# Practice of Tapping Potential of Remaining Oil near Faults under Dense Well Conditions

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**Abstract.** At present, Daqing Oilfield has entered the late stage of high water cut, and the difficulty of remaining oil exploitation has been increasing. Multidisciplinary research indicates that there is a large amount of residual oil at the edge of the fault. In order to tap the remaining oil, it has been deployed in the rising plate of the pure oil zone fault in recent years. Large displacement directional wells have achieved good results. This paper proposes favorable structural conditions and reservoir conditions for the design of large displacement wells through the study of well-seismic combined fine structure research, reservoir modeling research and injection-production relationship around faults. Combined with the distribution of remaining oil, the fault rise disk, the descending disk and the large displacement directional well in the transition zone are designed to improve the residual oil tapping method at the edge of the fault.

## Introduction

With the deepening of well-seismic geological research, the accuracy of structural description has been greatly improved, and the faults and micro-amplitude structures are more accurately described [1]. Multidisciplinary research indicates that there is a large amount of residual oil near the fault [2]. In recent years, it is recognized that in the ascending disc of the fault, the large displacement directional well was designed to tap the remaining residual oil, and good results were obtained. In this paper, the study of the change of faults, the comprehensive structural features, the development of reservoirs and the relationship between injection and production, breaking the tradition and personalizing the design of large displacement directional wells, not only in the fault rise disk design, but also in the fault plate Large displacement directional wells, and designed to penetrate the fault directional wells in the transition zone, effectively tapping the remaining oil at the edge of the fault [3].

## Technical Route

The study area is located at the southern end of the Xingshugang structure in Changqing, Daqing. The Xingshugang structure belongs to the anticline structure reservoir with a dip angle of 2~3°. The structural axial direction is 28° northeast to 349° northwest [4]. The mining targets are three sets of oil layers of Sa II, Sa III and Portuguese I, which are subdivided into 72 sedimentary units. Among them, the Saertu oil layer is mainly deposited by the outer delta front, and the Portuguese I group is mainly composed of the delta diversion plain and the inner front margin [5].

This research is based on the comprehensive analysis of geological, well logging, earthquake and other data. First, through the combination of well-seismic and fine-structural interpretation, using the interpretation results to establish the structural model of the study area, compare the well faults, and find fault zones with large structural changes [6]. As a favorable area for large displacement wells, the second is to establish a reservoir model, predict the development of sand bodies, and give the well position. The third is to carry out research on remaining oil, to determine whether the well position is reasonable, and the fourth is to analyze the relationship between injection and production. Network deployment, determine a reasonable well position, and finally design the well

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trajectory in the model. Data preparation, structural analysis, sand prediction, residual oil analysis, injection-production relationship analysis, extended reach directional well design [7].

## Analysis of Combined Structure of Well and Earthquake

In terms of structural description, the old oilfield structure description mainly describes faults through two-dimensional seismic interpretation and well breakpoints. For faults, the faults can only be predicted by fault interpretation and well breakpoints of two-dimensional seismic interpretation. The error is relatively large. By incorporating 3D seismic information into the fine structure description, using the fine interpretation fault of 3D seismic combined with the fault location of the well to predict the fault, the subjective error of the interwell fault description can be reduced, and the well-seismic combined geological construction can be carried out in the depth domain through time-depth conversion. Modulus, construction description accuracy is more accurate.

The study of well-seismic combined structure mainly includes: firstly, the well-seismic combined with fine structure interpretation, the production of synthetic geological records, the simultaneous well horizon calibration, and the multi-window two-dimensional and three-dimensional linkage fault interpretation technology in the time domain to improve the fault interpretation. Accuracy, the second is to establish an accurate velocity model, the time domain fault interpretation results are transformed into the depth domain, and the third is to carry out the well-seismic combined structural modeling in the depth domain, mainly in the depth domain for fault-breaking breakpoint locking, fault and well division. The layer is finely matched, and the fault model is established. The structural model is established by using well point stratification data and depth domain seismic horizon constraints. The introduction of seismic interpretation information can improve the accuracy of crosswell micro-amplitude structure identification.

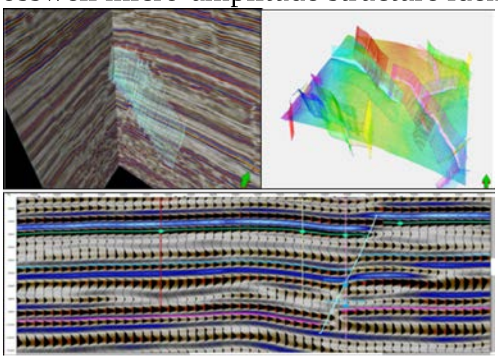

Figure 1, three-dimensional linkage fault interpretation technology

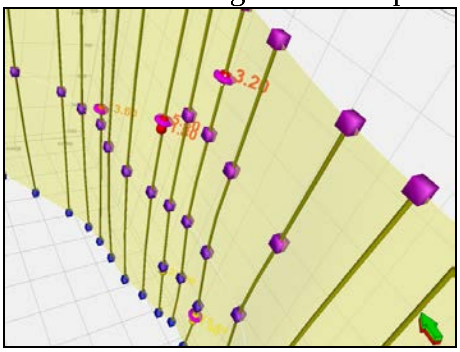

Figure 2 breakpoint fault locking technology

## Reservoir Analysis

The purpose of reservoir research is to determine the situation of designing large displacement directional wells to meet sand bodies. If there are few sand bodies encountered, it is difficult to ensure the development of large displacement wells. Reservoir analysis mainly analyzes reservoir description results and reservoir modeling results. The study mainly uses the well-seismic combined reservoir modeling method to analyze the sand body. Based on the fine structure model, the logging data and the seismic data model are resampled, and the variogram analysis is performed. Based on the well point microphase data, the earthquake is used. The inversion data is used as a constraint, and the sequential modeling of stochastic simulation is used to carry out reservoir modeling to simulate the distribution of sedimentary microfacies. Through development practice, several types of sand body dominant sand bodies are designed for large displacement wells. One is to cover the distributary channel sand body by fault, the other is to cut narrow river channel sand body by fault, and the third is to block the reservoir in the surface by fault. The three-point combination structure determines the position of the large displacement well.

