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The research of oil-water distribution in the eastern block of Chao202-2 area

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Abstract: - The eastern block of Chao202-2 area belongs to the channel sand body deposition，where the faults are well developed and complex combination. The oil, water and gas distribution is relatively complex and influences the injecting-producing relation, so the study of control factors is needed. According to the geological characteristics of the eastern block of Chao202-2 area, clear regional geological characteristics, logging identification technology as the core technology and logging identification technique for identifying oil and water layer, oil-water layer logging interpretation chart was established. With a combination of the oil-water layer interpretation results, the test resultsand the existing research results of regional geological features, the characteristics of the oil and water distribution in the block were induced and analyzed. In the study area, structural reservoir is the main reservoir type. Oil-water distribution is controlled by structural factors and space configuration of fault and sand body control the oil-water distribution border. From the fault analysis of the plane, oil-water distribution was determined.

Keywords：*oil-water distribution，fault，structure，channel sand body，logging interpretation*

I. REGIONAL GEOLOGICAL BACKGROUND

The eastern block of Chao202-2 Area is located in the territory of Zhaozhou County, Daqing City, Heilongjiang Province, the alar part of Chaoyanggou oil field. The air permeability of the block is $5.2\times10^{-3}\mu m^2$, the formation oil viscosity is 14.1mPa·s and the ground crude oil viscosity is bigger, which achieves 42.48mPa·s. The study area belongs to river-lake deposits, where the faults are well developed and complex combination. The results of structural history research show that the tectonic development of the inner block has the close relation with the structure of the songliao basin development and the formation of the depression. Roughly experience four stages: fault-depression stage (The Jurassic sedimentary period), rift-depression stage (Denglouku formation sedimentary period), downwarp stage（ the depositional period of Quantou group and Nenjiang group) and rising stage （After the deposition of the nenjiang formation). The Major reservoir is located in Fuyu oil layer which belongs to microfacies of the delta front. The main sand body type is subaqueous distributary channel, whose distribution is mainly controlled by the southwest direction sedimentary systems distributed from southwest to northeast direction. There is no obvious characteristics on oil and gas distribution in the study area. The average production of single oil well has decreased year by year and the average injection water of single water well has decreased after the production. The production declines fast and the development effect is poor. Therefore, to improve the development effect and guide the core area evaluation of the similar blocks, we conduct a related study on the oil and water distribution characteristics in the block.

II. THE RESEARCH ON OIL AND WATER LAYER IDENTIFICATION

Oil and water layer identification is a key link in the process of reservoir development. Either oil layer mistaken for water layer or water layer mistaken for oil layer will have adverse effect on calculation of reserves and oil field development produce. Different regions and horizons have different selected evaluation standards. The oil and water distribution in the study area is relatively complicated, so accurately determining oil and water layer identification and classification standard is of great significance[1]. Based on the characteristics of the oil reservoir in this area, the study of the "four sex of characters", and the logging theory, optimize deep lateral

resistivity curves which can obviously reflect the liquid property, and sonic time difference curves which can obviously reflect reservoir permeability as the standard for establishing logging parameters in the study area[2]. Combined with core and testing materials, apply the data of 52 layers from 8 coring wells including 10 oil layers , 21 poor oil layers, 16 dry layers and 5 water layer layers. Then, eliminate abnormal point. Finally, get oil and water layer interpretation and evaluation chart in the study area chart (figure 2.1).Chart accuracy can reach 87.5%, which meets the requirement of oil-water layers interpretation and evaluation in the study area. At the same time, the oil-water standards are determined as follows:

Oil layer: $R_{LLD} \geq -0.0543\ AC + 37.216$,of which $AC \geq 220\ \mu s/m$;

Poor oil layer : $-0.0543\ AC + 37.216 \geq R_{LLD} \geq -0.0438\ AC + 28.329$, of which $AC \geq 220\ \mu s/m$;

Dry layer $-0.0438\ AC + 28.329 > R_{LLD} > -0.023\ AC + 17$,eliminate abnormal points;

Water layer: $R_{LLD} \leq -0.023\ AC + 17$;

in the formula: RLLD—deep lateral resistivity, Ω·m.
AC—interval transit time，μs/m.

