

Source Faults of F, Y Oil Layer in Sanzhao Depression and its Control to Oil Accumulation

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Abstract: The research on the characteristics of oil migration mechanism and pathway of oil migrating from K_2qn^1 source rocks downward to F, Y oil layer in Sanzhao Depression shows that the source faults of F, Y oil layer should be the T_2 faults. The upper part of those faults disappeared in K_1qn_1 source rocks, and the main faults just cut through T_2 , along from T_2 to T_3 , from T_2 to T_4 and from T_2 to T_5 and distributed in the whole depression. The migration distance of oil downward from K_1qn_1 source rocks in Sanzhao Depression is mainly influenced by the difference between ancient overpressure of K_2qn^1 source rock and flow resistance during the process of migration downward and also influenced by combination way of faulted sandstone and mudstone in F, Y oil layer. It makes the deviation of actual downward migration distance with the theoretical migration distance. The actual distance of oil downward from K_2qn^1 source rocks is 300 m, and the high-value area mainly distributed in oil fields. The control factors of source faults to oil accumulation and distribution are given. The development area of source faults controls the area of oil distribution. The development degree of source faults controls oil downward migration distance. The high fault blocks nearby source faults are favorable for oil accumulation in F, Y oil layer. The distance to source faults controls the productivity of oil wells.

Keywords: Sanzhao Depression; F, Y oil layer; source faults; oil downward migration; oil accumulation.

INTRODUCTION

Sanzhao Depression is located in the northern Songliao basin of the central depression area. Its west is close to Daqing placanticline, the east and south are near Chaoyang ditch terrace. Its north joins with Suihua depression, SuiLeng anticline belt and the south of Anda syncline. It is a successive development depression which went through periods of fault depression, depression and tectonic inversion.

Sanzhao Depression develops the Huoshiling group, Shahejie group, Yingcheng group, Dengloulou group and Quantou group of Lower Cretaceous in fault depression period, the Qingshankou group, Yaojia group, Nenjiang group of Upper Cretaceous in depression period and the Palaeogene, Quaternary in structural inversion period. The fluvial facies Fuyu and Yangdachengzi oil layer (F, Y oil layer for short) which located in the three and four sections of Quantou group is the main production reservoir of petroleum-bearing combination in the central depression.

So far, it has discovered Shenping, Song Fangtun, Zhaozhou, Yushulin, Chaoyang oilfield and so on. This fully shows the oil prospects of Fu Yang reservoir in the depression. Oil source correlation results show that [1-3] the oil of Fu Yang reservoir mainly comes from the dark mudstone in the first section of the overlying

Qingshankou formation. Oil produced by the overlying K_2qn^1 source rock migrating along which type of fault to the underlying F, Y layer and the migration distance is the key point to the research of F, Y reservoir forming mechanism and distribution law. Past studies [4] show that the source faults of F, Y reservoir are the faults that across T_2 interface to T_{06} interface.

FAULT TYPES OF OIL "BACKWARD" MIGRATION AND DISTRIBUTION CHARACTERISTICS

The Sanzhao Depression K_2qn^1 source rock is not only generally has over pressure but also develops lots of faults at the bottom of the T_2 interface [5]. It has the theoretical condition of "backward" migrating to the downward. Sanzhao Depression develops 6 kinds of faults since fault depression period. The first kind is fault that act in fault depression period, including faults which cut through from the basement to Quantou group ($T_2 - T_5$ fault), and faults that broken from Dengloulou group to Quantou group (T_2, T_4 fault). The second kind is fault which formed during depression period, mainly the faults developed in K_2qn^1 . The third formed in tectonic inversion period, mainly developed only in K_2n^3 (fault T_{06}). The fourth kind of fault formed in fault depression period and continued to act during depression period, including the fault that cut from the basement and Dengloulou group to K_2n^1 , namely $T_2 - T_5$

fault, T₂-T₄ fault, T₁-T₅ fault and T₁ - T₄ fault; The fifth type of fault formed in fault depression period, acted in depression and tectonic inversion period, including the faults which cut from the basement and Denglouku group to K₂n³, namely T₀₆ -T₅ and T₀₆ - T₄ fault. The sixth type fault, including faults had broken from Quantou group and K₂qn¹ to K₂n³, namely T₀₆ - T₃ fault and T₀₆ - T₂ fault. They forms in depression period and acted in tectonic inversion period. The faults developed on T₂ interface are mainly the second, the fourth, the fifth and the sixth kind of fault; they formed the network state intensive belt on the surface. Statistics shows that there are 4230 faults on San zhao Depression T₂ interface, but not all of these faults can be the K₂qn¹ oil downwards migration channels.

