Study on sedimentary microfacies and sand body distribution of Chang 8 oil reservoir group in Xunyi area, southern Ordos

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Abstract. Geological surveys were conducted in this area as early as the 1960s. Only a few wells were drilled in the 1970s, and there will be no large-scale exploration in the future. It is currently difficult to meet the need for further exploration. The provenance direction of the Chang 8 reservoir in this area is still controversial, the sedimentary microfacies characteristics and sand body distribution are unclear, and the development law is unclear. Therefore, the subsequent exploration and development process of Chang 8 reservoir in this area is greatly affected. Therefore, it is urgent to carry out research on sedimentary microfacies and sand body distribution. This paper studies the distribution of sedimentary microfacies and sand bodies of Chang 81 and Chang 82 oil layers, which provides an important basis for future reservoir research and analysis of accumulation factors, ascertaining the distribution of oil reservoirs, predicting favorable zones, and evaluating and optimizing exploration targets.

1. Introduction

The study area is located in the southern Ordos Basin, across Shaanxi and Gansu provinces, with an area of about 12,000 km², starting from Zhangjiawan in the north, Liulin in the south, Panke in the west, and Huangling in the east. The structure is located in two tectonic units of the northern Shaanxi slope and the Weibei uplift [1,2]. This paper studies the sedimentary microfacies and sand body distribution characteristics of Chang 8 reservoir in Xunyi area. Another section of your paper.

2. Regional sedimentary background

The Chang 8 sedimentary period of the Ordos Basin was controlled by four major provenance systems in the southwest, northwest, west and northeast. Among them, the northwest, northeast, and southwest are important source systems, and the west is a secondary source system. The Chang 8 sedimentary period is in the middle of the Chang 9 Lake flooding period and the Chang 7 Lake transgression period. The lake basin changes rapidly, and delta accumulation and degeneration occur in a short period of time. Therefore, the Chang 8 oil layer is divided into Chang 81 and Chang 82. Chang 82 is the process of base-level descent after the flooding period of Chang 9 Lake, and delta proliferation occurs [3-4]. Chang 81 is the period of base-level rise before the transgression of Lake Chang 7 and most of it is the period of delta regression.
3. Sedimentary facies signs
Most of Chang 8 in this area is light gray, gray subangular fine sandstone, silty mudstone intercalated with dark mudstone, and medium sandstone is seen locally. There are obvious oblique bedding, progressive positive bedding, homogeneous bedding and bottom conglomerate in medium and fine sandstone, and wave bedding and sand-grain bedding in siltstone. Wormholes and carbonized plants are common in Well C hang 8 and it is determined that the Chang 8 sedimentary period in this area should be a shallow delta sedimentary environment.

4. Granularity characteristics
The particle size probability curve of length 8 can reflect that the debris particles are between 1.90 and 5.10. The cumulative probability curve shows a "three-level" pattern of traction flow samples, and the jump is mainly divided into "two stages". The particle size characteristics indicate the effect of two-way flow (Figure 1). Generally speaking, the underwater distributary channel at the front edge of the shallow delta has such hydrodynamic characteristics.

![Probability accumulation](image)

**Figure 1** Grain size probability curve and C-M diagram of Chang 8 sandstone

The analysis of the CM map of the Chang 8 oil layer group in this area (Figure 2) shows that the C value is between 168 and 404 μm, the M value is between 82 and 237 μm, and the average value of C/M is 1.85. The formation of sampling points is roughly parallel to C=m-line bars. The gradual suspended sedimentation of traction flow.

5. Logging facies
The Chang 8 logging curves of 67 wells in this area have been studied. The results show that the SP and GR curves of Chang 8 wells are mainly shaped like a toothed bell, and the thickness is generally between 4 to 14m; the second is a toothed box shape. The thickness is usually 11~21m, and the shape and scale of the sand body are easily formed on the front edge of the shallow lake delta (Figure 2).
6. Sedimentary microfacies and distribution characteristics of sand bodies

Based on the analysis of the color, lithology, sedimentary structure, grain size characteristics and logging curve shape of the Chang 8 oil layer group, Chang 8 is determined to be a delta-lacustrine sedimentary system, and the delta front is the main one. Two types of sedimentary facies, three types of sedimentary subfacies, and seven types of sedimentary microfacies are identified from the Chang 8 reservoir group, as shown in Table 1.

| phase          | Subphase                        | Microphase                      | Developmental characteristics                                      | Identification mark                                                                                     |
|----------------|---------------------------------|---------------------------------|--------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------|
| Delta-lake     | The front edge of the delta      | Underwater diversion channel     | There are multiple sub-diversion and pooling functions              | The delta front deposits are composed of medium to fine sandstone, fine sandstone and siltstone, with mudstone interbedded, with trough, plate-like cross bedding, parallel bedding and sand-line bedding, often with sliding deformation bedding and enveloping bedding And horizontal bedding, including ostracods, leaf limbs, lobular branches, fish fossils, and plant fossil fragments |
|                | Estuary dam                      | Underdeveloped, often scoured   | Underdeveloped, often scoured and reformed by the submerged diversion channel in the later period |                                                                                                                                                              |
|                |                                 | and reformed by the submerged    |                                                                 |                                                                                                                                                              |
|                |                                 | diversion channel in the later   |                                                                 |                                                                                                                                                              |
|                |                                 | period                           |                                                                 |                                                                                                                                                              |
|                | Far sand dam                     | The end of the delta front       | The end of the delta front extending to the lake is mostly siltstone with a small thickness |                                                                                                                                                              |
|                |                                 | extending to the lake is mostly  |                                                                 |                                                                                                                                                              |
|                |                                 | siltstone with a small thickness |                                                                 |                                                                                                                                                              |
|                | Diverging channel flanks         | Mostly submerged embankment      | Mostly submerged embankment flood deposits                          |                                                                                                                                                              |
|                |                                 | flood deposits                   |                                                                 |                                                                                                                                                              |
|                | Diversion bay                    | Often separated by a network of  | Often separated by a network of underwater diversion channels      |                                                                                                                                                              |
|                |                                 | underwater diversion channels    |                                                                 |                                                                                                                                                              |
|                | Shallow lake mud                 | Deposited with horizontal       | Deposited with horizontal bedding dark to dark gray mudstone, silty  | The lithology is fine, dominated by mudstone, and the color is mostly gray and dark gray. There are often fishes, lobulins, leaf limbs and ostracods, and plant fossil fragments are also seen. The natural gamma curve is basically low amplitude, tooth-like, with low spikes |
|                | /Front Delta Mud                 | bedding dark to dark gray        | mudstone or argillaceous siltstone mainly                           |                                                                                                                                                              |
|                |                                 | mudstone or argillaceous         |                                                                 |                                                                                                                                                              |
|                |                                 | siltstone mainly                 |                                                                 |                                                                                                                                                              |