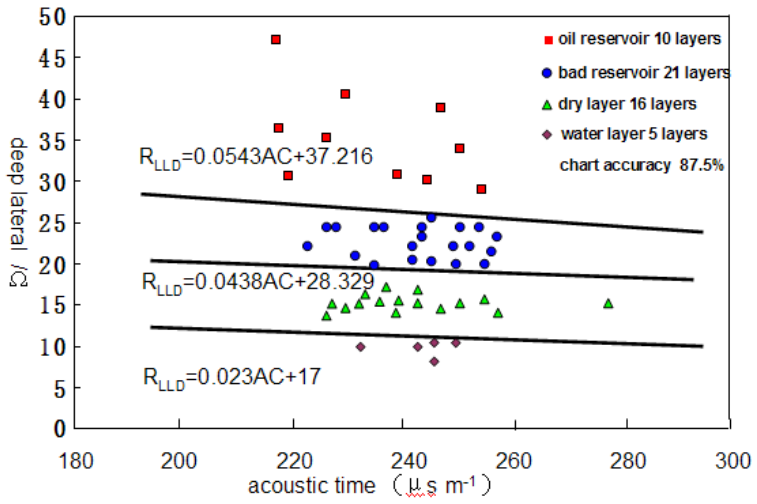

Figure2.1 Oil-water interpretation and evaluation chart in the eastern block of Chao202-2 area

Applying oil-water interpretation and evaluation chart has explained 120 wells in the study area, which were divided into 152 oil layers, 289 poor oil layers, 220 dry layers, 78 water layers.

III. OIL AND WATER DISTRIBUTION CHARACTERISTICS

3.1 The whole region of oil and water distribution

The interpretation results projected to the scattered point, it can be seen that the whole region has no uniform oil-water interface (Figure 3.1).

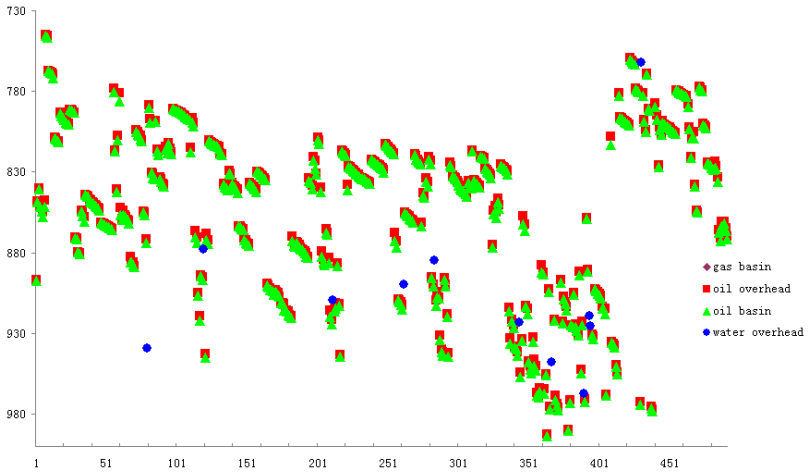

Figure 3.1 oil-water distribution map of the whole region

Seen from the reservoir section of it, structure becomes low and sand body development gradually becomes poor from west to east (figure 3.2). Different fault blocks have different oil-water distribution characteristics, roughly divided into “up oil, bottom water”, “up water, bottom oil” and “water in oil”. Seen from the Figure 3.3, structure becomes low from north to south and the oil-water distribution characteristics of different fault blocks are very complex [3-4], which is the same as east-west profile.

