Study on the regularity of the development of fracture Remaining Oil in Taizhao Oil Field

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Abstract. According to the data gathered from 49 core wells in Taizhao Oil Field, there are 17 wells without fractures and 32 wells with obvious fractures. Despite an average of 7.1 fractures in each well, there are 10 fractures in W426, W424 and W406 respectively in Taizhao Oil layer. After a preliminary analysis, the axial of anticline as well as the place near fracture are the areas for the development for fractures while the two limbs are under-developed. By describing regularities of distribution about fractures as well as remaining oil in a quantitative and qualitative way, this paper designs a flexible adjustment scheme aiming at the encryption and injection-production of complex fractured oil reservoir so as to improve the results of oil field exploration.

Keywords: Multidisciplinary; Taizhao Oil field; Remaining Oil; Exploring Potential.

1. Introduction
By using analysis data in core wells, this paper analyzes the relationship between lithology, sedimentary microfacies and the development of fracture in Taizhao Oil field, and provides a basis for the following conventional logging and the explanation for the fraction in the single well or the single zone.

According to the data about 25 wells in a lithology level, there are 164 fractures. Among which, there are 74 in siltstone, accounting for 45.2%; 32 in argillaceous siltstone, accounting for 19.5%, 35 in silty mudstone, accounting for 15.2%; 33 in mudstone, accounting for 20.1%. According to the above results, fractures in the former research emerge mainly in siltstone and argillaceous siltstone, jointly accounting for 64.6%, and the remaining 35.4% exists in silty mudstone and mudstone. Analyzing from the sedimentary microfacies in fractures, fractures in channel sand take up for 31.6%, sheeted sand take up for 32.9%, and the rates for their emergence are almost the same. Therefore, fractures in reservoir stratum are mainly caused by lithology instead of sedimentary microfacies.

2. 3D Geological Modeling Technology in Fractured Oil Reservoir
The key factors influencing the simulation accuracy of fractured oil statistics is the accuracy of fracture equivalent model. Therefore, research technique in 3D Geological Modeling Technology in Fractured Oil Reservoir should be improved. Information in fractures includes the angle, direction and intensity. Because high angle cracks emerge most in Taizhao Oil Field, therefore, focus should be put on the direction and intensity of fractures [4].
2.1. Research on the Direction of Fracture
According to the results gathered by the Passive microseismic method from 66 wells and 97 well times, there are 230 fractures. Among which, 83 North-West ones account for 36.09%; 73 North-East ones account for 31.74%; 42 East-West ones account for 18.26% and 32 South-West ones account for 13.91%. There are no obvious main directions among these fractures. 8 wells in Taizhao Oil Field was carried out by using Micro resistivity imaging and interactive multipole array sound waves. There are obvious vertical fractures in two wells, and the direction are NE68° and NE76° respectively. Learned from the changing date, one can analyze the direction of development of fractures between wells and sedimentation units: in the 21 wells and 7 sedimentation areas in 401, there are 39 fractures. Among which, 17 East-West ones take up 43.6%, 10 South-North ones take up 25.6%, 6 North-West ones take up 15.4% and 6 North-East ones take up 15.4%.

In a word, there are fractures in North-East, North-West, almost East-West and North-South directions and there are no obvious main directions among these fractures. Therefore, Taizhao Oil Field takes Passive microseismic and dynamic monitoring as the basis, and takes Petrel to digitalize directions in all wells so as to calculate the directions in the real fields.

2.2. Research on Fracture Intensity
Intensity of sandstone fraction refers to Fracture points in sandstone per meter. Therefore, the stronger the intensity, the more well-developed the fracture. At the same time, the thickness of fractures also has some connection with sample interval of logging curves. When LOC is 8/m and intensity is 1, the thickness of fracture development is 0.125m.

Model of fracture intensity, reflecting the intensity of fracture development, is the key to stimulate fracture modeling. Therefore, in order to set up a model accurately, on one hand, the influence of paleotectonic flexure, and the distance from well point to faultage should be considered; on the other hand, vivid monitoring guarantees the accuracy of fractures. By combining the five fracture intensity models, fracture intensity models constrained by former standards can reflect both well point and fracture directions (Figure 1).

![Figure 1. Fracture strength model with multiple constraints](image-url)
3. Residual oil distribution

3.1. The distribution of the remaining oil in the plane

According to the static and dynamic analysis of residual oil and the comprehensive analysis of numerical simulation data, it is believed that the residual oil mainly exists in the following types.

Large-area distribution type: refers to that the number of remaining oil wells in a certain layer accounts for more than 40% of the total number of wells in the block, and the distribution is relatively continuous on the plane. For example, the remaining oil of PI4-2 is distributed in a large area on the plane. The remaining oil is mainly caused by the poor water injection efficiency, the contradiction between fracture layers and the water breakthrough in fractures, and the remaining recoverable reserves of this kind of remaining oil account for 14.95% of the total remaining recoverable reserves (Figure 2).
(b) PI1-2

(c) PI2
Figure 2. Distribution map of remaining oil saturation in Taizhao layer in block W401 of Taizhao oilfield
Local distribution type: refers to that the percentage of remaining oil wells in the total area is between 15-40%, and such remaining oil is distributed in the local well area, including PI1-1, PI1-2, PI2, PI3, PI5-1 and PI6-1 sedimentary units. The remaining oil is mainly formed by the reasons of poor water injection efficiency, the contradiction between fracture layers, formation water invasion, etc., and the remaining recoverable reserves of this kind of remaining oil account for 59.02% of the total remaining recoverable reserves, which is the main type of plane remaining oil distribution in Taizhao oilfield [5].

Scattered distribution: refers to the percentage of remaining oil wells in the whole area that is less than 15%. It is mainly the residual oil that forms a lump or strip in a small range. There are four deposition units of PI4-1, PI5-2, PI6-2 and PI7 (Figure 2). The remaining recoverable reserves of this kind of residual oil account for 26.03% of the total remaining recoverable reserves.

3.2. The longitudinal distribution of the remaining oil
According to the analysis and numerical simulation results of residual oil in combination with dynamic and static conditions, the longitudinal residual oil is mainly distributed in PI1-1, PI4-2 and PI6-1 sedimentary units.

4. Conclusion and understanding
(1) The multidisciplinary reservoir research technology based on reservoir fine description and by means of three-dimensional geological modeling and reservoir numerical simulation provides technical support for the study of fracture distribution law and residual oil distribution law of Taizhao oilfield and the preparation of infill adjustment scheme.

(2) The structural axis and the vicinity of faults are fracture zones in Taizhao oilfield, the fractures in the two wings of the structure are weakly developed, and the distribution of fractures in the reservoir is mainly influenced by lithology and less by sedimentary microfacies.

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