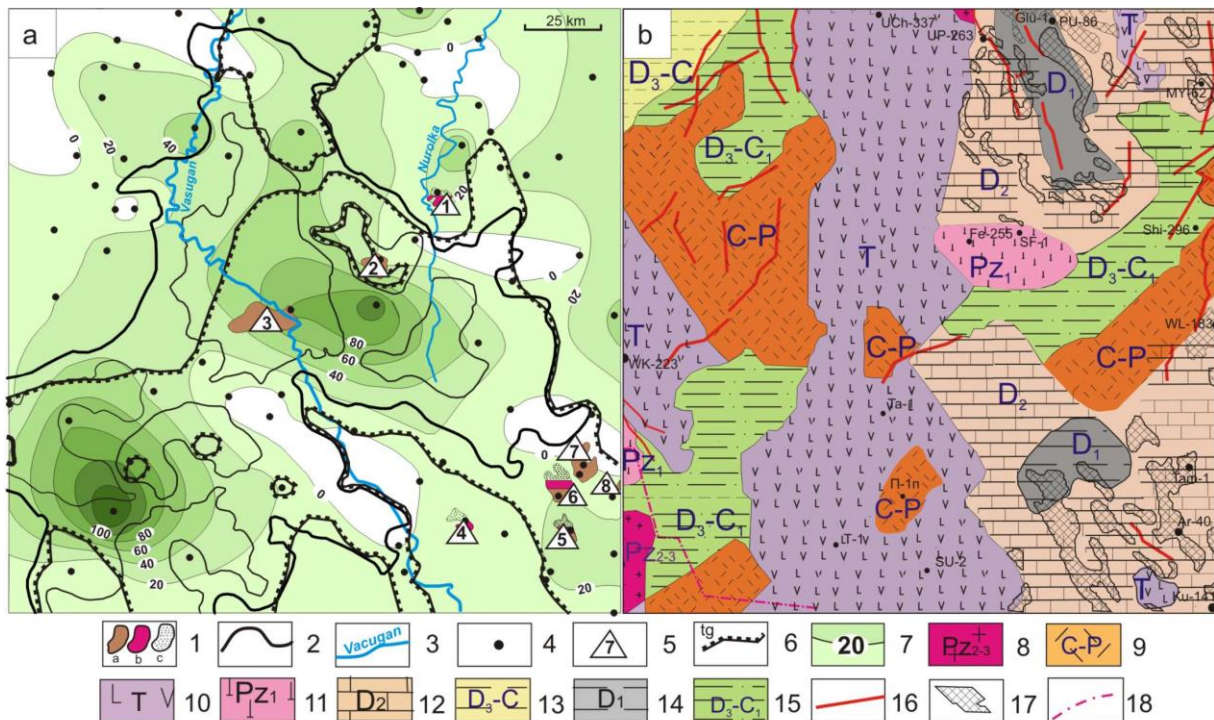


Figure 2. Schematic maps of isopach line weathering crust (a) and spread of petrotypes of basement rocks (b) in Nurok'ka mega-depression and its framing structures. To figure (a): 1 – oil field: a – oil, b – condensate, c – gas; 2 – boundaries of tectonic elements of the I order; 3 – river set; 4 – wells, used to build the maps of isopach line; 5 – conditional number of oil fields; 6 – boundary of Togur suite; 7 – isopach line map of the weathering crust. Oil fields with deposits in the weathering crust: Rechnoe (1), Festival (2), Glukhov (3), Elley-Igay (4), Arch (5), Urman (6), Tambaev (7), South-Tambaev (8). To figure (b): facies of complexes of basement rocks showing its age: 8 – Granites, 9 – Liparites 10 – Andesite-basalts, 11 – Ultrabasites, 12 – Carbonates, 13 – Shales, 14 – Clay-siliceous Shales, 15 – clastic breeds, 16 – faults, 17 – zone of improved collectors in the basement, 18 – boundary of Tomsk region

Three of the most promising areas in the weathering crust reservoir with resource density of more than 30 conventional units (figure 3b) according to preliminary data were allocated.

An analysis of petrotypes basement rocks [9, 10] was taken into account and were shown areas on the map (figure 4a) with improved filtration-capacitive properties of reservoirs formed by siliceous-carbonate, clay-siliceous rocks and igneous rocks of acid composition, and areas with unfavorable FCP formed by magmatic rocks of basic composition and species of clay-shale formation.

The perspective areas (figure 4b) were indicated, taking into account the density distribution of the generated resources of Togur oils, distribution of collectors petrotypes and distribution of tectonic disturbances density in the reservoir of M formation (figure 2b).