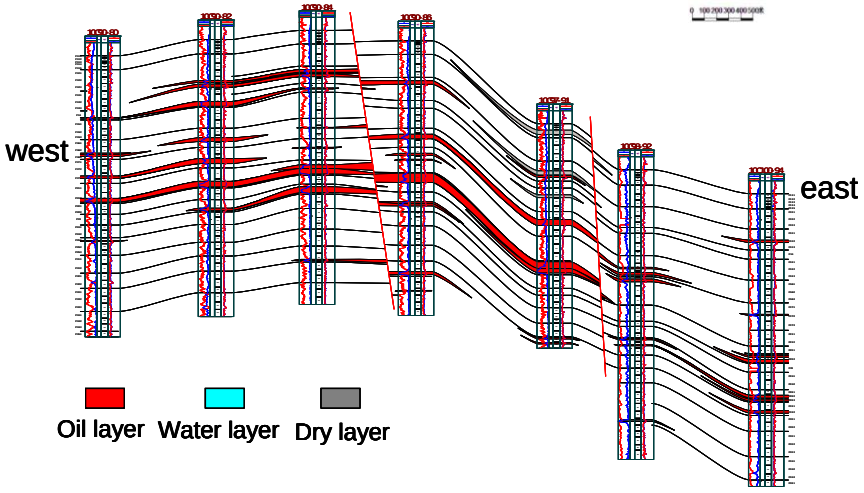

Figure 3.2 East-west reservoir profile map in the eastern block of Chao202-2 area

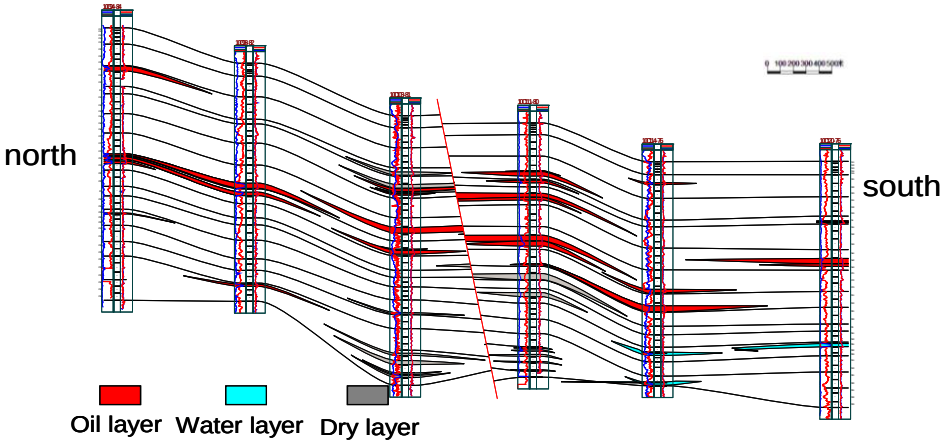

Figure 3.3 South-north reservoir profile map in the eastern block of Chao202-2 area

3.2The controlling factors of oil-water distribution

According to above analysis, the oil-water distribution is mainly controlled by two factors in the research blocks.

1. The fault structure has some influence on oil-water distribution. The faults are developed well in the study area. By the study of chemical and physical properties of oil, gas and water in the reservoir near both sides of faults, it shows that the oil, water and gas property has many differences near both sides of faults, which indicates that the fault in the study area has a certain sealing ability and can form a mutual non-nterference reservoir. Therefore, the fault block may have a complex oil-water distribution from vertical (horizontal) direction in both side of the fault [5-6].

2. The sedimentary lithology has some influence on oil-water distribution. The sand body in the reservoir of the study area is preexisting sand body relative to the structure while the structure of the sand body is late structure relative to the sand body. The research area mainly develops channel sand body and point bar sand body. The river channel sand body is in dendritic distribution. The air permeability of the main channel is $6.1\times10^{-3}\mu m^2$, the air permeability of the non main channel is $4.8\times10^{-3}\mu m^2$, and the reservoir permeability is lower. There is a large amount of argillaceous filling between river and river and the connectivity between sand body is poor, which ensures the independence of sand body between oil and water distribution characteristics [7-8].

3.3 The characteristics of the oil-water distribution controlled by different blocks

Based on the analysis of the above, the spatial configuration of fault and sand body controls the boundary of oil-water distribution. On the basis of controlling factors, the district can be divided into 10 blocks (figure 3.4). According to the characteristics of oil and water distribution, it is divided into three types.

