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Sedimentary Characteristics and Source-sink Process of Fan Delta in Nantun Formation of Beixi Area in Baer Depression

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Sedimentary Characteristics and Source-sink Process of Fan Delta in Nantun Formation of Beixi Area in Baer Depression

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Abstract. Fan delta is a very important oil and gas gathering place of continental faulted basin, to establish an accurate and reliable fan delta depositional model is of great value to predict dominant reservoir group. With the comprehensive application of core, earthquake and logging data, the typical fan delta depositional system developed in the Baer sag of the Nantun formation has been clearly defined by the fine depiction of the internal sedimentary units and phase marks of the fan. It can be subdivided into 3 subphases and 11 types of microfacies. The fan delta plain subfacies developed 3 kinds of microfacies, namely plain distributary channel microfacies, plain distributary channel microfacies, plain natural dyke microfacies. There are 6 types of microfacies developed in the fan delta front subfacies, namely, the main channel microfacies of the leading edge of the front, the microfacies of the subaqueous distributary channel in the front edge, the front edge mat microfacies, the sandstone microfacies of the estuarine dam, the sandstone microfacies of the far sand bar and the inter subaqueous microfacies of the leading edge. There are 2 kinds of microfacies in the delta facies, namely, the front delta siltstone microfacies and the front delta mudstone microfacies. The fan delta deposits in the Nantun formation of the Baer sag are mainly developed in the Beixi slope zone, the Huoduomoer tectonic belt, the Suderte tectonic belt, and so on, which are close to the steep slope of the basin margin or the control fault. According to the different characteristics, two sedimentary models of steep slope and steep slope are established.

1. Introduction

Most of the fan delta depositional systems are developed in areas with active tectonic movements, often accompanied by large-scale synsedimentary faults, mainly near-source coarse-grained sediments. Since Holmes put forward the concept of fan delta in 1965, scholars at home and abroad have done a lot of research work on it. The discussion on sequence characteristics, sedimentary characteristics, genetic mechanism and hydrocarbon accumulation law of fan delta has never stopped. The middle fan delta depositional systems in continental rifted lake basins are widely developed in China, such as Jiyang and Liaohe depressions in Bohai Bay basin, Baiyinchagan depression in Erlian basin and Liangjia structural belt in Yitong basin. Fan delta depositional system is also widely developed in Baer Sag of Hailaer Basin (Fig. 1). Although a lot of research work has been done in this area, the sedimentary characteristics and sedimentary model of fan delta in this area are seldom reported. This paper expounds the sedimentary characteristics of the fan delta of Nantun Formation in the study area from the aspects of lithofacies types, facies identification and bedding types, and establishes corresponding sedimentary models according to different characteristics, so as to have guiding significance for oil and gas exploration and development in the fan delta deposits of the study area.



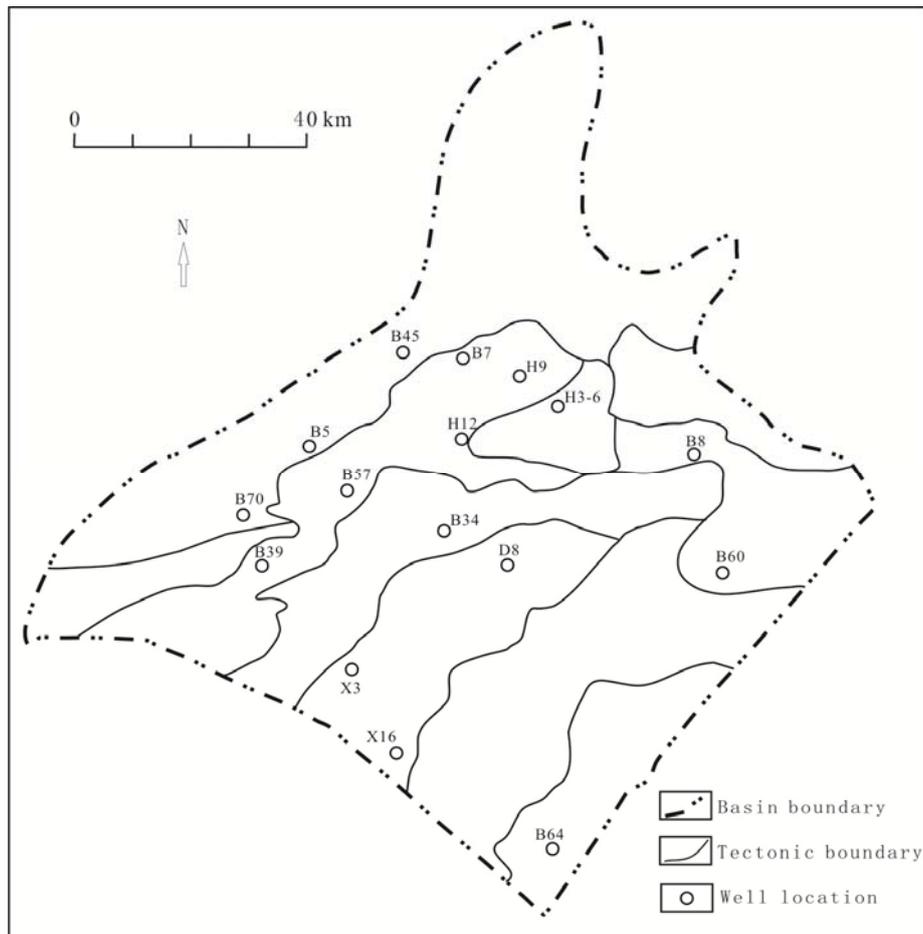


Figure 1. Partition map of Baer depressions source analysis

2. Identification Marks of Fan Delta Facies

Identification and confirmation of Paleo-sedimentary environment is mainly based on the analysis and study of core color, lithologic composition, structure, vertical cycling and other characteristics. In this study, 57 drilling cores and 1200 rock slices in the study area were observed and described, combined with logging, seismic response characteristics and tectonic background. The sedimentary characteristics of fan delta of Nantun Formation in the study area are discussed.