From figure 1 you can see that only the faults on T₂ interface which upside disappeared in K₂qn¹ source rocks can be the migration channel of “backward” oil. Though it didn’t diastrophism obviously in the end of Mingshui formation—the main hydrocarbon generation and expulsion stages, because this kind of faults disappeared in K₂qn¹ source rocks, it will still present on-state under the action of tensile stress field and be the of oil migration access. Oil in K₂qn¹ could not transported upward, it can only migrating downward to F,Y reservoir under the action of overpressure, overcoming the formation pressure, the capillary resistance and the buoyancy of oil and gas itself, and this kind of fault should be the main source fault of F, Y reservoir.

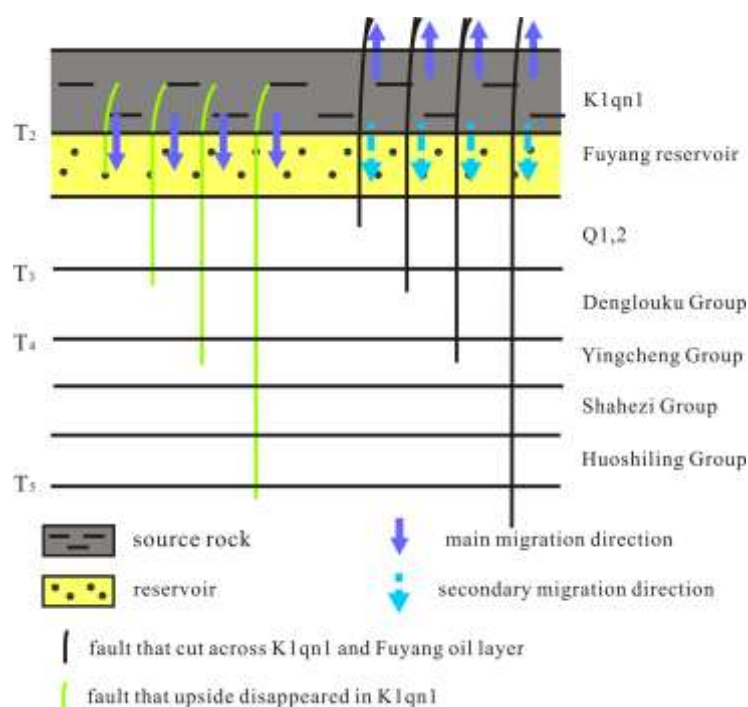


Fig-1: Type of faults of F, Y oil layer in Sanzhao Depression and its migration transporting model

THE DISTANCE OF OIL MIGRATED BY T₂ SOURCE FAULTS

The "backward" migration distance of K₂qn¹ oil that migrated along T₂ source fault not only depends on the ancient overpressure values of K₂qn¹ source rock and the oil "backward" resistance differences, but also influenced by the syntagmatic relations of sandstone and mudstone in F, Y oil layer that cut across by T₂ faults. The largest theoretical “backward” migrating distance of oil that migrated into F, Y reservoir can reach 150-300m [1]. This result is almost the same to the distance which F, Y reservoir’s oil bottom to K₂qn¹ source rock bottom, but not identical. It may cause by the lateral migration of oil. When oil of K₂qn¹ source rock migrated under the overpressure by T₂, it met the sand carrier bed which communicates with T₂, and then it no more migrated downwards, but happened lateral

migration. This made the real “backward” distance less than the theoretical value. Another case is that due to the fault dislocation, the footwall Fuyu oil layer joint the Yangdachengzi reservoir hanging wall, the oil first migrated to the largest distance, then happened lateral migration to the footwall and transported into Yangdachengzi layer. It makes the footwall Fuyang layer’s actual oil reservoir bottom distance bigger than the biggest calculated "backward" oil migration distance.

The control action of T₂ source faults to oil accumulation and distribution

T₂ source faults developed zone controls the oil accumulation. Sanzhao Depression F, Y reservoir has a good corresponding relation with the T₂ faults development degree. Shengping, Songfangtun and

Zhaozhou Oilfield are all distribute in area where T_2 faults relatively developed. This is because only in these areas, it has more "backward" migration pathway, and more oil can migrate into the F, Y reservoir and accumulate. Instead, if there is less migration pathway, oil supply is limited; it is difficult to form large-scale accumulations.

The developmental stage of T_2 faults controls the oil migration "backward" distance. By figure 2 it can be seen that oil migrated downwards to the F, Y reservoir has a good corresponding relation with the T_2 faults

development degree. In T_2 faults developed region, the more develop degree the faults are, the longer the "backward" distances are the smaller the opposite. This is because in T_2 faults developed region, the range of graben or horst in F, Y reservoir which formed by the broken of T_2 is lager. The lower the horizon where Fuyu reservoir footwall and Yangdachengzi hanging wall interface is, the lower the horizon that oil lateral migration from footwall to hanging wall is This results in the longer "backward" migration distances of oil which created by the hanging wall K_1qn^1 source rock. The shorter the opposite.