4. Results and Discussion

The most interesting one in relation to oil and gas potential is *section 1*, which stretches to the west and covers the southern side of Kulan-Igay and Tamrad basins, and its junction (figure 4b). The high density resource of Togur oils and improved filtration-capacitive properties of the M formation coincided in this area. The deep well Tamrat 1 parametric (figure 3b, conditional index of well T-1p) is situated within this area while drilling some pre-Jurassic rocks were discovered but the test productivity in this part of the section was not carried out. Glukhov's oil field is located in this region (figure 2a, the conditional oil field number 3) confirmed its high prospectivity.

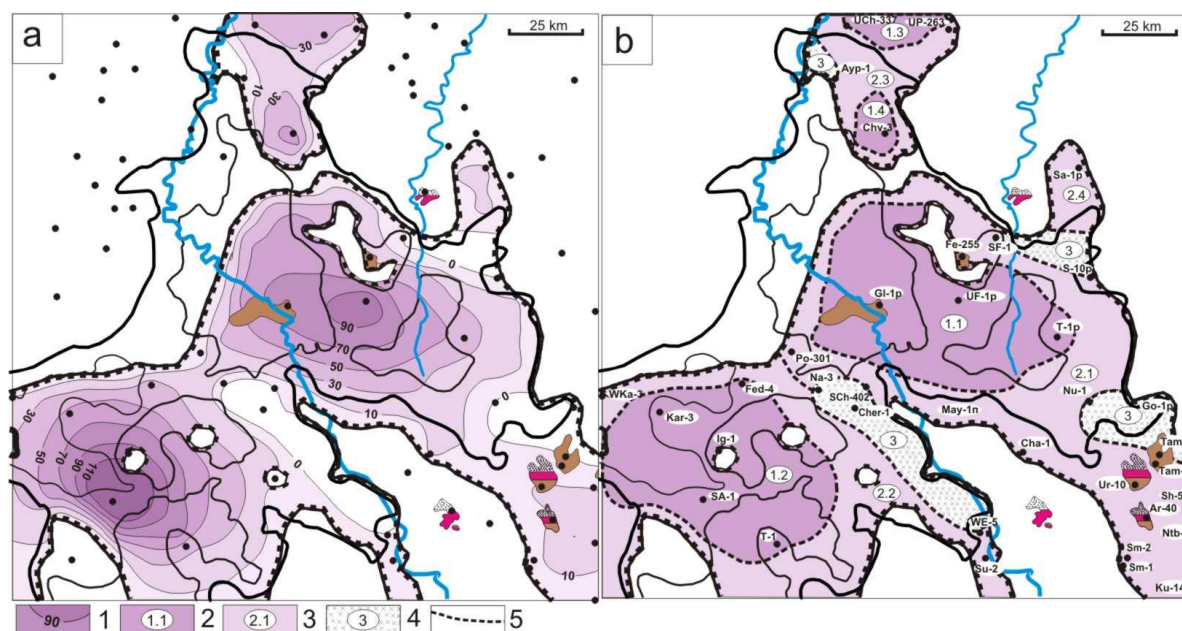


Figure 3. Schematic maps of the calculated density of Togur oil resources in the M layer reservoir according to the power of the weathering crust (**a**) and zoning of Nurol'ka megadepression (**b**). To figure (**a**): 1 – contour values of resource density, conditional unit. To figure (**b**): 2-4 – zones (zone number, the value range of resources density, cond.unit): 1.– more than 30, 2. – less than 30, 3. – zones of wedge out the weathering crust within the spread of Togur deposits; 5 – borders of zones. The rest of the symbols are the same as in Fig. 2

The next perspective one – *section 2* (figure 4b.) was indicated in the north-western part of Chuzik-Chizhap mezosaddle. The oil fields, such as Tambaev, Arch, Urman and South-Tambaev (figure 2 a) with different phases of deposits in the M formation (reservoir weathering crust) were opened here and in this case some prospectivity of this area is confirmed.

Potential *section 3* tectonic confined to the southern slope of Srednevasyugan megaswell and its northern edge of Nurol'ka megadepression (figure 4b). The well Salat 1 parametric (figure 3b, conditional index of well is Sa-1p) is situated within this area, while drilling some pre-Jurassic rocks were discovered, but the test productivity in this part of the section was not carried out.

Local *section 4* located in the south-western part of Nurol'ka megadepression by ranking is in the fourth place. There are no any data on the direct signs of oil saturation in the cross section on this lot.

