

Study on reservoir characteristic and sedimentary facies of Chang 8 Oil-bearing Formation in Wuqi-Dingbian area, Ordos Basin

Yuhai Fan^{1,2*}, Hui Wang¹, Xingke Yang², Wenbo Wang² and Furong Tan¹

¹Geological Exploration Institute of Aerial Photogrammetry and Remote Sensing Bureau, Xi'an, 710054, China

²School of Earth Science and Land and Resources, Chang'an University, Xi'an 710054, China;

*Corresponding author e-mail: 170269854@qq.com

Abstract. Recent few years great breakthroughs have been made in oil exploration activities at Chang 8 Oil-bearing of Yanchang Formation in southwest and south-mid of Ordos basin, several hundred million geological oil reserves have been confirmed. Therefore, it is of great value to study reservoir characteristic and sedimentary facies at the Chang 8 Oil-bearing of Yanchang formation in Ordos basin. Taking Wuqi-Dingbian area in the middle of the west Ordos basin as an example, reservoir petrological characteristics, pore structure characteristics and physical property distribution characteristics are studied, based on routine thin section, casting thin section, particle size analysis, scanning electron microscope, mercury injection and other laboratory analysis data. On basis of petrofacies characteristics of drill cores and analysis of well logging electrofacies, it is studied by means of comparison profile of joint well sedimentary facies and distribution regulations of sandy land ratio. The results of the study show that reservoir characteristics studies have shown that the rock of Chang 8 reservoir of the study area is mainly composed of lithic feldspathic sandstone. Cementing materials is mainly composed of the authigenic clay mineral mainly consisting of kaolinite, chlorite and illite and carbonate cements consisting of ferrocalcite, calcite and dolomite. Pore types of the reservoir develops mainly intergranular dissolved pore. The result of the mercury penetration experiment suggest that the reservoir has a characteristic of low initial expulsion pressure and high median expulsion pressure. Chang 8 oil-bearing formation in Wuqi-Dingbian area develops frontal deposition of shallow water terrace type deltas, which were sourced from northwest, northeast and southwest, of which deltas frontal depositions of northwest and northeast sources are dominated. Distributions of subaqueous distributary channels of deltas front in different directions have the characteristics of becoming width and sheet like overriding along river mouth.



1. Introduction

Recent years, hydrocarbon exploration activities of Chang 8 Oil-bearing of Yanchang Formation in Dingbian area of western Ordos basin has obtained a great improvement, and a giant or super giant oilfield is expected to be developed [1-2].

Because of its greater depth, higher exploration costs, reservoir distribution regulation had not been found out. Clarifying the reservoir characteristic and sedimentary facies of Chang 8 oil-bearing of Yanchang Formation in Dingbian area can not only direct the oil exploration, but also has academic interest.

2. Regional geological outline

The study area located the Yi Shan slope western centre zone of Ordos Basin, west adjacency of Tian Huan central depression (Figure 1). Late Triassic of Ordos Basin overallly perform the northeast slow, southwest steep south-west water body with gradually deepening dustpan-like shape, the study area located norther regions of in the western middle of basin at that time [3]. A series of fluvial lacustrine terrigenous clastic rocks are deposited in Yanchang formation in the process of continuous depression and stable subsidence in the Ordos Basin [4]. According to lithology, electricity and oil-bearing property, the Yanchang formation is divided into 10 Oil-bearing formation from top to bottom. The Chang 8 oil-bearing formation has deposited a set of grey silt and mudstone interbedding. According to the sedimentary cycle, it can be divided into two sand formations: Chang 8¹ and Chang 8².