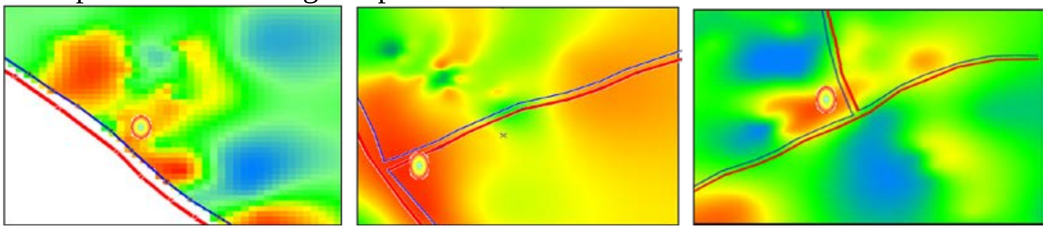

Fig.3 Distribution of remaining oil in directional well area of large displacement well

### Design of Large Displacement Directional Wells

Through the study of the structure of the target area, the reservoir and the remaining oil, the principle of design of the large displacement well is determined. First, the selection of the directional well area is near the fault, and the development of the fault is clear. Second, the development of the sand body in the large displacement well area ensures the sand body drilling rate; the third is to select the area where the remaining oil is enriched; the existing well distance is greater than one well spacing; the fourth is to integrate the oil and water wells around the well. If there is a water well, it is necessary to further analyze the development level of the well to ensure there is no perforation in the target layer. Using the above principles, the large displacement directional wells are individually designed. The design of the 293# and 330# fault large displacement wells is taken as an example:

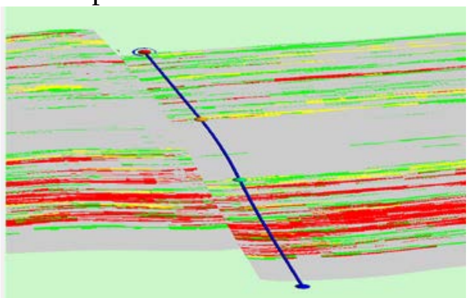

Fig. 4 Depression trajectory profile of extended reach directional well

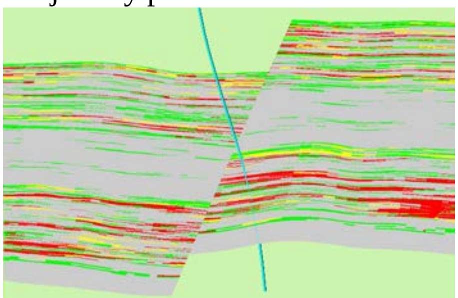

Fig.5 Trajectory section of large-displacement directional well in fractured layer

### Analysis of Design Effect of Large Displacement Directional Wells

From the production effect, a total of 65 new wells were counted, including 31 straight wells. The initial average daily oil production was 4.1t, the water content was 92.7%, and the large displacement directional wells were 34. The initial single well produced 10.5t of oil per day, and the water content was 76.7%. The three large-displacement wells of the descending plate design, the initial average single-well oil production of 9 tons, the water content of 80.2%, the 330# fault design of the 2-port fracture large displacement directional well, the drill encounter breakpoint at the bottom of the Sa II group, and the design is slightly There is a deviation, but it does not affect the target layer. The initial average single well produces 7.5 tons of oil and 42.1% of water. The effect of the descending disk and the large displacement directional well passing through the fault is relatively poor, but the effect is significantly better than that of the vertical well.

Table1 Effect of extended reach direction all well

| Design well type | | Well number /mouth | Sandstone thickness /m | Effective thickness /m | Initial daily oil production /t | Initial water cut /% |
|---|---|---|---|---|---|---|
| Vertical well | Vertical well at fault edge | 31 | 43.9 | 18.5 | 4.1 | 92.7 |
| Extended reach directional well | Rising pan Extended reach directional well | 29 | 53.0 | 21.2 | 14.5 | 61.2 |
| | Extended reach directional well with descending pan | 3 | 56.1 | 20.1 | 9.0 | 80.3 |
| | Large displacement directional well through fault | 2 | 39.2 | 16.8 | 7.5 | 42.1 |
| | Total | 34 | 49.9 | 20.7 | 10.5 | 76.7 |

## Conclusion

Using well-seismic combined with fine structure interpretation results to construct and re-recognize, the fault characterization is more accurate, the fault plane position changes greatly and the old well is far away from the fault is the important area of large displacement directional well design. When designing large-displacement wells, the well trajectory can be designed according to the structure, reservoir and residual oil distribution of the study area. The pure oil zone can design large displacement directional wells along the fault tending on both sides of the fault. The transition zone can Designed to penetrate large displacement wells.

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