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Study on the sedimentary facies of the member 4+5 and 6 of Yanchang Formation in Zhaike and north of Danba area

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Abstract： Zhaike and north of Danba area is located in Shanbei slope of Ordos Basin in the central south, which is on a tilting monoclinal structure towards west. Its prototype appeared in the late Jurassic and formed in the early cretaceous. The exploratory degree is low here, therefore, the study on depositional system, sedimentary facies, reservoir distribution, traps accumulation, and the hydrocarbon enrichment of the member 4+5 and 6 of Yanchang Formation is not enough and it needs further understands. This paper choose previous studies for the background, based on the outcrop, core and well log data, analyzing the lithologic characteristics, log facies and sedimentary microfacies. The result shows that the member4+5 and 6 are mainly belongs to delta systems, which can be further divided into one subfacies and four microfacies. Finally, according to the distribution and evolution law of the sedimentary micfacies, the depositional model of the study area can be obtained.

Key word: *Sedimentary facies; Depositional model; Depositional system; Zhaike and north of Danba area,*

I. INTRODUCTION

The Ordos Basin is a large, multi-cycle, craton basins, which is a overall lift, depression, migration and simple structure basin, and it is the main petroliferous basin in West of China. There are a lot of research work which mainly focused on the deposition system anatomy and analysis. To sum up, the basin center began in Wuqi Fuxian area, and then migrated to the area of Huachi-Huangling. Yanchang Formation which is large-scale developed in study area is the main reservoir in the research area and it formed large-scale oilfield. The author, taking exploration well and evaluating data as basis, finished the precise contrast of system of the region, and then combined with the source direction, tectonic background, basin evolution history, qualitative description and observation of the core, petrology and logging curve marks, to establish single well facies profile, and based on this, finished the fine characterization of the plane sedimentary microfacies by the method of the contrast of well facies profile.

II. HEADINGS

2. 1 The depositional background

Yanchang formation is an stable inland freshwater lake deposition, and the slope of basin is small, developing a set of shallow lake delta. In total, there are 9 reservoirs (Tab.1). Similarly, there are 4 rapid subsidence processes in the basin. The difference of member 4+5 and 6 on range is small, and its shoreline is so close. The outcrop profile of this two sets of the target layer is relatively developed, its lithology mainly are gradually reduced from the south to north, become thin from the south to north. According to the sub cycles, the author divide the target layer member4+5 into member4+5 (1), member4+5 (2) reservoir, and the member 6 reservoir is divided into 6 (1), 6 (2), 6 (3), 6 (4) reservoirs.

Tab.1 The two scheme of the classification and correlation in Ordos Basin

<table>
<tr><td colspan="4">The third census</td><td colspan="5">Chang Qing Oil Field</td></tr>
<tr><td>Jurassic System</td><td>The lower Jurassic</td><td>Fuxian Formation</td><td>The lower</td><td>Jurassic System</td><td>The lower Jurassic</td><td>Fuxian Formation</td><td>The lower</td><td></td></tr>
<tr><td rowspan="12">Triassic</td><td rowspan="10">Upper Triassic series</td><td rowspan="10">Yanchang Formation</td><td>（$T_2y_5^{1-5}$）</td><td rowspan="12">Three stack</td><td rowspan="10">Upper Triassic series</td><td rowspan="10">Yanchang Formation</td><td>T_3Y_5</td><td>Member1</td></tr>
<tr><td rowspan="2">（T_3y_4）</td><td rowspan="2">T_3Y_4</td><td>Member 2</td></tr>
<tr><td>Member 3</td></tr>
<tr><td rowspan="4">（$T_3y_3^{1-3}$）</td><td rowspan="4">T_3Y_3</td><td>Member 4+5</td></tr>
<tr><td>Member 6</td></tr>
<tr><td>Member 7</td></tr>
<tr><td rowspan="2">（$T_3y_2^{1-2}$）</td><td rowspan="2">T_3Y_2</td><td>Member 8</td></tr>
<tr><td>Member 9</td></tr>
<tr><td>（T_3y_1）</td><td>T_3Y_1</td><td>Member 10</td></tr>
<tr><td rowspan="2">Middle Triassic</td><td rowspan="2">Zhifang Formation</td><td>（T_22f_2）</td><td rowspan="2">Middle Triassic</td><td rowspan="2">Zhifang Formation</td><td>（T_22f_2）</td><td></td></tr>
<tr><td>（T_22f_1）</td><td>（T_22f_1）</td><td></td></tr>
</table>

2.2 The characteristics of sedimentary miacrofacies

(1) The characteristics of color

The lithology of Member 4+5, 6 mainly are grey, grey black, gray and green colors in several sand and mud deposits interactively. The performance of color shows that the sedimentary environment is under the water.