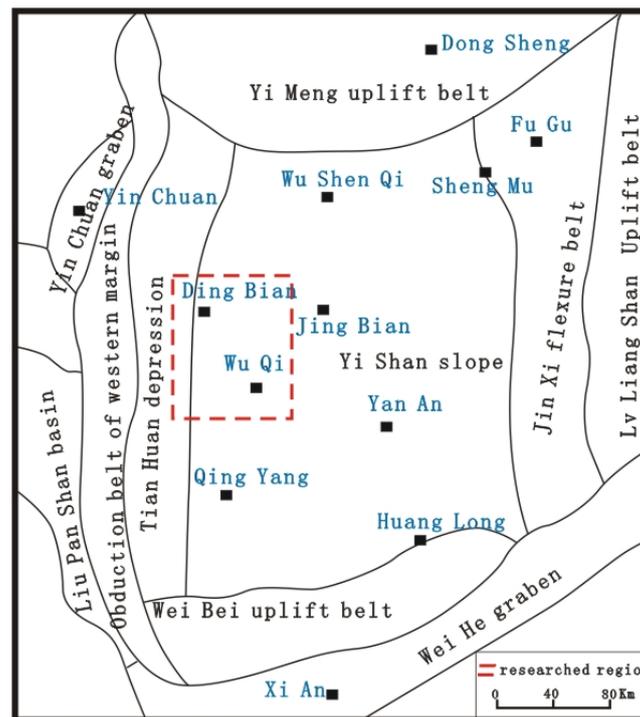


Figure 1. Tectonic location map of the researched region

3. Reservoir characteristics

3.1. Petrological characteristics of reservoir

Based on the identification and statistics of more than 90 pieces of rock in the study area, and combined with scanning electron microscopy, particle size and other data and means, the petrological characteristics of Chang 8 reservoir are analyzed. Chang 8 reservoir lithology is lithic feldspar sandstone, with a small amount of feldspar lithic sandstone (Figure 2). The grain size distribution

curve of reservoir sandstone is positively skewed and kurtosis is higher. The reservoir is mainly fine-grained sandstone with a content of 70.32%. The overall separation of sandstone is good, and the grinding circle is poor.

Interstitial material of the Chang 8 reservoir in the research area has a larger change, about 6.2%~22%, with an average of 12.39%. There are various types of cements, which are mainly composed of authigenic clay minerals (kaolinite, chlorite, illite, etc.) and carbonate cements (mainly iron calcite and a small amount of calcite and dolomite) (Table 1).

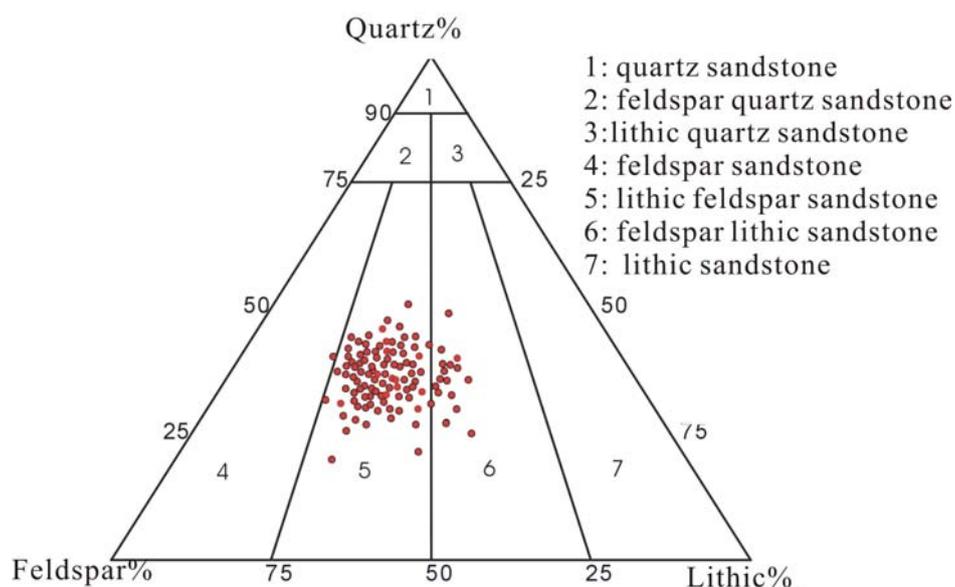


Figure 2. Triange map of the rock types of Chang 8 Oil-bearing of Yanchang Formation in Dingbian area

Table 1. The types, content and the percentage in thin sections of cements of Chang 8 Oil-bearing

Forma-tion	Percentage content	Clay mineral			carbonate cement		Lomo-ntite	Silic-eous	Feldsp-athic	other
		Kaoli-nite	Illite	Chlo-rite	Calci-te	Ferrc-alcite				
Chang 8	Percentage content in thin slices (%)	3.62	0.88	1.67	0.32	3.82	0.91	0.84	0.22	0.04
	Percentage of various types of cementation (%)	29.22	7.10	13.44	2.54	30.79	7.34	6.78	1.74	0.32

