OIL AND GAS GEOLOGY

Analysis of the physical parameters of the sedimentary cover rocks of the northwestern part of DDD in connection with its oil and gas bearing capacity

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Orliuk M.I.,

Doctor of Geological Sciences

Drukarenko V.V.

Institute of Geophysics of NAN of Ukraine

Density and volume magnetic susceptibility were studied from 8 boreholes drilled in north-western part of Dnipro-Donets Depression. The variations of these parameters were analyzed for the major rock types found in each of the wells. Magnetic susceptibility investigations of dry and fluid-saturated samples in heating process were pursued.

The forecasting oil bearing capacity problems of crust requires consideration of a wide range of processes and phenomena that somehow can be related to various aspects of the origin, migration and accumulation of hydrocarbons. One of the promising regions in this regard is the north- west part of the Dnieper- Donets basin. Oil and gas deposits are associated with Paleozoic sedimentary rock deposits, and probably of Precambrian basement formations. Here are drilled parametric and search wells: 333- Stroyivska (depth - 3803 m), 15- Borkowska (4776 m), 338- Nijinska (5337 m), 370- Zorkivska (6200 m), 303- Borznyanska (4508 m) , 305 - Huzhivska (5501 m), 361- Savynkivska (6005 m) and 1 Petrivska (5501 m) from which was received important information about the composition and structure of the sedimentary cover and its relationship with the structures of the foundation. Magnetic susceptibility and density of rocks are the important parameters are very sensitive to the composition and structure of the geological section as well as the processes occurring in the earth's crust as a whole and in the sedimentary cover. These parameters are used to study the conditions of sedimentation, magnetostratigraphic separation of the sedimentary cover, as well as ways to predict migration and accumulation of hydrocarbons [1-4 , etc.].

Laboratory studies of magnetic susceptibility and density of rocks are held on the same core material which is undoubtedly is very important for further explanation of anomalies in the density separation and magnetization of rocks and determine their relationships.

In general, the crust section of the study area represented by mudstones, siltstones, sandstones, limestones, marls, tuffaceous sandstones, tufaceous argillites, dolomites, salt, tuff breccia, gneisses, basalts and gneissose granite. Gneiss and gneissose granite present the Precambrian basement. Measurement of density and magnetic susceptibility of rocks made for about 900 samples from all wells.

Research results

Magnetic susceptibility and density of samples are measured by standard technology. In result has been made density distribution and magnetic susceptibility rocks diagrams with depth of each well [5, 6]. Fig. 1 shows an example of the distribution of these values for the section of Borkowska well.

According to measurements, density and magnetic susceptibility of similar rocks vary in wide

limits. Except density of salt and basalt, which varying in minor limits, the density of other types of rocks covered in a wide range of values. In some wells are samples with anomalous density values: in particular for mudstones from Huzhivska well $\sigma = 1{,}78$ g/sm^3 (3564 m), siltstones of Petrivska well $\sigma = 3{,}36$ g/sm^3 (2793 m) and $\sigma = 3{,}19$ g/sm^3 (2783 m), limestone Nizhyn well $\sigma = 3{,}01$ g/sm^3 (2992 m). Note here, that siltstone samples of Petrivska well with anomalous density are characterized also by high value of magnetic susceptibility. Perhaps this can be explained by high content of magnetite, which is the main magnetic mineral of modern natural sands [7].

Also for samples of Borkowska, Borznyanska and Savinkivska wells was measured remaining magnetization. Its value is very small (0,003-0,1 A/m) for almost all samples, except noddles of Savynkivska well with $I_n = 1{,}1$ A/m and magnetic sandstone of Borkowska well with $I_n = 0{,}3–3{,}7$ A/m.

To find some common samples of spatial variation in the density and magnetic susceptibility of rocks was made the construction of complex crust section from 1400 to 6400 m in all wells to mudstones, but siltstones, sandstones and limestones.