(2) Sedimentary structure

There mainly are 8 lithofacies types in study area. The first is massive bedding; the second is parallel to bedding; the third is cross bedding; the fourth is horizontal bedding; the fifth is deformation bedding; the sixth is ripple bedding; the seventh is wavy bedding and the last one is scour surface structure.The 1th to 3th type is mainly developed in the delta front water diversion channel; the 4th to 6th is mainly developed inshunt bay; the 7th is generally found in the delta front sheet sand deposits; the 8^{th} is generally found in the channel bottom.

(3) Structural characteristics of rock

The sandstone in member4+5, and 6 grain grinding roundness is better, the psephicity mainly are assumed hypo-edge angle; medium to well sorted; grain size frequency distinguish values in the fine side and indicate the sedimentary features of underwater. Probability curves of grain size mainly for two, occasionally three section type, suspension population and jump overall cumulative percentage content of more than 80%, indicating the conditions of strong hydrodynamic force.

(4) Ancient biological markers

The ancient biology is the important carrier of geological information, especially the environmental information, and it is a good indicator of the sedimentary environment. Not only can determine the geological age, but also can distinguish the sedimentary environment. At the same time, the fossil remains is a medium that can reflect the environment and the water power well.

That Member 6 reservoir appeared a large number of plant debris and stems, the results show that the strong power of water is formed by the action of rivers.

(5) The logging facies

Because of the high cost of the core, it is impossible to take the core of all the purpose well, so the importance of the log curve is becoming more and more important. Logging curve is the physical response of the various physical properties of rock along the wellbore, and it reflects the important cause of the rock, such as lithology, grain size, sorting, clay content and vertical sequence.

The sedimentary type of member4+5 and member6 reservoirs are delta front subfacies. The underwater distributary channel is mainly fine sandstone, sorting and roundness is good to medium, the spontaneous potential curve shape is bell shaped or box; natural gamma curve shows strong negative anomalies, microelectrode amplitude difference is big, indicating good permeability; the resistivity curve is in the medium range. The lithology of the main flow is mainly dominated by brown mudstone, and the natural potential and gamma curves are slightly lower or linear. The difference of the sedimentary characteristics between the front sheet sand and estuary dam are obvious, the natural electric potential curve is in the shape of the finger and the dentate. The main lithology of the estuary dam is the silt, and the log curves are in the middle of the high amplitude funnel type.

By describing the deposition signs, combined with the sedimentary characteristics of member4+5 and member6 formation, determine that member4+5 and member6 formation in Zhaike and north of Danba area can be divided into 1 sub facies and 4 micro phases (Tab.2).

Tab.2 The depositional system table of member4+5 and 6 layer in Zhaike and north of Danba area

