Study on oil-water distribution law of Saertu reservoir in T66 block of Aogula oilfield

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Abstract. T66 block of Aogula Oilfield is a block structure area, in which faults are relatively developed, with different oil-water systems in different fault blocks, obvious oil-water interbedding phenomenon in longitudinal direction, no unified oil-water interface and complex oil-water distribution. In order to solve this problem, the oil-water layer identification and oil-water distribution law of reservoirs in this area are studied by using drilling data and resistivity correction model, and the oil-water interpretation chart is established. The analysis shows that the whole area is controlled by fault-structure, and the oil-water difference between the two sides of the fault is large, which is obviously blocked by the fault, and the fault cutting controls the oil-water distribution Local fault blocks are controlled by structure-lithology, and the whole reservoir of high fault blocks is well developed, showing the characteristics of high oil and low water, while the reservoir of low fault blocks is discontinuous, showing the characteristics of lithologic upward dip and pinchout and lens controlling oil and water.

Keywords: Oil-water layer identification; Oil-water distribution law; Tectonic-lithologic reservoir; Oil-water interface.

1. The raising of questions
T66 block is located in the block structure area on the east side of Aogula fault zone, where faults are relatively developed, with different oil-water systems in different fault blocks, obvious oil-water interbedding in longitudinal direction, no unified oil-water interface and complex oil-water distribution. In order to improve the accuracy of fluid identification and understand the oil-water relationship, the following oil-water layer identification and oil-water distribution laws are studied.

2. Study on oil-water layer identification and oil-water distribution law

2.1. Oil-water layer identification
In order to improve the accuracy of fluid identification, 343 layers of 20 wells (15 development wells and 5 exploration and evaluation wells) in the region are classified by using the reservoir classification standard in the reserves report.
Table 1. Saertu reservoir classification standard

| Type  | Classification standard of reservoir logging |
|-------|---------------------------------------------|
| Class I | $\Delta GR < 0.016 DT - 1.13$ or $\Delta GR < 0.17$ |
| Class II | $0.016 DT - 1.13 \leq \Delta GR < 0.016 DT - 0.94$ and $0.17 \leq \Delta GR < 0.32$ |
| Class III | $\Delta GR \geq 0.016 DT - 0.94$ and $\Delta GR \geq 0.32$ |

Because the reservoir in this area contains mud and calcium, which has certain influence on the resistivity logging curve, the resistivity parameters are corrected based on the resistivity correction model of parallel conduction theory.

Resistivity correction model:
- Interpretation model of shale content: $V_{sh} = 41.02 \Delta GR + 2.510$
- Interpretation model of calcium content: $V_{Ca} = 0.03203 RMSFL - 1.152 DT + 106.9$

Symbol in the formula:
- $R$: Formation resistivity before correction, $\Omega \cdot m$
- $R'$: Corrected formation resistivity, $\Omega \cdot m$
- $R_{sh}$: Clay resistivity, $\Omega \cdot m$
- $R_{ca}$: Calcareous resistivity, $\Omega \cdot m$

On the basis of reservoir classification, resistivity argillaceous and calcareous correction, the oil-water identification chart of class I reservoir and class II reservoir in Saertu reservoir of T66 block is established.

According to the chart, the reservoir in this area is comprehensively interpreted. According to the interpretation results, the average sandstone, effective thickness and layer ratio of drilling are counted. It can be seen from the histogram that the comprehensive proportion of oil, gas and water in the same layer is larger than that of oil layer and oil and gas in the same layer. Among them, the average sandstone thickness is 1.7m in the same layer of oil and gas, followed by 1.2m; in the same layer of oil and gas and water. Average effective thickness ratio: the proportion of oil, gas and water in the same layer is 57.9%, and that of oil layer and oil and gas in the same layer is 42.1%; Layer ratio: oil, gas and water in the same layer account for 20.7%, and oil layer and oil and gas in the same layer account for 13.6%. Overall, the comprehensive proportion of oil, gas and water in the same layer is larger than that of oil layer and oil and gas in the same layer.

2.2. Oil and water distribution law

2.2.1. Plane oil-water distribution law. According to the interpretation results, the plane oil-water distribution map of this area is drawn. From the plane view, the SI oil reservoir group mainly develops oil layer and water layer, followed by poor oil layer and gas-water layer, in which the gas-bearing layer is mainly located in the structural high part of the fault block.

![Figure 1. Oil-water plan of T66 block -SI group](image-url)
The upper reservoir of SII reservoir group is mainly composed of oil layer and oil-water layer; The lower part is mainly composed of oil and water layers. In the same fault block, the oil layer transits from the high part to the low part of the structure into the same oil-water layer and water layer.

2.2.2. Longitudinal oil-water distribution law. First, the whole block is controlled by structures and faults. On both sides of faults in this area, there is a big difference between oil and water, which is obviously blocked by faults. Fault cutting controls oil and water distribution. T66 fault block located at the high part of the structure, oil layer and oil-water layer are developed above SII13-14, and oil-gas layer is developed at the upper part of SI Group. Fault block T50-S16 in the middle part, sandwiched by faults on both sides, oil and water interbedded vertically and superimposed vertically; The T66-S3 fault block located in the low part of the structure, and all the layers below SI4-2 are developed as water layers or dry and poor layers.

Second, local fault blocks are controlled by structure and lithology. Fault block -T66, the high part of the structure: the reservoir development is relatively continuous, the sand body is large in scale and the effective thickness is large, and the oil-water distribution between adjacent wells is obviously controlled by the structure. Multiple sets of oil-water layers are vertically superimposed on a single well, which is a multi-set oil-water system, which is characterized by high oil and low water as a whole.

Low part of the structure -T45-S21 fault block: the reservoir development in the low part fault block is discontinuous, with small sand body scale and small effective thickness. the development of sand body between adjacent wells is quite different, with lithology dipping and pinchout. the oil-water properties of single sand body are different, and the oil-water distribution in the oil-water fault block controlled by lithologic lenses is obviously controlled by lithology.

Through the above identification of oil-water layer while drilling and gradual understanding of oil-water distribution law, on the one hand, the success rate of drilling in this area is ensured, on the other hand, the formulation of perforation principle is effectively guided, which lays a foundation for the preparation of completion scheme. At present, all perforation schemes have been issued. The average thickness of perforated sandstone is 6.0m and the effective thickness is 3.1m The thickness and layer ratio of oil and water in the perforated layer are larger than those of oil layer.

The perforating principles in this area are as follows: ① avoiding perforation in gas-bearing layer; ② All reservoirs are perforated; ③ For wells with poor reservoir development, the oil and water are in the same layer, and the poor reservoirs are partially perforated; ④ The reservoir development of the whole well is poor, and the perforation of the well in the low part of the structure is not fractured.

3. Conclusion and the next step
Recognition: The oil and water in this area are relatively developed in the same layer, and the oil and water distribution is controlled by structure-fault as a whole and structure-lithology in local fault blocks.
Next step:
1. Pay close attention to the change of output after putting into production, and analyze the effect of putting into production in time;
2. Verify the oil-water interpretation conformity according to the initial stable output, and summarize the experience of fluid identification;
3. Summarize the oil-water analysis methods of complex fault blocks to provide reference and help for other productivity blocks.

4. References
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