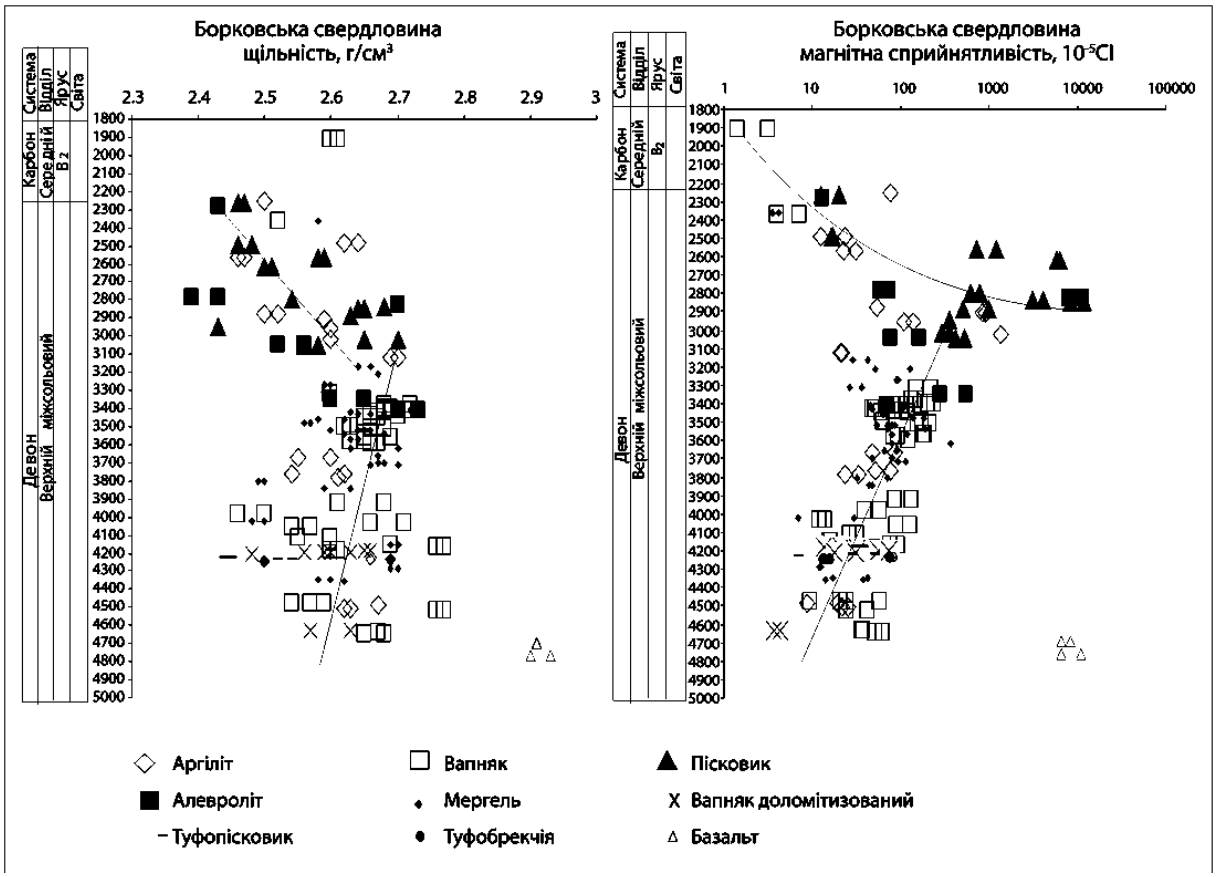

Fig. 1. Density and magnetic susceptibility of rocks of the Borkowska well

First of all we note that the density and magnetic susceptibility of rocks vary widely, but unless consideration of sandstone and limestone of Borkowska well and innumerable dense and magnetic rock samples from other wells, it is possible to identify such patterns.

The density of most of the mudstone samples varies from $\sigma = (2{,}45 \div 2{,}7)$g/cm^3, and magnetic susceptibility is $\chi = (8 \div 120) \cdot 10^{-5}$ CI unities. The value of slightly increased, while the density increases sharply to the depth of 4500 m and from 5000 m decreases (Fig. 2). The density and

magnetic susceptibility of most sandstone samples are σ = (2,3÷2,7)g/cm^3 and χ = (8÷100)·10^{-5} CI units. Both parameters are characterized with slight increase with depth. Such dependence is observed in the siltstone and limestone. A large number of samples siltstone has a density of σ = (2,4÷2,72) g/cm^3 and magnetic susceptibility χ = (12÷120)·10^{-5} CI units. The density of limestone is within σ = (2,5÷2,75) g/cm^3, χ = (5÷50)·10^{-5} CI units.

Changing of the magnetic susceptibility of rocks under the influence of hydrocarbon and temperature.

To identify possible genetic link between the magnetic susceptibility of different types of rocks and crowded places or passing hydrocarbons were studied changes for saturated and unsaturated rock samples under the influence of temperature for Stroyivska, Zorkivska, Borkowska and Nizhinska wells [6]. For the first time such an experiment has been carried out on the example of sedimentary and crystalline rocks of the Carpathian basin [4]. The result - the magnetic susceptibility of all types of rocks saturated with fluid, significantly increased and tumor magnetite was proved by X-ray analysis. A significant increase in the magnetic susceptibility of sediment experimentally determined for sedimentary rock formations of the Central Depression DDA[2].