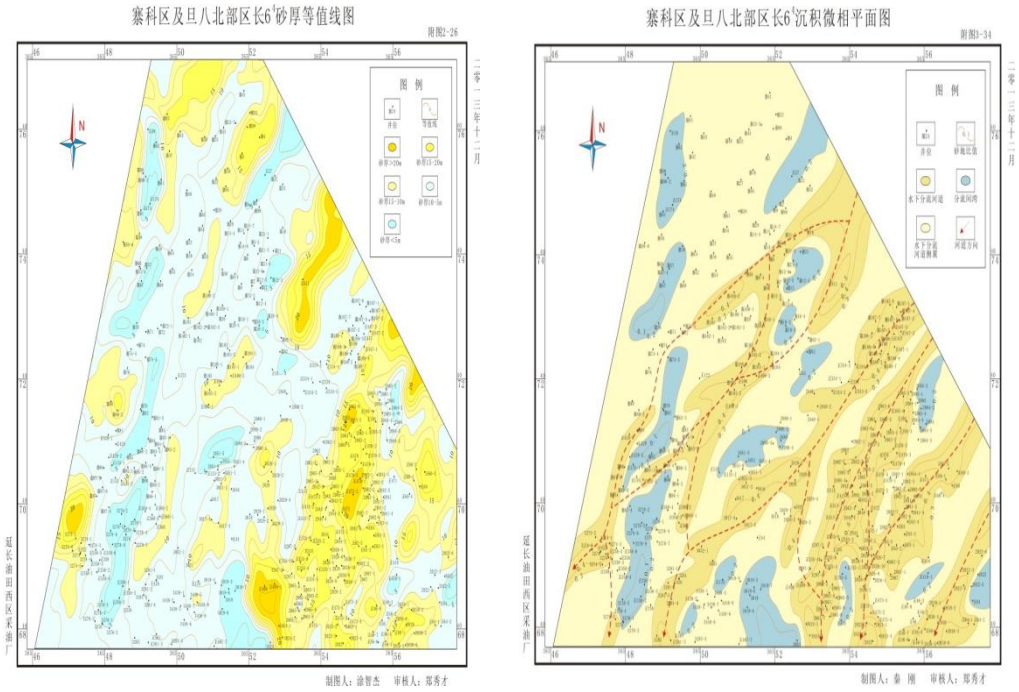
Facies	Sub facies	Micro-facies
Delta	Delta front sub facies	Underwater diversion channel
		Estuary dam
		Front sheet sand
		Shunt Bay

2.3 The distribution of sedimentary microfacies

According to the comprehensive analysis of the core data, the vertical evolution of the member4+5 and 6 sedimentary micro facies is characterized by a variety of micro facies. The member4+5 and 6 constitute a delta front sub facies retrograde deposition: underwater distributary channel microfacies→underwater shunt bay→sand sheet microfacies, the sequence of granularity gradually becomes smaller from the bottom up, also the bedding structure will change accordingly.

Of member6 formation, the shrinking of the lake basin, basement started to uplift, deposition rate is greater than the settling rate, deposition was enhanced gradually, around the delta rapid development into the construction of high type delta phase. Member4+5 period, compared to member6 period, the deposition pattern is about the same, the different is that the delta front deposition is shrinking, the supply of debris is weakened, and the basin is in a state of compensation.

Sedimentary microfacies distribution in plane from northeast to southwest is underwater distributary channel microfacies→underwater shunt bay→front sheet sand, reflecting the main reservoir space variation. Because of the limited scope of the study area, it is difficult to see the whole picture of the plane distribution, but the distribution of sedimentary microfacies confirms the conclusion that the former is mainly from the northeast to the southwest.



(a) (b)

Fig.1 Sand thickness contour map(a) and sedimentary phase map(b) of the member 6(1) of Yanchang formation in Zhaike and north of Danba area

(1)The member6-4 layer mainly are underwater diversion channels and flank of underwater diversion channels, and its underwater distributary channel along the northeast to southwest direction distribution, concentrated in the Zhai 15, Zhai 16, Zhai 5, Zhai 8, Zhai 105, Zhai 107-1, Zheng334, Zheng 2028, Zheng 2063-1, Zheng 470, Zheng 2042, Zheng 63 well area. Lithology is mainly fine sandstone, and its thickness range is 7-24m, the average thickness is 9m (Fig.1).