6.1. Chang 82 sedimentary microfacies and sand body distribution

As shown in Figure 3, it is jointly controlled by the southern provenance and the southwestern provenance. There are 6 underwater distributary channels entering the study area: Xunyi-N 71 well area, 0.94-12.87km wide and 14.00-22.40m sand thickness; Xunyi Z 65 well has a width of 0.22-9.52km and a well thickness of 14.00-24.0. m; the Luoshan area of N 29 is 0.86～4.58km wide, and the sand...
thickness is 14.00~32.70m. The inflow area of the two underwater distributary channels is about the intersection of N 28 and N 88 well.

![Figure 3 Distribution of Chang 82 sedimentary facies and sand bodies](image)

There are 10 irregular diversion bays, of which 3 are larger, with an area larger than 220km$^2$, and the remain have a larger area of about 11-24km$^2$.

The underwater distributary channel flanks are distributed between the underwater distributary channel microfacies and the interdistributed bay microfacies, mostly in the southwest and west of the area, with a width of about 1.51-17.27km and a sand body thickness of 6-15.9m.

6.2. Chang 81 sedimentary microfacies and sand body distribution

It is controlled by provenance in the south, southwest and northeast. There are 4 underwater diversion channels entering the study area: N 201 Zheng 71 well area, 1.65~14.53 km wide and 15~23.90 m thick; N 51 well and N 41 well area, well width 1.74~3.49 km, sand thickness 15~17.70m; T1-N 73 well area, the well width is 1.1-19.3km, the sand thickness is 15-22.5m; the width of the T 19 to the north of Luoshanfu is 4.29-22.50km, and the sand thickness is 15.00-22.50m. There are two underwater distributary channels that enter the study area, which converge in the area from Well N 73 to Well N 39 north of Luoshan Prefecture. There are 5 irregular diversion bays, of which 3 are larger than 270km$^2$ and 2 are smaller, with 106.74km$^2$ and 68.53km$^2$ respectively.

The side of the underwater distributary channel is distributed between the underwater distributary channel microfacies and the interdistributed bay microfacies. The most developed area in the north-central part of the study area is 1.4~20.74km wide and 5~14.6m sand thickness.
Figure 4 Distribution of Chang 81 sedimentary facies and sand bodies

The distribution of sedimentary facies and sand bodies of the Chang 81 reservoir in this area is generally distributed in an irregular band. The sand rate of Chang 81 is 0.01 to 0.62, with an average of 0.27. The number of wells with a sand ratio greater than 0.4 accounted for 5.45%, the number of wells with a sand ratio between 0.2 and 0.4 accounted for 36.63%, and the number of wells with a sand ratio less than 0.2 accounted for 53.61%; the cumulative thickness of the sand body was 2-30m, with an average of 11.2m. The number of wells with a thickness of 20m accounted for 8.32%, the number of wells with a thickness of 13-18m accounted for 21.46%, the number of wells with a thickness of 11-16m accounted for 24.22%, and the number of wells with a thickness of 10m accounted for 42.51%; the thickness of a single sand body was 1.60m-15.30m, with an average of 3.5m. In general, the average value of the total thickness of the sand body is slightly smaller than that of the single sand body, and the average value of the total thickness of the sand body is basically the same as that of the single sand body (Table 2).

Table 2  Statistics of sand-to-ground ratio and sand thickness of each layer of Chang 8 in the study area

| Stratum                  | Chang81        | Chang82        |
|--------------------------|----------------|----------------|
| Range of sand-to-ground ratio (m) | 0.01 ~ 0.62 | 0.01 ~ 0.72 |
| Average sand to land ratio (m) | 0.27 | 0.20 |
| Accumulated thickness range of sand body (m) | 2.00 ~ 32.00 | 2.00 ~ 38.90 |
| Average cumulative thickness of sand body (m) | 11.2 | 8.60 |
| Single sand body thickness range (m) | 0.50 ~ 15.3 | 0.50 ~ 23.4 |
| Average thickness of single sand body (m) | 2.80 | 2.81 |

7. Conclusion

(1) From the lateral view of the Xunyi-Chang 8 reservoir group, the underwater distributary channel sand bodies and the remote sandbar sand bodies of the delta front interweave in the diversion bay, surrounded by shallow lake subfacies.

(2) On the plane of Chang 8 oil layer group in Xunyi area, there are delta front and shallow lake subfacies. Multiple underwater distributary rivers in the study area converge and diverge. The flanks of the underwater distributary channel are relatively developed. The diversion bay
is irregular in shape and distributed around the diversion bay. Shallow lakes are distributed in the middle and northeast. The size of Chang 81 sand body is larger than that of Chang 82 sand body.

References
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