GEOPHYSICAL CHARACTERISTICS OF BAZHENOV FORMATION IN EASTERN PART OF TOMSK REGION

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Major oil and gas reserves of Tomsk region are located in the western part (Kaymyisovskaya, Middleobsskaya and Vasyuganskaya oil and gas bearing regions). Some oilfields were also found in western part of Payduginskoya oil and gas bearing region. According to provided geophysical and geological data the eastern part of Tomsk region is poorly explored. Recently hardly any oil or gas field has been discovered in the area.

Hydrocarbon potential of west Siberian petroleum province is associated with Upper-Jurassic oil and gas complex (formation J1) and oil source bed – Bazhenov formation. Bazhenov formation is composed by mixture of shally, siliceous and carbonate rocks and contains anomalous amount of marine fauna – liquid bitumens. In eastern direction Bazhenov formation transforms into stratigraphical analogue called Marjanov formation.

The study is aimed to evaluate oil bearing potential of Upper-Jurassic complex located in the eastern part of Tomsk region using geophysical data interpretation results.
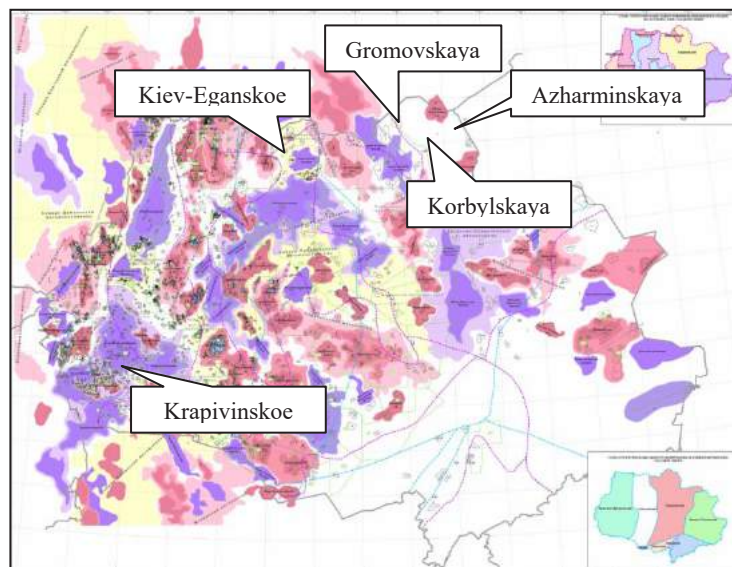

Fig 1. Tectonic classification plan of Jurassic structural stage

18 wells located in eastern part of Tomsk region have been subjected to a detailed analysis. The most representative wells are Gromovskaya well which is located close to west boundary of Pred'eniseyskaya oil and gas bearing region; Krobylskaya well is located in the middle part of exploring territory; Azharminskaya well is located on eastern boundary of Tomsk region. All wells are characterized by standard well logging complex which includes resistivity method (RM), gamma-ray method (GM), neutron gamma ray method (NGM), caliper and others. Geological profile was studied from Kuznetsovskaya formation till basement rocks. For comparison the data from well 226 in Krapivinskoe oil field and well 357 in Kiev-Eganskoe oil field were used; the latter is located next to the west boundary of Payduginskaya oil bearing region (Fig. 1).
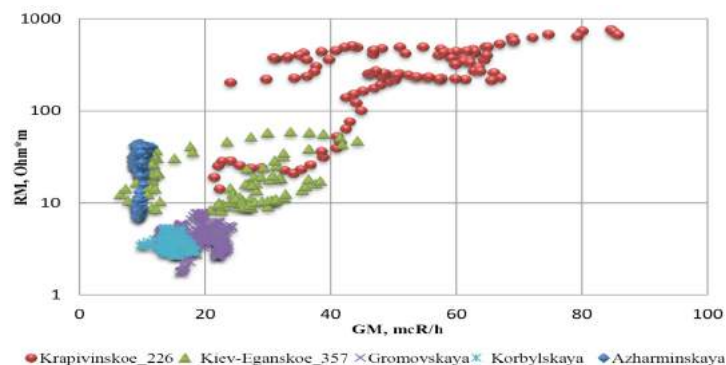

Fig. 2. Cross-plot GM-RM; interval of Bazhenov-Marjanov formation

The geophysical characteristics of the eastern part generally differ from the western one. Gromovskay well is the only well that has common features with geological profiles of western part. According to well logging data Upper-Jurassic complex is oil saturated but oil inflow was not obtained. Upper-Jurassic interval in other wells is water saturated.