Analysis of the results for the studied wells showed that not all rocks revealed the formation of new magnetic minerals, which exert itself in increasing of magnetic susceptibility of rocks saturated by hydrocarbon, i.e through the recovery process. Rocks of newly formed minerals after heating up to 350°C are mudstones, siltstones, marl, tuff breccia, sandstone. However, for a number of saturated hydrocarbon samples were observed abnormal growth of the values χ, and in some cases they even decreased.

A significant increase in the magnetic susceptibility observed for mudstones from the Borkowska wells with depth of 2250,8-2260,7m where the value χ of sample saturated with gasoline, are significantly higher than the corresponding values of pure sample (Fig. 3). The same can be said about siltstone with depth of 3348,7-3355m, but in this case χ of saturated sample is growing much more than unsaturated.

In Nizhyn borehole formation of new minerals with increasing temperature is observed in mudstones from the depths of 2620-2626m, where the saturated magnetic susceptibility of the sample increases in 5 times at 350°C, (χ ofunsaturated sample - only in 2.3 times), and mudstone from the depths of 3288-3295m, where χ of saturated sample increases more than in 32 times. The same can be said of sandstone from a depth of 2986-2993m, where χ of saturated sample increases more than in 13 times.

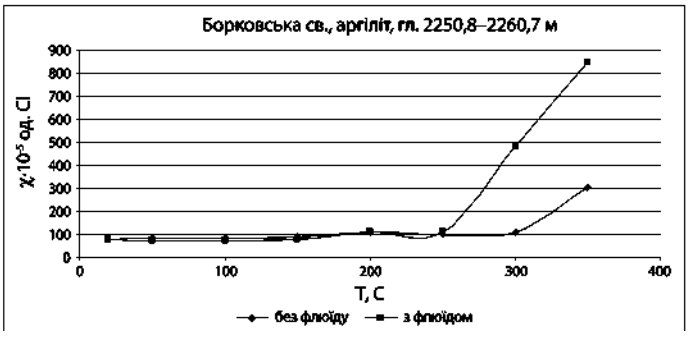

Fig. 3. Diagramm of the magnetic suspeptibility of the mudstone sample temperature from the Borkowska well

