Study on a New Exploration Field in Tamchag Basin

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Abstract. Based on seismic, geological, logging and mud logging data, the seismic reflection, electrical, sedimentary and production characteristics of Tongbomiao formation and Nantun formation in a depression are compared, and a set of horizons above Tongbomiao formation in a depression are studied. The results show that the original Tongbomiao formation is actually the fourth oil formation of the first member of Nantun Formation. It is a slope fan sedimentary system overlying the Tongbomiao formation and is a lithologic reservoir. This set of strata is mainly distributed in the steep slope break zone of the basement uplift area. Because it is the same strong reflection axis as Tongbomiao strata in the earthquake, it is difficult to distinguish them. It has been mistaken for Tongbomiao strata for a long time. The re-recognition of this set of reservoirs is of great significance for searching for lithologic reservoirs, tapping the remaining potential of the developed fault block structures at low positions and improving the effect of water injection development.

1. Introduction

In the early stages of the development of the petroleum industry, most of the oil and gas exploration was based on structural reservoirs, and lithologic reservoirs were regarded as hidden reservoirs, which were difficult to find, and the degree of exploration and research was low[1]. The discovery of lithologic traps is mostly "accidental" [2]. However, in recent decades, with the increase in awareness and the advancement of exploration and development technologies, more and more lithologic reservoirs have been discovered [3].

In rift basins, due to the violent fault activity, the drop between the upper and lower walls of the fault is large. Generally, the steep slope of the descending slope is easy to develop fan bodies, which become storage spaces. At the same time, deep lake-semi-deep lake deposits provide high-quality source rocks and have favorable conditions for hydrocarbon accumulation. However, the fan control factors in the steep slope zone are complex and concealed, making it difficult to be discovered [4-8], especially in fault blocks dominated by structural oil reservoirs, and lithologic reservoirs in the steep slope zone are often overlooked.

This paper takes a depression in a basin in Mongolia as an example, and discusses the effective identification and discovery of lithologic reservoirs in fault blocks dominated by structural reservoirs based on the discovery of lithologic reservoirs developed in the Lower Cretaceous.
2. Geological profile
In a sag, good oil and gas shows have been seen in the Budate Formation, Tongbomiao Formation, Nantun Formation and Damoguaihe Formation in the basement from bottom to top. At present, Tongbomiao Formation and Nantun Formation are mainly developed. The Tongbomiao Formation mainly develops fan delta front subfacies deposits, mainly structural oil reservoirs; the Nantun Formation mainly develops middle and outer fan deposits of nearshore and far shore underwater fans, with lithology or structure -Mainly lithologic oil reservoirs. Early studies believed that the accumulation of oil and gas in an uplift area of a sag was controlled by faults and unconformities, while the accumulation of oil and gas in the slope zone was controlled by sand bodies and lithological traps [10-13].

3. Questions
During the period after the Tongbomiao strata was deposited, tectonic activities were frequent, and the strong tectonic movement caused the weathered denudate in the high part to collapse and quickly slide down, and the deposition was slowed down at the waist break of the steep slope belt. One or two sets of sand bodies were deposited in a sag during this period. This set of sand bodies is confined by the overlying Nantun Formation mudstone and bottom mudstone. It has always been considered as the Tongbomiao formation and was developed in the way of a structural oil reservoir. However, many contradictions have been discovered in actual production and in geological research.

Well 1 is an appraisal well. This well is located in a relatively low part of a fault block structure in the southern part of the oilfield (Figure 3). The oil test was conducted at the originally thought Tongbomiao layer at 2282.0-2285.0m and 2363.0-2379.0m, and the conclusion was that the industrial reservoir and water Floor. The high part of the fault block well 2 Tongbomiao layers 2070.0-2075.4m and 2170.0-2179.4m oil test, the conclusion is a water layer.

| WELL  | Test well section (m) | Thickness (m) | Oil testing method | Daily output Oil (t) | Water (m³) | conclusion |
|-------|-----------------------|--------------|--------------------|----------------------|------------|------------|
| WELL1 | 2282.0-2285.0         | 3.0          | MFEI+MFEII+Swab    | 0.680                |            | Low-yield oil layer |
|       | 2282.0-2285.0         | 3.0          | Fracture+Swab      | 3.960                |            | Industrial reservoir |