The main difference between the geological profiles of the eastern and western parts can be observed in Bazhenov formation interval (figure 2). In the eastern part it has greater thickness and is hypsometrically higher. That fact indicates that there is a transition zone between the internal and external boundaries of West Siberia plate [2]. Bazhenov formation in the western part is characterized by great anomalies of resistivity and radioactivity and that criterion reflects oil source properties [1]. According to well logging data and the above mentioned criteria, Marjanov formation has lower oil potential.
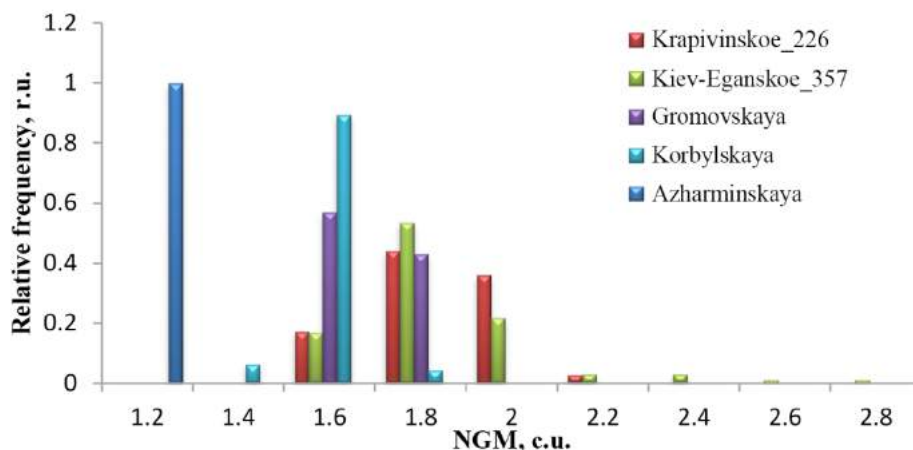

Fig 3. Bar graph of NGM values distribution in interval of Bazhenof-Marjanov formation

Statistical processing results of well logging data show that geophysical characteristics of Bazhenov (west part of Tomsk region) and Marjanov (east part of Tomsk region) formation logically changes in west direction (Krapivinskoe oil field→Kiev-Eganskoe oil field→ Gromovskaya well→ Korbylskaya well→ Azharminskaya well; Fig. 2,3). The main changes are associated with decrease in resistivity and radioactivity; correlability for pairs NGM-RM and NGM-GM (Table). The split of correlation points for Krapivinskoe, Kiev-Eganskoe fields and Gromovskaya well and shift of geophysical anomalies to the top of Bazhenov formation reflect the complexity of anomaly formation processes.

Table

Equation of constraints between NGM, GM and RM for Bazhenov and Marjanov formation

Krapivinskoe_226	Kiev-Eganskoe_357	Gromovskaya well	Korbylskaya well	Azharminskaya well
Bazhenov formation		**Marjanov formation**		
NGM = 0,0005RM+ 1,6061 $R^2 = 0,3513$	NGM= 0,0042RM + 1,6849 $R^2 = 0,0815$	NGM = 0,0128RM + 1,5394 $R^2 = 0,0638$	NGM = 0,0134RM + 1,4608 $R^2 = 0,0159$	NGM= -0,0001RM + 1,0852 $R^2 = 0,0065$
NGM = 0,0078GM + 1,3618 $R^2 = 0,6049$	NGM = -0,0067GM + 1,9286 $R^2 = 0,1022$	NGM = 0,0072GM + 1,4566 $R^2 = 0,127$	NGM = 0,0115GM + 1,3354 $R^2 = 0,103$	NGM = 0,0088GM + 0,9973 $R^2 = 0,081$

The observed dependencies can be interpreted as follows: in western direction content of bitumens and oil decreases, that correlates with content of uranium; degree of rugosity is greater – result of shale minerals content increase and lower extent of carbonatization processes. Starting from Korbilskaya well interval of Marjanov formation has the same geophysical properties as typical shales. All those processes lead to decrease in oil potential of Upper-Jurassic complex. The only well that could contain oil in Upper-Jurassic complex in western part of Tomsk region is Gromovskaya well. The universal trends observed in geophysical data are due to the results of regional geological processes.

References

1. Nomokonova G.G., Kolmakov A.J., Rastorgueva A.O., Parubenko I.V. Bazhenov formation-geophysical anomaly. Non-conventional hydrocarbon resources: distribution, genesis, estimations and development prospects. International conference, vol.6, pp.183-188, 12-14 November, 2013.
2. Kontorovich V.A. Tectonics and petroleum potential of the Mesozoic-Cenozoic deposits of the southeastern regions of west Siberia, Novosibirsk publishing house of SB RAS branch "GEO", vol. 237, pp.112-116, 2002.