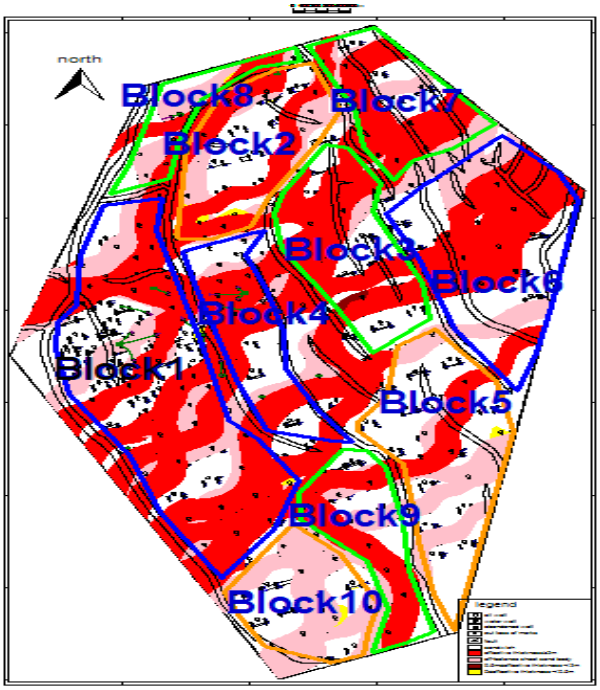

Figure 3.4 oil-water distribution map of the whole region of blocks

1、The oil layer and water layer are developed at the same time within the same fault block. The characteristics of the oil-water distribution is "up oil, bottom water". In fault block 4, for example, the structure of the fault block becomes low from north to south. Although the water well 135-46 is in the higher position than the oil wells in the south, due to the combination of fault and structure, the water well 135-46 located In different blocks compares with the well in the south. The characteristics of the oil-water distribution in the block is that the oil reservoir is in the north and the water reservoir is in the south. The regularities of distribution accord with oil-water distribution characteristics of structural reservoir (figure 3.5).

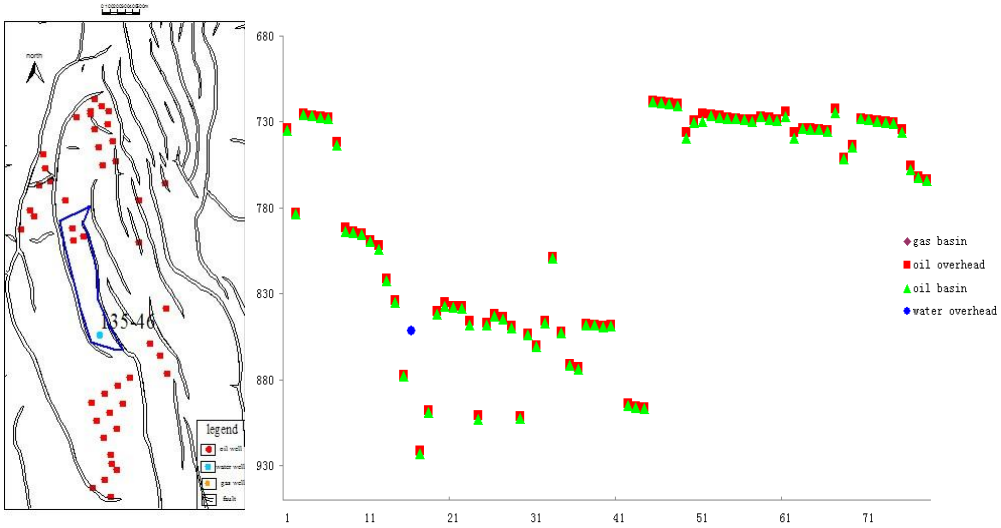

Figure 3.5 oil-water distribution map of the F131

2、The oil layer and water layer are developed at the same time within the same fault block. The characteristics of the oil-water distribution is "up water, bottom oil". In block 10, for example, with relatively higher position, the well 131-24 inside the fault belongs to the water layer, while other wells with relatively lower position belongs to oil layer. The main reason for forming this type is that sedimentary facies belts of the well 131-24 are different from the other three wells. Mudstone segment in the middle causes the different distribution of oil and water (figure 3.6).