During the re-examination of the exploration well, it was found that there was suspicious potential at 2300m of Well 1. The lithology of this layer was glutenite, surrounded by mudstone; in terms of electrical properties, high resistance, high density, low gamma, and negative natural potential anomalies. At 2282.0-2285.0m in the upper part of the layer, the previously recognized Tongbomiao layer was an industrial oil layer, with a cumulative oil production of 1075t. For this reason, it is believed that this layer may have certain potential.

Well 1 has 12.0m refilled holes (without fracturing) at 2325.0-2337.0m, with 96t spout on the first day; the initial average daily oil production is 65t; the production is 110 days and the cumulative oil production is 3144t.

The oil layer of the Tongbomiao Formation is a low-permeability oil layer with low natural productivity and requires fracturing and commissioning. However, the production characteristics of the filling hole horizon in Well 1 are different from that of the Tongbomiao Formation, which is very different from the previous understanding. As a result, there are questions about the geological understanding and attribution of this set of holes. For the time being, call this set of levels the X level.
4. X layer features and attribution

From the seismic reflection characteristics, electrical characteristics, sedimentary characteristics and production characteristics, the two sets of reservoirs in the Tongbomiao Formation and Nantun Formation are compared, and the ownership of the X layer in the well 1 refilling layer is discussed.

4.1. Seismic reflection characteristics

Earlier studies believe that the reflection characteristics of Nantun Formation T2-3 on the seismic profile have the characteristics of medium-strong amplitude, intermediate frequency, continuous, parallel-subparallel reflection structure, and obvious pro-product reflection structure locally, and the top super reflection. The top surface T3 of the Tongbomiao Formation is an unconformity surface. It is the first strong reflection below the Nantun Formation. The seismic feature is an interface with a large difference between the upper and lower reflection structures, which is easy to identify and track (Figure 1).

![Figure 1. Seismic reflection profile of Tongbomiao and Nantun formations in a sag](image)

Through further research, it is found that affected by the seismic resolution and the strong amplitude reflection shielding effect of the unconformity surface, the T3 interface of the Tongbomiao formation appears as a double-track reflection wave group with time and thickness, and on the envelope surface of this wave group Up and down have obvious angular unconformity characteristics. After calibration of the composite record, the X layer is exactly within the range of the double-track reflection wave group, that is, within the T3 reflection envelope, while the Tongbomiao formation is under this set of envelopes and is in angular unconformity contact with the X layer.

4.2. Electrical characteristics

Compared with the electrical properties of the overlying Damoguaihe Formation, the electrical properties of the Nantun Formation have the characteristics of high resistance and slightly lower natural gamma value. The electrical properties of the Tongbomiao stratum are characterized by high natural gamma, high resistance and high density.

After the combination of wells and earthquakes, it is believed that the X layer is in the seismic reflection envelope above the Tongbomiao formation, surrounded by mudstone up and down, and some reservoirs are box-shaped with high resistance, high density, and low acoustic wave characteristics; The
sand and mud interbeds of the reservoirs have a large zigzag-like electrical resistance and are characterized by low resistance.

4.3. Sedimentary characteristics
Due to frequent structural activities in a sag, the supply of materials is complicated. The differences in the supply of provenance in different periods have controlled and affected the development characteristics of the sedimentary system in the basin to a certain extent.

After the deposition of the Tongbomiao Formation, the violent tectonic movement uplifted the local basement of the depression, forming a number of interconnected fault lakes. The lower part of the lake basin formed a huge accommodating space and developed deep-semi-deep lake mudstone, which is of high quality. Source rock. During the active period of the fault, the basement uplift has a strong effect, and the erosion of the parent rock is rapid. Coarse clastic rocks are deposited on one side of the steep slope zone and enter the lake basin as a fan. After the water system enters the lake basin from the uplift area, the water flow energy is reduced, the sand carrying capacity is weakened, and the coarse clastic material is deposited in the zigzag zone. Affected by the expansion of the lake basin, the sand layer overlapped upward along the slope, forming a sandstone complex superimposed on each other. Due to the small scale of the fault lake and the small source water system, the scale of the sand body is generally small. However, because the sand body penetrates deeply into the oil-generating strata and directly contacts the oil source, it has good oil-bearing properties. This set of sedimentary strata is called the X layer (Figure 2).

