The research of Junggar Basin ppw block gas reservoir identification method

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Abstract: Through the deep understanding of the reservoir characteristics of PPW block and the in-depth analysis of the gas layer identification method, this paper proposes a series of effective methods for identifying the characteristics of the local gas layer. Combining different logging methods and selecting the proper logging data processing method to amplify the atmosphere contains gas information, the air-layer recognition rate can be improved, which plays a fatal role for the exploration and development of gas reservoirs in PPW block.

1. Introduction
The gas layer identification technology is based on well logging responses that are related to the physicochemical properties of natural gas. For an insignificant gas layer needs to find an effective method to identify the gas layer. These gas layer identification methods are based on the differences in logging response characteristics of gas-bearing reservoirs, by combining different logging methods and selecting appropriate logging data processing methods to amplify the gas content of gas reservoirs and to improve the signal-to-noise ratio and gas recognition rate.

2. Apparent Double porosity differential method
Double porosity difference method is a widely used gas recognition method. It achieves better effect in the practical application by using this method to handle PPW block dozens of Wells. The principle of double-porosity difference recognition method is exactly the same as that of the three-hole overlap method, which is based on the gas reservoir as neutron is smaller while the waves and the apparent density is larger.

\[ AN = \phi_S - \phi_N \]  
\[ DN = \phi_D - \phi_N \]  

In the formula, \( \phi_S, \phi_D, \phi_N \) respectively represent the porosity of acoustic, density porosity and neutron porosity.

The reservoir should be explained as the gas layer when fulfilling the following condition: \( AN > 0, DN > 0 \). Otherwise, the reservoir should be divided into non-gas-bearing reservoirs. The crude oil of PPW is light oil, and light oil and natural gas have similar logging response characteristics, It is only in the same reservoir condition that the three porosity log response characteristics are smaller. So, \( AN > 0, DN > 0 \) is still presented in the reservoir.
3. The method of acoustic time difference for the porosity of the neutron

The characteristics of acoustic and neutron porosity are explained by logging response characteristics. Assuming the pore fluid of the target layer is saturated with formation water, and then synthetize pseudo formation acoustic, and pseudo formation acoustic as background, the measured acoustic overlaps with it, there is a positive range of measured acoustic and synthetized acoustic and the reservoir is the gas-bearing reservoir, the almost complete coincidence of the two curves is interpreted as water layer.

Pure formation, the volume model of the acoustic wave time difference of 100% water content in the synthetic strata of the neutron porosity:

\[ \Delta t_N = \phi_N (\Delta t_f - \Delta t_{ma}) + \Delta t_{ma} \]  

(3)

In the form, \( \Delta t_N \) serves as the synthetic pseudoscience jet lag, \( \Delta t_{ma} \) serves as the frame time difference, \( \Delta t_f \) serves as the formation water interval, \( \phi_N \) serves as the matrix porosity value, \( \phi \) serves as the neutron log value, \( f \) serves as the hydrogenation of fluids.

Because of the formation of gas or light oil, there is no apparent neutron porosity that is not corrected for oil and gas calibration, the physical properties of natural gas show that the gas jet lag is much greater than the jet lag, so \( \Delta t > \Delta t_N \). When the measured acoustic curve is overlapped with the generated acoustic jet lag curve, there is a bigger positive amplitude, so the objective layer is interpreted as a gas-bearing reservoir, and the reservoir with the basic overlap of the curve is explained as the non-gas layer.

This method is used to deal with the log data of PPW block, the collapse in the lithology complex or well section. Compared with the degree of distortion of the density curve, the neutron and acoustic curves are less distorted, this method can be used to deal with the results of the above situations, the results of the process and the test results were higher.

4. Background value identification method of neutron synthesis elastic modulus

Compared with the neutron synthesis acoustic recognition method, using the neutron synthesis elastic modulus method to process the well data of PPW block to process the better reservoir is more effective. Since there is a collapse of the reservoir, as density log curve jump big, the acoustic and the neutron curve are relatively small, in this condition, the effect of using this method to treat the effect of the method is poor.

