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Diageneses and Their Influences on Reservoir Properties of Chang 2 Oil Member in Renshan Region, Zhidan Oilfield, Ordos Basin

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1 Introduction

Yanchang Formation in Upper Triassic, Ordos basin contains the most abundant hydrocarbon resources in North China (Wang *et al.*, 2014). The sandstones are the most important oil-bearing reservoirs in Yanchang Formation, and their reservoir properties are usually controlled by initial sedimentary compositions and subsequent diagenetic modifications (Mansurbeg *et al.*, 2008; Ozkan *et al.*, 2011; Jin *et al.*, 2016). Chang 2 oil member, the upper part of Yanchang Formation, characterized as layers of fluvial sandstones, siltstones, and mudstones, is one of the major productive reservoirs in Zhidan Oilfield. However, the exploitation facts show that Chang 2 reservoirs are highly heterogenetic and that seriously constrains the productive efficiency.

Here, based on cores and thin-section observations, granularity analysis, scanning electron microscope (SEM), electron microprobe analyses (EMPA), X-ray diffraction, nuclear magnetic resonance (NMR) experiments, and fluid inclusions analysis, petrological features, diageneses and diagenetic stages of Chang 2 sandstones are investigated aiming to discuss the diagenetic influences on reservoir properties in Renshan region, Zhidan Oilfield.

2 Diageneses and their influences on Chang 2 reservoir properties

2.1 Diagenetic influences on Chang2 sandstones

Renshan region lies in western part of Zhidan County, Ordos Basin, North China. Core and thin-section observations indicate that Chang 2 sandstones are mainly

grey, light grey, fine grained arcose and lithic-arcose sandstones with 23% -56.5% alkali feldspars and plagioclases, 45% -61.5% quartz, and 5% -12% detritus. The grain sizes vary from 0.125mm to 0.25 mm with medium sorting and subangular roundness. The effective pores of sandstones are composed of residual primary pores and secondary dissolution pores under microscopic and SEM analysis. The sandstones have endured diverse diageneses since burial, including mechanic compaction among clastic grains, pressure solution of quartz, clay minerals and carbonate cementation, dissolution and replacement of feldspars and detritus, and so on. The compaction and pressolution are the main reasons for decrease of original porosity and permeability. The intergranular cementation of authigenic kaolinite and calcite reduced part of intergranular pores, but the authigenic chlorite, coating on pore walls protected part of primary pores successfully to resist mechanic compactions from upper load during burial. Moreover, dissolutions of feldspars and some lithic clasts produced substantial secondary pores which improved about 3% to 8% of total effective porosity in the reservoir sandstones. The porosity of Chang2 reservoir varies from 8.0% to 30.3%, average of 16.45%; while the permeability changes from several to thousands of millidarcies possibly because of tectonic fractures. The nuclear magnetic resonance (NMR) data shows faint bimodal pattern, the main peak locating in the right side of T₂ cutoff time, another peak in the left side, which indicate relative large pores and good connectivity of pore throats in sandstone reservoirs (Fig. 1).