3.2. Pore structure characteristics of reservoir

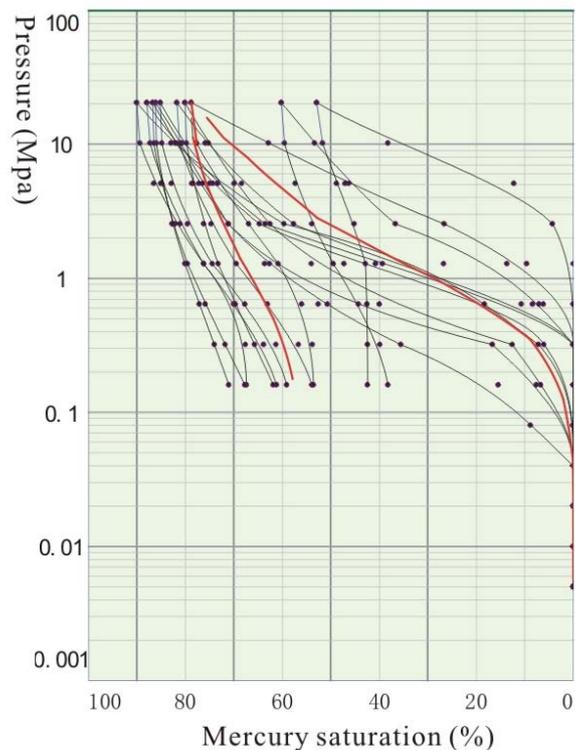
According to cast thin section data, Chang 8 reservoir pores are mainly dissolved intergranular pores, accounting for about 75.30% of total pores. The reservoir is mainly composed of small pores, accounting for 53%, followed by middle pores. Through statistical data of 20 mercury injection samples in this area, we found that the micro larynx is 43.5%, the micro throat is 34.2%, the fine throat is 16.8%, the middle and fine throat is 5.5%.

Comprehensive aforementioned data and analysis, the pore throat structures of Chang 8 reservoir are mainly small pores, micro throat or middle pore micro throat type.

Through the test data of 20 mercury injection samples in this area, it is known that the reservoir average mercury pressure capillary pressure curve has the characteristics of low displacement pressure, high median pressure and slightly skewness (Table 2, Figure 3).

Table 2. The parameter data of mercury test in the part of samples of Chang 8 Oil-bearing

Sample number (formation) characteristic parameter	4428-1 (8 ¹)	3604-3 (8 ²)	3604-5 (8 ²)	5131-2 (8 ²)	3605-1 (8 ¹)	4129-1 (8 ²)	1284-1 (8 ¹)	4806-1 (8 ¹)	4267 (8 ²)	4986 (8 ¹)
void volume(cm ³)	1.18	1.07	1.3	0.78	1.44	1.13	0.94	0.92	0.63	0.85
average(ϕ)	10.47	9.3	10.17	10.64	9.66	10.89	11.91	10.67	12.9	11.9
grading factor	1.85	2.7	2.45	1.85	2.33	1.84	1.89	1.76	0.99	1.5
Skewness	0.46	0.4	0.27	0.05	0.58	0.44	-0.44	0.63	1.12	0.26
Kurtosis	2.26	1.96	1.74	2.29	2.11	1.75	1.75	2.12	3.33	1.77
Coefficient of variation	0.18	0.29	0.24	0.17	0.24	0.17	0.16	0.16	0.08	0.13
Median pressure(Mpa)	1.48	0.59	1.1	2.19	0.63	2.03	7.85	1.8	18.5	6.08
Median radius(μ m)	0.5	1.24	0.67	0.34	1.16	0.36	0.09	0.41	0.04	0.12
Displacement pressure(Mpa)	0.29	0.06	0.14	0.27	0.13	0.58	0.55	0.51	2.79	0.97
Maximum pore throat radius(μ m)	2.5	11.69	5.27	2.71	5.53	1.27	1.34	1.44	0.26	0.76
Mercury removal efficiency (%)	30.39	17.61	22.68	25.22	21.93	34.11	36.53	30.57	19.9	32.0
Volume ratio of optic hole and larynx	2.29	4.68	3.41	2.97	3.56	1.93	1.74	2.27	4.02	2.12
Average capillary radius(μ m)	0.71	3.20	1.43	0.77	1.69	0.55	0.36	0.59	0.08	0.25
Homogeneity coefficient	0.21	0.17	0.18	0.19	0.22	0.33	0.17	0.32	0.24	0.24
Unsaturated pore volume percentage (%)	12.15	13.84	19.98	9.95	13.27	18.26	39.78	14.90	47.1	21.3

**Figure 3.** The capillary pressure curves map of pressure mercury and average pressure mercury (red line) of the reservoir of Chang 8 Oil-bearing

4. Sedimentary facies distribution

According to the study of provenance and paleodirection, the Chang 8 oil-bearing formation is mainly influenced by the northwest and northeast provenances[5]. On the basis of the previous research results, based on the rock facies marks observed by the core and the well logging analysis of the well section, the comparative profile of the sedimentary facies in the study area is drawn (Figure 4). By using the distribution regulations of sandy land ratio, the plane distribution of sedimentary facies of Chang 81 sand group and Chang 82 sand layer is determined (Figure 5).

