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Sedimentary Sequence and Evolution of Channel-Lobe in Li Wan Deep-water Areas, Baiyun Sag, Northern South China Sea

H.R.L Liu* (China University of Geosciences)

SUMMARY

Deep-water channels and lobes have become important exploration targets in Baiyun sag. Channels in LiWan deep water areas of Baiyun sag shows transformation on the morphology from type 'V' to type 'U' which illustrates the main channels' migration. Recent researched has revealed the sedimentary models of Baiyun sag, namely the model of 'delta front' to 'deep-water fan'. Furthermore, this paper classifies Zhujiang formation as one sequence which can be subdivided as LST, TST and HST. In early LST period, the morphology of channels are almost type 'V' and mainly controlled by erosion effect. Under the relative sea level decreasing quickly, lobes appear progradation. In middle LST period, morphology of channels transforms from type 'V' to type 'U'. With the relative sea level decreasing smoothly, lobes move with the channels and synchronously appear aggradation. In the later LST period, relative sea level and accommodation space increases quickly. Morphology of channels transforms from type 'U' to type 'W' and channels gradually migrate to the source direction. Meanwhile, sediment scope of lobes reduces and lobes mainly appear retrogradation. In TST and HST period, relative sea level continues to rise until over the shelf slope break belt, but gravity flow of channels relatively weakens.

Introduction

As the greatest potentiality of source rocks in South China Sea, Bai Yun sag has good exploration prospects and many similarities with successful world-class deep-water depressions. In recent years, deep-water channels and lobes have become important exploration targets in Bai Yun sag. However, the sequence-sedimentary pattern and analysis of evolution between channels and lobes are lacking. In this paper we first analyze the transformation of channels on the morphology. Then we discuss the lows in migration of channels and lobes. Finally, based on the depositional model and classical sequences stratigraphy, we discuss the evolution of channel-lobe in the study area.

Geological Setting

The study area is located in the southeast of Baiyun sag. We mainly use four main seismic sections, and also drilling data of four single wells in the Pearl River Formation, respectively named well X – 1, X – 2, X-3 and X – 4 (Fig.1)

Figure 1 location of the study area and seismic sections.

Figure 2 Amplitude extraction maps of channel and lobes.

It shows components from the seismic multi-attribute section of Pearl River Formation in Fig.2. Since the lobes and channels serve as the main reservoirs of Liwan area, they are the main contents discussed in this paper.

Table 1 Classification of types of channels.

geometry of channels	Development period	Packing style	Examples of seismic section
Type W	Early stage
Type U	Middle period	Vertical stack
		Lateral stack
Type V	Later period

Figure 3 Classification of depositional periods of channels.

Transformation on the morphology of channel

This paper divides channels into three types (Table 1). In all, morphology of channel transforms from type "V", type "U", to type "W" from the provenance to sedimentary area, which reflects that effect of erosion abates and sedimentation strengthens relatively with the decline of hydrodynamics.

Lows in migration of channel

Furthermore, focusing on comparison of sedimentary facies of Well X-1, X-2, X-3(Fig.3), evolution of channel is divided into two phases, which reflects the different phases of sedimentary filling and constantly migration of channels as active zone.

Evolution of channels and lobes

This paper divides Pearl River formation into a Megasequence. Internally, it can be subdivided into LST, TST, HST. It lays the foundation for creating the relationship between lobes and channels under analysis of relative sea level changes below. Combining with the above study and the data analysis of Well X-1, X-2, X-3, X-4, lobes present progradation, aggradation, and retrogradation with the changes of relative sea level.

Figure 4 Evolution of channels and lobes.

In early LST period (Fig.4A), the morphology of channels are almost type 'V' and mainly controlled by erosion effect. Under the relative sea level decreasing quickly, lobes appear progradation. In middle LST period (Fig.4B), morphology of channels transforms from type 'V' to type 'U'. With the relative sea level decreasing smoothly, lobes move with the channels and synchronously appear aggradation. In the later LST period (Fig.4C), relative sea level and accommodation space increases quickly. Morphology of channels transforms from type 'U' to type 'W' and channels gradually migrate to the source direction. Meanwhile, sediment scope of lobes reduces and lobes mainly appear retrogradation. In TST and HST period (Fig.4D), relative sea level continues to rise until over the shelf slope break belt, but gravity flow of channels relatively weakens. Moreover, sediment scope of lobes becomes smaller, which is filled with large-scale argillaceous sediment.

Conclusion

We propose a new way to analyze the evolution of channels and lobes. Our approach is based on the transformation of channels and lobes, on the changes of morphology of channel and on the analysis of sequence framework. It links the whole development process of lobes and channels in the study areas. We believe studies on evolution of lobes and channels within a chronological framework can help reservoir predicting in deep water exploration.

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