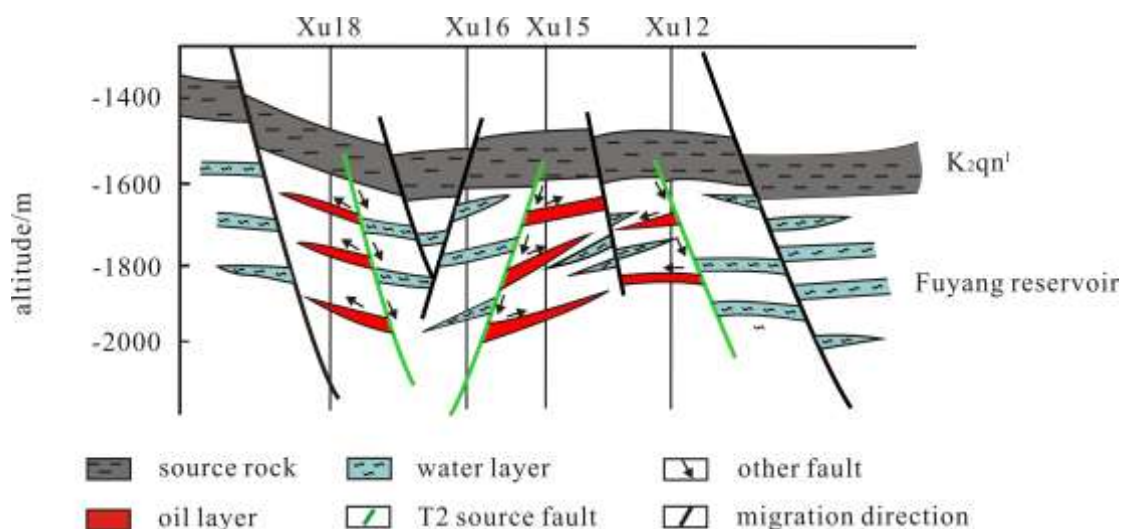


Fig-2: Oil accumulation mode of F, Y oil layers in Sanzhao Depression

The high fault block traps near T_2 faults are beneficial to oil accumulation. On the way of "backward" migrating along the T_2 source faults, when meeting appropriate traps, oil produced by K_2qn^1 source rocks can accumulate. From figure 3 we could find out: T_2 faults which cut through K_2qn^1 source rocks and extend upwards is not the main access for oil to migrating "backward" to the underlying F, Y layer, but the access to transporting upwards. So, the nearby area does not fit for the F, Y oil accumulation. Oil accumulation can be found only nearby T_2 faults. But whether the oil can gather accumulation or not depends on the development degree of sand body and its configuration with T_2 faults. San zhao Depression reservoirs has flat structure, anticlinal traps agensis, trap types are mainly fault block, fault screened traps and fault - lithologic traps which formed by the cross match of faults and channel sand body. These traps can form reservoirs only when communicated by the T_2 source fault.

Based on the analysis above, combining the K_2qn^1 source rocks maturing area distribution range and the T_2 (figure 2) source faults distribution, it comes that in the western Shengping Oilfield, eastern Song Fangtun Oilfield and northern Zhaozhou Oilfield ,although the F, Y reservoir reserves has not been submitted, these

areas develops T_2 faults. Oil comes from the overlying K_2qn^1 source rocks can migrating to F, Y reservoir. If the fracture and the sand body matching well, oil accumulation can formed here. This area should be the next favorable exploration area of F, Y reservoir in the depression. The high fault block traps near T_2 faults should be the main objects of the next exploration. Though the northwest area of Shengping Oilfield located in the oil source area, the K_2qn^1 source rocks thickness of is small, its oil supply capacity is insufficient, and F, Y oil layer has thin thickness sand layer. As a result, even the T_2 faults developed, the oil migration to the F, Y oil layer is relatively little, hard to gathered a large accumulation. Little amount of oil has been found in the area so far.

CONCLUSIONS

- (1) The Sanzhao Depression F, Y layer oil source faults are not the faults that used to be considered to cut across K_2qn^1 . They are faults that widely develop in the whole depression which top side disappeared in K_2qn^1 source rocks, mainly include faults develop in K_2qn^1 , faults grow from Quantou group to K_2qn^1 , faults grow from Dengouku group to K_2qn^1 and faults that broken across basement to K_2qn^1 .
- (2) The oil "backward" migrating distance mainly

controlled by the ancient overpressure values and the oil "backward" resistance differences. Meanwhile, it also influenced by the syntagmatic relations of sandstone and mudstone in F, Y oil layer that cut across by T₂ faults. The oil "backward" real distances can reach 300m deep. Its high value areas are mainly distributed in oil field area.

- (3) The control action of the source faults in Sanzhao Depression F, Y oil layer to oil accumulation and distribution mainly displays in: T₂ source faults development zone control the oil zones; The development degree of T₂ faults control the oil "backward" migration distance; The high blocks near T₂ faults are advantageous to the oil accumulation; The distance to T₂ faults control the oil well productivity.

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