Subaqueous distributary channel of delta front from Chang 81 to 82 has obvious trend of progradation (Figure 4). In large lake basins, with the filling effect of the lake basin, the delta system tends to have regular evolution trend in time.

Chang 8 oil-bearing formation in Wuqi-Dingbian area develops frontal deposition of shallow water terrace type deltas, which were sourced from northwest, northeast and southwest, of which deltas frontal depositions of northwest and northeast sources are dominated. Distributions of subaqueous distributary channels of deltas front in different directions have the characteristics of becoming width and sheet like overriding along river mouth (Figure 5), which is the same as the development characteristics of the shallow platform delta front [6].

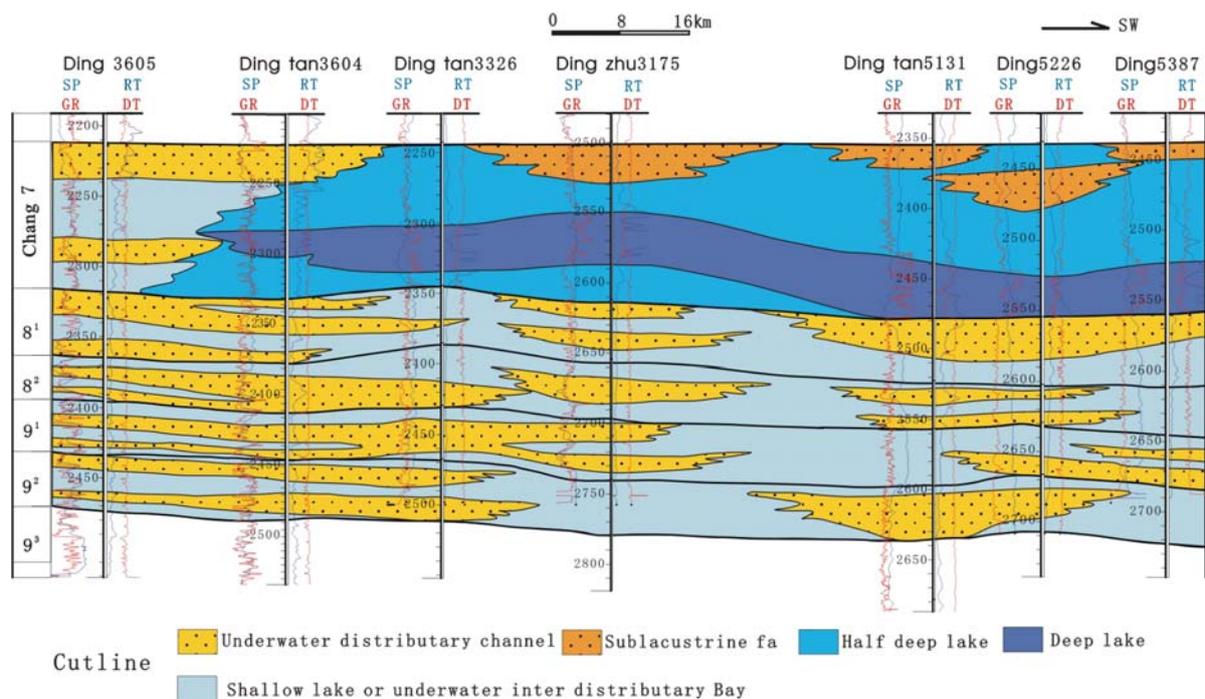


Figure 4. Progradation of subaqueous distributary channels along northeast direction provenance in Chang 8 oil-bearing formation

5. Conclusion

Reservoir characteristics studies have shown that the rock of Chang 8 reservoir of the study area is mainly composed of lithic feldspathic sandstone. Cementing materials is mainly composed of the authigenic clay mineral mainly consisting of kaolinite, chlorite and illite and carbonate cements consisting of ferrocalcite, calcite and dolomite.

Pore types of the reservoir develops mainly intergranular dissolved pore. The result of the mercury penetration experiment suggest that the reservoir has a characteristic of low initial expulsion pressure and high median expulsion pressure.

Chang 8 oil-bearing formation in Wuqi-Dingbian area develops frontal deposition of shallow water terrace type deltas, which were sourced from northwest, northeast and southwest, of which deltas