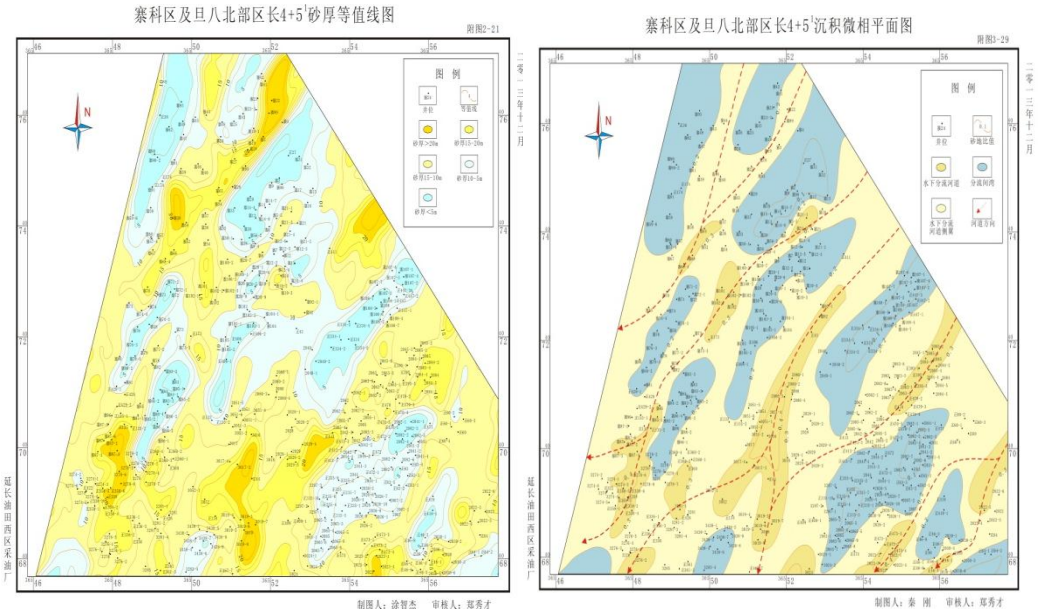
(2) The member6-3 layer mainly are underwater diversion channels and flank of underwater diversion channels, and its underwater distributary channel along the northeast to southwest direction distribution, concentrated in the 2040, 2080, 2005, Zhai108-7, Zheng335-2, 2084, 2082 well area. Lithology is mainly fine sandstone and siltstone, and its thickness range is 4-25.4m, the average thickness is 7.5m.

(3) The member6-2 layer mainly are underwater diversion channels and flank of underwater diversion channels, its underwater distributary channel along the northeast to southwest direction distribution, concentrated in the Zhai 15, Zhai 16, Zhai 8, Zhai 108, 2028, Zheng60-1, Zheng63, well area. Lithology is mainly fine sandstone and siltston, and its thickness range is 9-29.5m, the average thickness is 9.4m.

(4) The member6-1 layer mainly are underwater diversion channels and shunt bay, its underwater distributary channel along the northeast to southwest direction distribution, concentrated in the Zheng32, Zhai56, Zheng411, Zhai104, Zhai 108, 2040, 2022, Zheng 64-1, Zhai85, Zheng44 well area. Lithology is mainly fine sandstone and siltston, and its thickness range is 1-38m, the average thickness is 17.3m.

(5) The member4+5-2 layer mainly are underwater diversion channels and shunt bay, its underwater distributary channel along the northeast to southwest direction distribution, concentrated in the Zhai 15, Zhai 101, 2028, Zheng470 well area. Lithology is mainly fine sandstone and siltston, and its thickness range is 1-30.6m, the average thickness is 12.1m (Fig.1).

(6) The member4+5-1 layer mainly are shunt bay, its development of the underwater distributary channel is poor, concentrated in the 3016, Zheng395 well area. Lithology is mainly fine sandstone shale, and its thickness range is 1-30.5m, the average thickness is 8.9m (Fig.2).



(a) (b)

Fig.1 Sand thickness contour map(a) and sedimentary phase map(b) of the member 4+5(1) of Yanchang formation in Zhaike and north of Danba area

III. CONCLUSION

The sedimentary facies of the member 4+5 and 6 of yanchang formation in Zhaike and north of Danba area mainly are delta front sub facies, its provenance direction are northeast towards southwest. This paper, based on several methods like structure, logging data and ancient biological markers, proposed that the sedimentary facies of the member 4+5 and 6 of yanchang formation in Zhaike and north of Danba area can be divided into 4 types micro-facies, such as underwater diversion channel, estuary dam, front sheet sand, underwater shunt bay. In all, the sedimentary facies of the member 4+5 and 6 of yanchang formation in Zhaike and north of Danba area are delta front sub facies, its obvious sign is the development of the underwater diversion channel and estuary dam is not development.

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