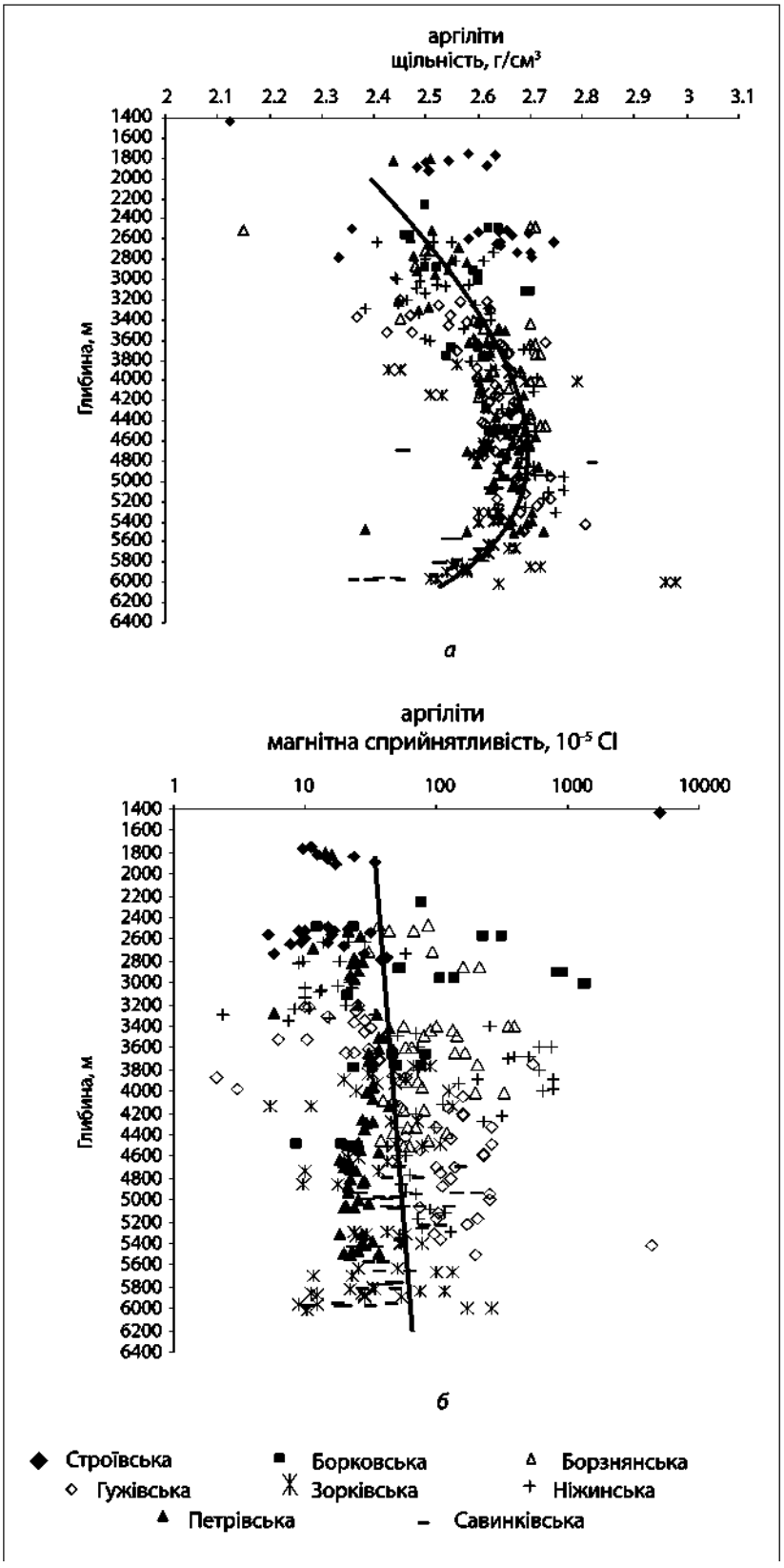

Fig. 2. Density (a) and magnetic susceptibility (b) of mudstones in 8 wells

In Zorkivska borehole formation of new minerals with increasing temperature occurs in clay (increase of χ saturated sample in 3 times) in sandstone (in 1.22 times) in siltstone (magnetic susceptibility of saturated sample is increased in 14 and unsaturated in - 9 times).

In all other samples investigated in family values increase χ saturated sample is almost there (as in gneisses Stroyivska wells) or increases less intensively than unsaturated. Very weak magnetic susceptibility changes siltstones and mudstones from the Borkowska wells during heating anomalies can be explained most the high values of χ before the experiment χ = 11450 · 10-5 m. CI siltstones with depth in 2832m).

In general, we can note the different nature of the changes of magnetic susceptibility of saturated rock samples under the influence of temperature, and the presence of very-governmental them were of no newly formed magnetic minerals. Most likely derived samples can be explained by the lack of iron in some rocks in some form that is able to recover magnetite, or that the process of reduction of irons for some the reasons already passed.

Thus, the enrichment of magnetic and dense minerals may be associated with magmatic and volcanic activities, which are widely developed in the region, as well as possible by the interaction of rocks with fluids [2, 4].

Cinducted investigations affords grounds for some conclusions, namely:

increased density volume and magnetic susceptibility of many samples from the Borkowska well, and some rocks from other wells can be explained by saturation of iron containing minerals such as magnetite;

experimentally demonstrated the possibility of magnetic minerals innovation in the event of temperature with saturated hydrocarbon fluid rock that found a genetic link of areas with high magnetic values with the ways of migration and accumulation of hydrocarbons;

An important feature is the identification in specific wells of intervals with decompaction of rocks, accompanied by elevated values of magnetic susceptibility. These intervals are allocated at different depths in Borznyanska, Nizhynska, Zorkivska, Petrivska, and Huzhivska and Savynkivska wells. According to operations [1, 8], the following areas may be potential oil and gas bearing;

great interest has a detection of mudstone decompaction area deeper than 5,000 m, near the crystalline basement, with increasing of their magnetic susceptibility, which creates prerequisites for predicting and finding this deep origin of hydrocarbons.

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Authors of the Article

Orliuk Mykhaylo Ivanovych

Doctor of Geological Sciences, Academician of UNGA, Head of Department of geomagnetism at the Institute of Geophysics. n.a.S.I. Subbotin NANU. Graduated from the KNU. Taras Shevchenko - specialty engineer-geophysicist. Fields of research - analysis of the geomagnetic field and the development of spatial-temporal magnetic models of the crust due to the forecasting of oil and gas content.

Drukarenko Victoria Volodymyrivna *Senior Geophysicist of the Department of geomagnetism at the Institute of Geophysics n.a.S.I. Subbotin NANU, graduated from Kiev University of Taras Shevchenko - a specialty geophysicist. Fields of research - the study of the magnetic properties of rocks of the crust due to the forecasting of its oil and gas bearing.*