5. Formation resistivity synthesis of acoustic method

The detection depth of acoustic, neutron and density logging is relatively shallow, which is greatly affected by mud invasion. And the deep resistivity logging is the deepest, which is less affected by the mud invasion, and the measured depth resistivity is close to the resistivity of the original formation. Combined Archie formula, acoustic porosity formula, and 40% of water saturation in PPW block are the equation of acoustic jet lag equation:

\[ \Delta t_R = \left( \frac{abR_w}{0.4^m R_f} \right)^{\frac{1}{m}} (\Delta t_f - \Delta t_{ma}) + \Delta t_{ma} \]  

(4)

As for the synthesized acoustic jet lag, the jet lag is 620us/m, and the skeleton jet lag is 168us/m for the formation water resistivity, which is the deep lateral resistivity. Formation porosity 40% water of synthesis of acoustic should be the background. As the measured acoustic curve and the use of the resistivity of synthesis of acoustic overlap, there is a clear is the interpretation of the amplitude difference for oil and gas layer, and the curve is basically coincident or negative amplitude difference explained by water or dry layer. The method is more conducive to identifying the deeper oil and gas
layers. By applying this method, well-bore irregularities have little effect on acoustic and resistivity relative to the neutron and density. The method is more suitable for low porosity and low permeability reservoirs than other methods. The resistivity synthetic acoustic method is good for logging data in PPW block.

6. Resistivity - porosity - oil and gas identification method
Resistivity - porosity - saturation rendezvous is an intuitive and effective quantitative interpretation method that discriminated between oil and gas reservoirs and non-hydrocarbon reservoirs. The oil and gas reservoir resistivity value of PPW block Jurassic river three working groups is significantly higher than that of the water layer resistivity. Oil-water formation resistivity value is greater than $16 \Omega \cdot \text{m}$, and pure hydrocarbon reservoir formation resistivity is more than $21 \Omega \cdot \text{m}$, oil and gas saturation is greater than 60%. The oil and gas reservoirs and non-oil-bearing strata can be effectively recognized by the saturation rendezvous plot with resistivity and porosity.

7. Conclusion

7.1. Aiming at that some of the reservoir in PPW block having a lower density changes large, acoustic and neutron log response characteristics, the neutron synthetic acoustic recognition method should be put forward, which can improve the atmosphere of the recognition rate.

7.2. In complex lithology or hole collapse, compared with the density curve distortion extent, neutron and sound wave curve have low distortion, and using the neutron porosity synthetic sonic move out processing is better. The result of processing and testing results in turn should be at high degree.

7.3. For formation with strong longitudinal heterogeneity or well-bore collapse, the neutron and density curve is seriously distorted and the influence of acoustic and resistivity curve is small, the use of this method not only makes effective use of acoustic and resistivity detection to have relatively small effects, but also considers that when the reservoirs water saturation is less than 40%, the oil and gas becomes more visible. This method is used to process logging data of PPW block and obtain good results.

Reference

[1] Jingming li, shengzhi liu, dongxu li, etc. China's natural gas exploration situation and development trend [J]. Gas industry, 2004, 2 (12) : 1-4.
[2] Yuan jiang wei, yihao zhang, da-zhong dong etc. The present situation of natural gas exploration in junggar basin and countermeasures [J]. Oil exploration and development, 2006, 33 (3) : 270-288.
[3] Chu qiaogao, xing shui zhong, xiaodong yuan, etc. Logging information identification of low resistivity atmosphere [J]. Journal of jianghan petroleum institute, 1999, 21 (4) : 15-17.
[4] Wenquan li, ruihua wang. Analysis of gas layer identification technology and exploration development potential in block 10 [J]. Special oil and gas reservoir, 2006.
[5] Qinlian wei, xiao ling, kangthi li. Conventional well logging identification of dense formation of gas [J]. Special oil and gas reservoir, 2007, 14 (4) : 22-25.
[6] Yiming chen, dehuai zhu et al. The second edition of the logging data of geophysical well logging in the field [M]. Beijing: petroleum industry press, 1994:200-216.
[7] Shiheyong, chaomo zhang. The data processing and comprehensive interpretation of logging data [M]. Beijing: petroleum university press, 1996:516-532.
[8] Wu hong. Study on the discriminating gas layer of 3-block log in hainan [J]. Special oil and gas reservoir, 2008, 15 (supplement 2)
[9] Zhangxiong, pan heping, luo miao, et al. Overview of the interpretation methods of dense sandstone gas layers [J]. Journal of engineering geophysics, 2005, 2 (6) : 431-435.
[10] Wenzheng, shu-qin li, yanqiu zhong. Using background value to identify the gas layer [M]. Daqing petroleum and geology, 1996, 15 (2) : 11-13.

[11] Wiley of state Richard armitage nd Patchett, J.G. The Effects of Invasion [C]. SPWLA 35th Annual Logging Symposium, 1994:1121-1134.

[12] Shen hui, zhenqin shi, guoan qiao, et al. Research on deep gas identification method [J]. Natural gas industry, 2005, 25 (10) : 47-48.

[13] Surdam R c. A new lot for Gas Exploration in Anomalously Pressured “Tight Gas Sands” in Rocky Mountain Laramide Basins [J]. AAPG, Memoir, 1997:124-131.