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Analysis on Preferred Flowing Path in Shallow Water Delta Front Based on Reservoir Architecture

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1 Introduction

The shallow water delta reservoir in South Wen 79 Block is in the stage of high water-cut stages, and is still on the rise. The degree of recovery is low, preferred flowing path is developed and surplus oil is generally distributed with local enrichment (Zhang, 2009). The potential of surplus oil is considerable, while the difficulty is also great. And the basis of effective tapping for remaining oil is to figure out the regularities of distribution. However, the precondition is the identification of preferred flowing path and the effective control for the movement of fluid (Gong et al., 2014). Therefore, it is urgent to identify the preferred flowing path of the $Es_2$2 in South Wen 79 Block.

With many years of waterflooding on sandstone reservoir, the appearance of preferred flowing path increased the heterogeneity of reservoir, resulting in a large number of invalid circulations of injected water (Zhang et al., 2013). Thus overwhelmingly reducing the availability of water injection rate, reducing the water flooding volume as well as increasing difficulty of reservoir development. With the increasing rate of water content in reservoir, water-oil ratio increases sharply and the recovery factors reduce. Meanwhile, a series of problems such as sewage treatment are brought forward (Sun, 2015). With the investment and cost of oilfield development increasing, the economic and social benefits are becoming worse. Consequently, the identification of preferred flowing path is the key to reduce the adverse effects on the oilfield development with the premise and foundation of application for the plugging and modification technology (Yin et al., 2014).

2 Geological setting

The South Wen 79 Block is located in the southern part of the central uplift of Dongpu Depression, between the graben zone of east part of Wendong fault and weat Xulou fault. It is a fault-lithologic reservoir with NNE trending. Previous researches showed that sedimentary environment of $Es_2$2 in South Wen 79 Block is intermittent lake facies under the effects of seasonal climate. The mainly developed sandbodies are within shallow water delta system, belonging to the underwater delta front subfacies. The principle sedimentary body is underwater distributary channel sand, underwater distributary channel flank sand and front sand (Xiong et al., 2003; Huang et al., 2004).

In view of the importance of the identification of the preferred flowing path, magnanimous researches have been undertaken at home and abroad with plentiful achievements. However, there are also many problems remained. Researches from abroad are mainly based on the characteristics of oilfield production data as well as using tracers, and make them applied to the field site. But the formation and mechanism are relatively limited. While in China, the research on the quantitative assessment for the preferred flowing path is relatively mature, whilst the research on effective methods to identify is relatively week. Especially for the shallow water delta front facies in South Wen 79 Block, which is a reservoir with serious heterogeneity reservoir. There is still no mature method. Currently the common methods used for identification and description of preferred flowing path are these follows, Wang Xiang et al. (2011) put forward the identification method based on logging technology. Wei (2008) put forward the identification method of well logging profile recognition. Zhao Xiaoqing et al. (2009) figured out the method of logging interpretation with carbon oxygen spectral logging curves. These methods with logging data to identify the preferred flowing path may have relatively

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large deviation, although fuzzy identification of quantitative technology is relatively simple, the subjectivity is stronger.

3 Method

Based on the above problems, this paper makes a research on the reservoir of $Es_2$3 in South Wen 79 Block. This study is different from the traditional method of the identification for preferred flowing path, which based on the reservoir architecture and the distribution of remaining oil distribution. Thus it is more close to the real seepage situation of reservoir fluid, and the ultimate confirmation of dynamic data makes this identification more accurate. Moreover, on the basis of extensive investigation of a large number of domestic and foreign literature, and combined with previous sedimentary microfacies and high-resolution sequence stratigraphic division research, this paper utilizes data of core, logging and drilling to anatomize the reservoir architecture of $Es_2$3 sand group. Based on the identification of internal reservoir architecture, the possible buffer zones and high permeability channels are forecasted. And through the validation with dynamic data, the final distribution of preferred flowing path gets confirmed, providing the basis for the prediction of residual oil distribution and technical support to improve the development effect.

4 Conclusion

Via the study for the preferred flowing path of reservoir of Es23 in South Wen 79 Block, the following conclusions are obtained:

1. The division scheme of configuration grading in underwate distributary channel based on deposition process is established. The internal foreset of underwater distributary channel is third grade configuration unit, the underwater distributary channel is fourth grade, while complex distributary channel is the fifth.

2. The reservoir of $Es_2$3 mainly developed with structure elements of the underwater distributary channel, underwater distributary channel flanks and delta front sheet sand.

3. Regularities of distribution of the preferred flowing path is identified. It is generally distributed in the lower part of underwater distributary channel and the bottom of underwater distributary channel flanks. The fragment distribution of preferred flowing path is less and controlled by the reservoir structure, most distribution is characterized with narrow, stripped or potato-shaped.

4. Geological factors for the form of preferred flowing path is analysed, which include: reservoir configuration characteristics (lithology, reservoir thickness and configuration of combination relation and channel vertical superimposition relationship), reservoir properties (porosity, permeability rate), reservoir heterogeneity (inner layer, interlayer and plane), oil-bearing and tentonic characteristics (dip angle) etc.

5. According to the development of dynamic data, identification technology of preferred flowing path based on reservoir configuration constraints is taken into use in the application of target layer. Therefor the identification of preferred flowing path is compared with dynamic data, showing that this method is feasible for distinguishing the reservoir preferred flowing path in this area.

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