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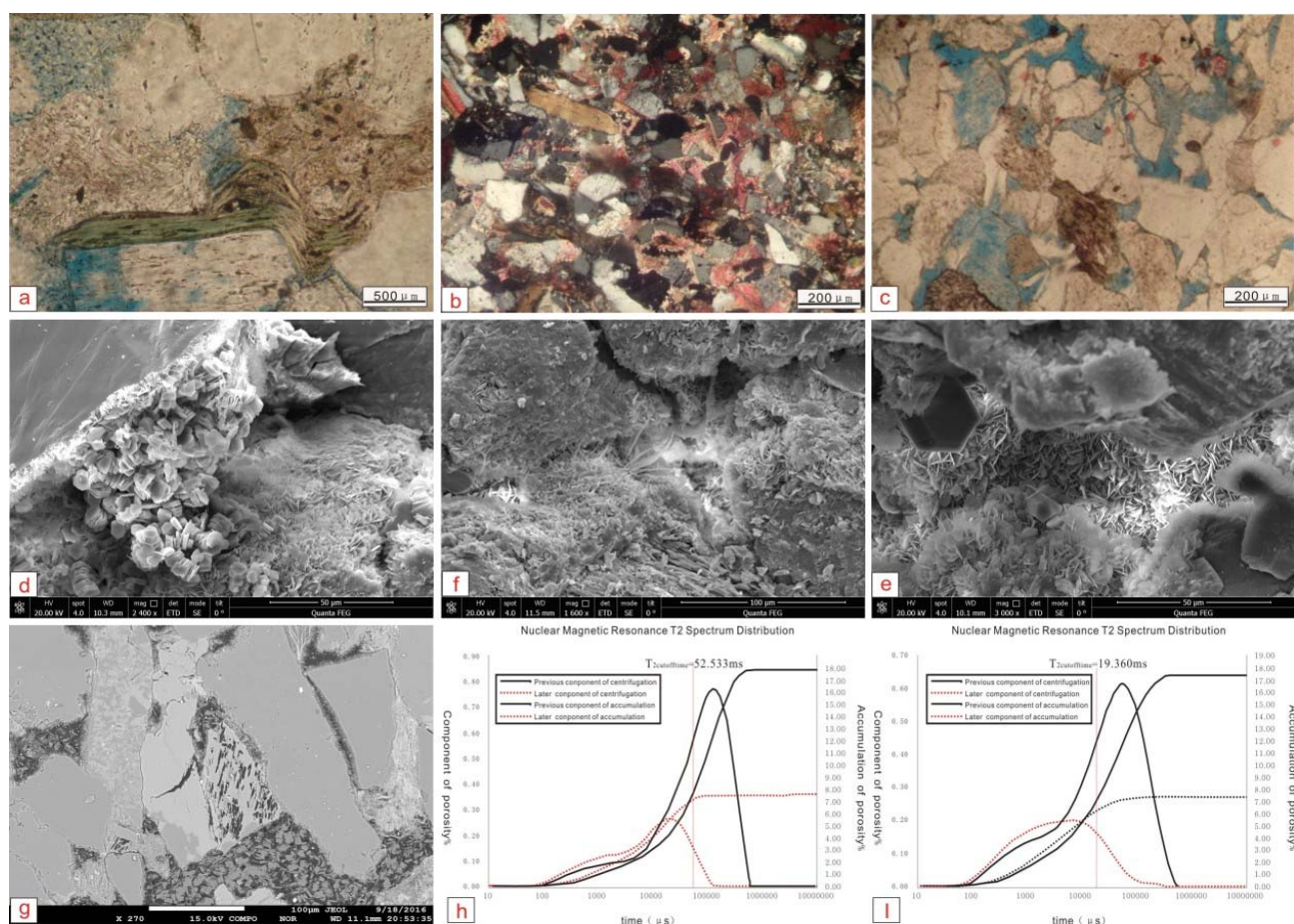


Fig. 1. Microphotographs of Chang 2 sandstone reservoirs in Renshan region, Zhidan Oilfield. (a), Deformation of biotite, $\times 40$, plane-polarized light; (b), Cementation of calcite, $\times 10$, cross-polarized light; (c), Dissolution of feldspars, $\times 10$, plane-polarized light; (d), Aggregations of authigenic kaolinite, $\times 2400$, SEM; (e), Authigenic quartz and chlorite in the residual pores, $\times 1600$, SEM; (f), Authigenic chlorite and illite, $\times 1600$, SEM; (g), Dissolution of feldspar and authigenic kaolinite, $\times 270$, EPMA; (h), Nuclear magnetic resonance (NMR) patterns of Chang 2 sandstone reservoirs; (i), Nuclear magnetic resonance (NMR) patterns of Chang 2 sandstone reservoirs.

2.2 Diagenetic stage

The homogenization temperatures of fluid inclusions on quartz surface range from 84°C to 198°C , mostly in the zone of 110°C to 160°C . There is obvious overgrowth along detrital quartz edges according to microscopic and EMPA analysis. X-ray diffractions shows main clay minerals of authigenic kaolinite (18%~58%), chlorite(29% 98%), illite(1% 10%) and illite/smectite mixed-layers (5% 11%). Authigenic illite crystallinity ranges from 0.56 to 0.74. Such quantitative and semi-quantitative date indicate that Chang 2 oil sandstones have been in early time of middle diagenetic stage.

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