Prospective *zone 5* is divided into six sections, with the same density of resources of Togur oils, ranked by area and the presence of tectonic faults. The *section 5.1* is confined to the northern board of Tamyran trough. The *section 5.2* is located on the northern hillside of the North-Mezhov megamonoklin. The *section 5.3* is located in the south downcutting of Nurol'ka megadepression. The *section 5.4* belongs to the northern hillside of the Festival arch. The *section 5.5* is situated in the south-western slope of Srednevasyugan megaswell. The *section 5.6* is located in the south-western side of Kulan-Igay depression.

It should be noted, that the two deposits with the M pools formation were opened outside of spreading Togur suite: Elley-Igay and Rechnoe, (figure 2a.).

5. Conclusion

Thus, carrying out the geothermal modeling with use of geological and geophysical data of the last years allowed to carry out the zone forecast of oil and gas presence perspectives of Nurol'ka megadepression and structures of its frame for the deep-laying structural floor – weathering crust.

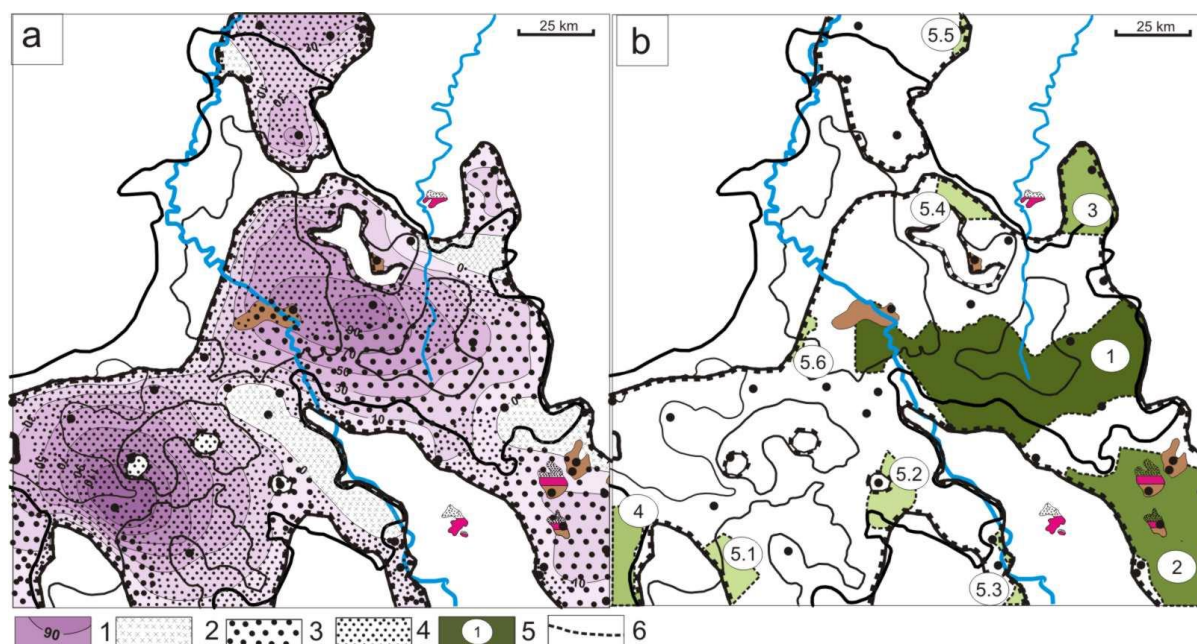


Figure 4. Scheme of zoning ratios (figure 3) and distribution of quality of collectors in the reservoir of the weathering crust (a), the scheme selection of priority areas for the discovery of oil deposits in the sediments of the weathering crust (b) of Nuroł'ka megadepression. To figure (a): 1 – isoline of significance of estimated resource densities, condit.unit; 2 – zone of lack weathering crust within the spread of Togur suite; 3 – zone of weathering crust with improved FCP; 4 – zone of weathering crust with unfavorable FCP. To figure (b): 5 – prospective area (section), ranking number (the intensity of the fill area (painted) of the lot is proportional to the extent of land prospects); 6 – border areas. The rest of the symbols are the same as in figure 2

The priority area for exploration and development of the weathering crust reservoir of Nuroł'ka megadepression – section 1 was indicated and proposed on the basis of performed research, this section (section 1) is situated on the southern edge of Kulan-Igay and Tamrad troughs and also its junction. The coincidence of high density resource of Togur oils and improved filtration-capacitive properties of the M formation (reservoir of weathering crust), makes the area more promising for the production of subsequent exploration work.

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