The Sediment Characteristics, Influencing Factors and Favorable Reservoir Distribution of Braided Delta Under Different Slope Gradients: An Example from KL10 Oil Field in Bohai Bay Basin

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Abstract

The deep-buried braided delta reservoirs have an important proportion in the global oil and gas distribution, especially in China, such as the discovery of KL10 oilfield in the Bohai Bay Basin with proven reserves of more than 10 billion barrels. And characteristics and distribution of braided delta are different under different slope gradients. However, as the reservoir is deeply buried (2500 meters), and the resolution of seismic data is low, how to study the genetic mechanism of deep-buried braided delta reservoir and accurately predict the distribution characteristics has always affected the oilfield drilling. Combined with the quantitative analysis of paleogeomophology, this paper studies the sediment characteristics, influencing factors and favorable distribution area of braided delta under different slope gradients. The theory of sequence stratigraphy is applied to study the bore core, well logging and seismic data, and after studying the characteristics of reservoir, the paleotopography is then reconstructed. Study shows that the strata can be divided into a lowstand system tract (LST) and a highstand system tract (HST). Six fourth-order sequences (Q1-Q6) are identified in HST, and one fourth-order sequence (Q7) is identified in LST. At the early time of the strata (Q1-Q6), the study area are controlled by a single slope. The slope width is about 5.5 to 8.5 km, with slope gradient to be 0.8 to 1.2 °. At the late time of the strata (Q7), the slope gradually becomes gentle, with the slope gradient to be less than 0.2°. Combining the

feature of slope and sedimentary facies, the delta can be divided into two types: (A) Steep-slope delta: the slope is relatively steep (greater than 0.8°) and has a significant effect on sedimentation. The sedimentary system is mainly composed of delta front and gravity sediment. The infrequent migration of underwater channel leads the single channel to be thick deposited (5-10 m) and the reservoir properties are proved to be good (permeability is greater than 100 mD). (B) Gentle-slope delta: the slope is relatively gentle (less than 0.2°) and has a weakened effect on sedimentation. Delta front mainly develops in the study area. Due to the small accommodating space, the delta frontal underwater channel oscillates laterally, and the stacked channel thickness can reach several tens of meters. The subaqueous distributary channel has good physical properties (permeability can be greater than 500 mD). As the favorable reservoir mainly develops on the slope zone, to accurately predict the distribution of favorable reservoir, the range of slope is first depicted according to the change of slope. And the strata slice of RMS amplitude attribute is then applied to describe the distribution of the favorable reservoir within the boundary of slope. The drilling confirms that the reservoir distribution pattern under the control of slope is consistent with the actual drilling.