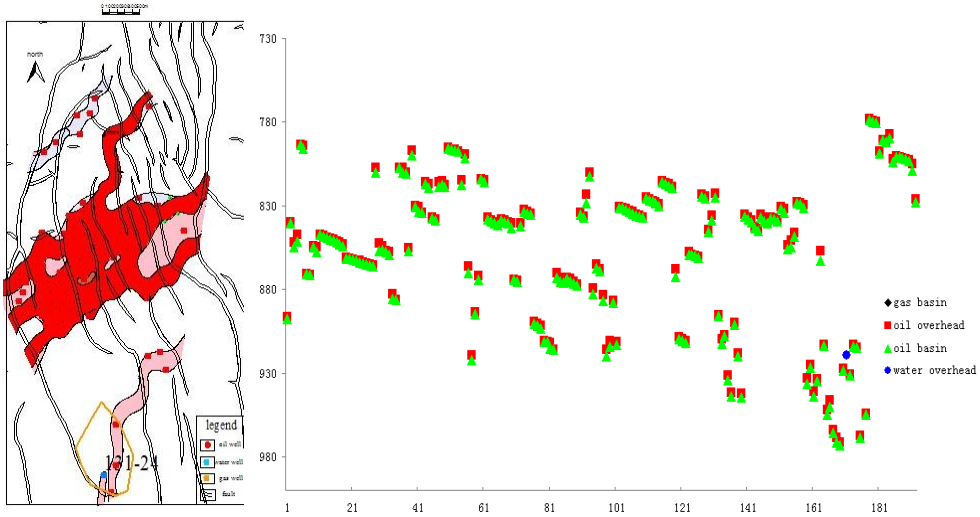

Figure 3.6 oil-water distribution map of the F171

3. Within the same fault block, just the oil layer or water layer is developed. In block 8, for example, the well 133-65 inside the block belongs to the water layer and the same layer in adjacent block is oil layer. Although the characteristic of " high water, low oil" can be seen in the oil and water distribution scatter plot, the water well and the oil well are divided by the fault which has a certain closed feature to make them form independent fault blocks. In the same oil layer, the wells of different fault blocks don't disturb each other (figure 3.7).

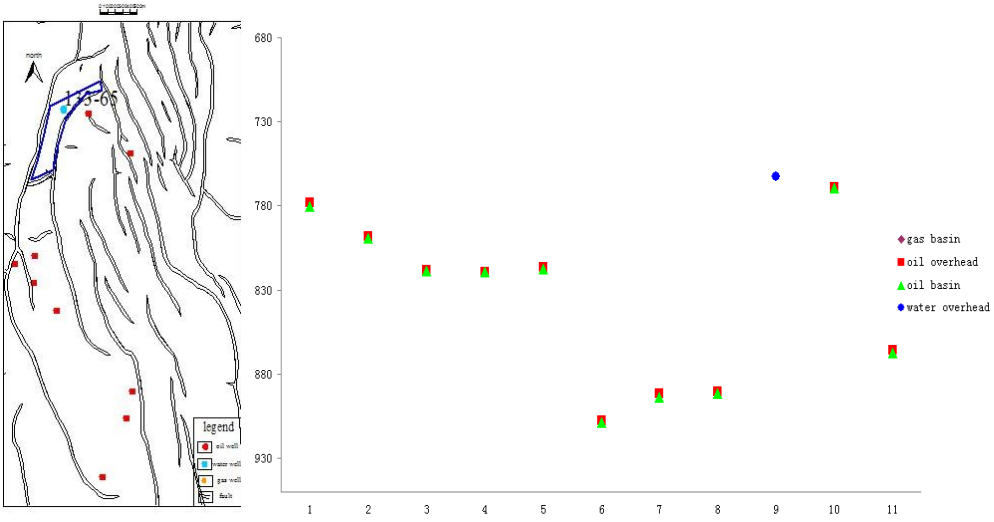

Figure 3.7 oil-water distribution map of the F171

IV. CONCLUSION

1. In the study area, the main reservoir type is structural reservoir. Oil-water distribution is controlled by structural factors and the space configuration of fault and sand body controlled oil-water distribution border.

2. From the analysis of the plane, the oil-water distribution can be divided into three types:

(1) Within the same block, oil and water layer are developed at the same time. Oil-water distribution is "up oil, bottom water".

(2) Within the same block, oil and water layer are developed at the same time. Oil-water distribution is "up water, bottom oil".

(3) Within the same fault block, the oil or water layer is only developed one.

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