4.4. Characteristics of oil test production
Count 31 wells and 35 layers of industrial oil flow in a certain depression. Among them, there are 15 wells and 15 layers in the Tongbomiao layer, and 16 wells and 20 layers in the X layer. The layer of Tongbo Temple has 1 layer of natural productivity, 14 layers after pressing, of which 1 layer is sprayed after pressing, and 13 layers are swabbed after pressing; layer X has 11 layers of natural productivity,
and 9 layers after pressing, Where 5 layers are sprayed after pressing, and 4 layers are swabbed after pressing (Table 2).

| Horizon | Number of wells (orifice) | Natural productivity layer (A) | Fracture productivity layer (A) | total (A) |
|---------|---------------------------|-------------------------------|---------------------------------|-----------|
|         |                           | Perforation swab              | Perforation Self spray          | Fracture + Swab Fracture Self spray | |
| T       | 15                        | 1                             | 0                               | 13        | 1         | 15        |
| X       | 16                        | 9                             | 2                               | 4         | 5         | 20        |

According to the analysis of oil test data, the Tongbomiao oil layer, except for the high-permeability fault block of Well 5, which has natural productivity, the other fault blocks are all low-permeability reservoirs, which need to be produced after fracturing [14]. The X layer has natural productivity, self-spraying or high yield after fracturing, indicating that the X layer has much better permeability than the Tongbomiao oil layer and belongs to a high permeability reservoir.

Based on the above studies, it is believed that the X layer belongs to the Nantun Formation. It is the IV oil group of the first member of the Nantun Formation. It is in unconformity contact with the underlying Tongbomiao Formation. It is a set of lithologic reservoirs deposited in the early Nantun Formation. It is a slope fan that is deposited near the shore and is transformed by lake waves near the wave base. The N1IV oil group is generally developed in the non-whole area, mainly distributed in the slope belt of the central and southern basement uplift area of a certain depression. It is preliminarily believed that there are two sets of sand bodies in the N1IV oil group. The lower sand body is an event slump deposit body caused by strong tectonic movement, and the upper sand body is a weathered denudation deposit body in the uplift area.

5. Application effect
The results of the study indicate that the Nantun Formation N1IV oil group developed in the well 1 fault block well area is an up-dip pinch-out lithologic oil reservoir. According to the sand body prediction, the favorable area is determined to be approximately 6.62km². The first batch of plans first deploy 8 wells around Well 1. At present, one well has been drilled, and two sets of sand bodies have developed in N1IV, with effective thicknesses of 4.0m and 11.7m respectively.

Similarly, the N1IV oil group of Nantun Formation is also developed in well 3 area. For this reason, 12 wells are deployed in this well area, with a predicted effective thickness of 15.3m.

On the basis of this understanding, two exploration wells are optimized for hole repair. After the hole is filled, there is natural productivity, and the oil recovery intensity is 1.1 t/d.m and 2.1 t/d.m respectively; after fracturing, the oil recovery intensity is 2.0 t/d.m and 3.2 t/d.m respectively. It is estimated that the favorable sand body range is 18.2km².

6. Conclusion and understanding
First, the slope fan of the faulted basin is small in scale and is covered by thick mudstone, which is often difficult to find. If the sedimentary fan is reformed by the lake and waves, it will become a favorable reservoir with good permeability.

The second is regionally, the use of seismic technology can preliminarily determine the distribution range of lithological sediments in the slope zone of the uplift area.

The third is that due to factors such as lake basin size, depth, and topography, the sedimentary characteristics of sand bodies are not the same even in the same period.

The fourth is to search for hidden lithologic oil and gas reservoirs, which will become the next key exploration direction of a certain depression.

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