The main rock types of fan delta deposits in Nantun Formation are clastic rocks, including mudstone, siltstone, sandstone and conglomerate, of which conglomerate accounts for 65%, sandstone 25%, siltstone and mudstone 5% respectively. The sandstones are mainly lithic sandstones with a small amount of feldspar lithic sandstones. The compositional maturity of the sandstones is low, which reflects the typical near-source rapid accumulation characteristics of fan delta deposits (Fig. 2).

According to the core of Nantun Formation in Baer Sag, the rock types in this area can be divided into 4 types and 6 sub-types according to grain size, color, sedimentary structure and grain support mode. Particle support is the main support mode and occasional hetero-base support. Depositional structures are divided into block bedding, trough cross bedding, plate cross bedding, parallel bedding and horizontal bedding according to bedding. Different rock types reflect different Paleo-sedimentary environments at that time, and the author gives a brief description and genetic analysis of these rock types.

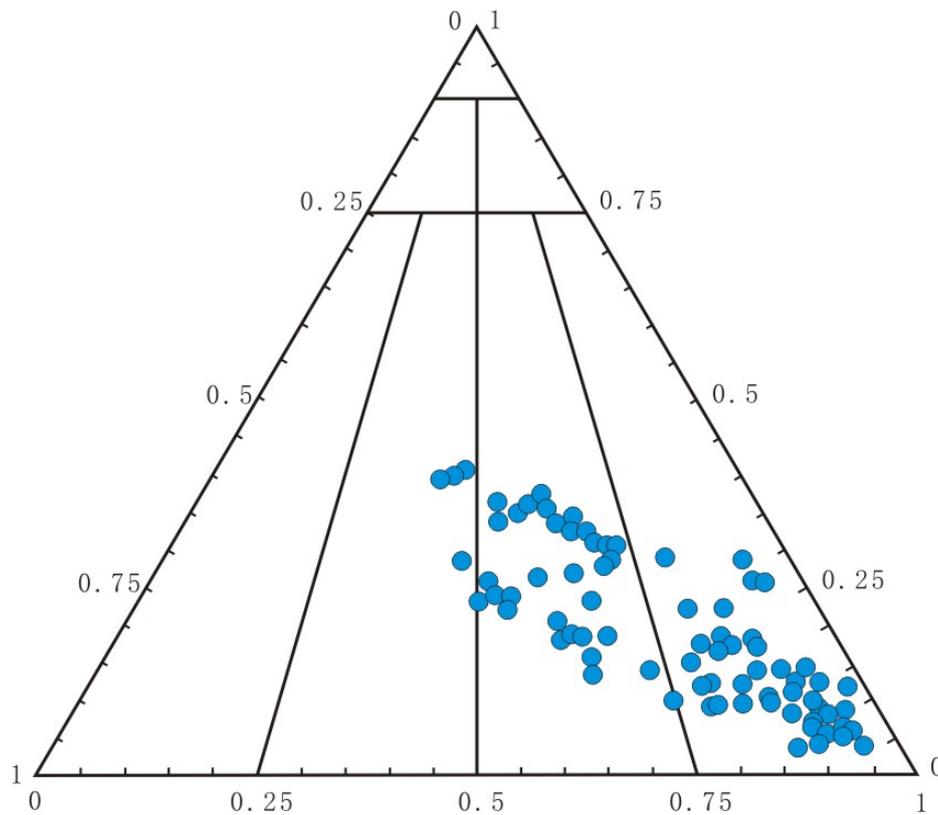


Figure 2. Classification triangulation of clastic rocks in Beier Depression

3. Granularity Characteristics

The structural characteristics of grain size can directly reflect the hydrodynamic conditions and energy intensity of sedimentary medium during its formation, so it is the basis of judging sedimentary environment and hydrodynamic conditions and delicately dividing sedimentary facies. Through detailed analysis of the grain size probability curves of typical coring wells in Nantun Formation, it is found that the cumulative grain size probability curves of fan delta sediments in this area can be divided into three types: (1) a section (Fig. 3a, 3b): the grain size interval has a large span and only suspended transport component, jump transport component and roll are developed. There is no development of dynamic transport components. The results show that the rocks are widely distributed, poorly sorted and blurred cut-off points, formed in a sedimentary environment with high energy, fast migration and strong hydrodynamic conditions. All the sediments are suspended load, which is a typical feature of gravity flow deposition and reflects the grain size characteristics of the near source of fan delta plain. (2) Two-stage (Fig. 3c, 3d): It has obvious sedimentary characteristics of river course. The content of rolling component is low (< 5%). It consists of jumping and suspending components. The content of jumping components is higher, about 55% - 75%. (3) Three-stage (Fig. 3e, 3f): The curve consists of a rolling population with a lower slope, a jumping population with a higher slope, and a suspension population with a lower slope. The sorting is better, reflecting the grain size characteristics of the sediments in the far end of the front of the fan delta after repeated washing and reforming by the lake waves.

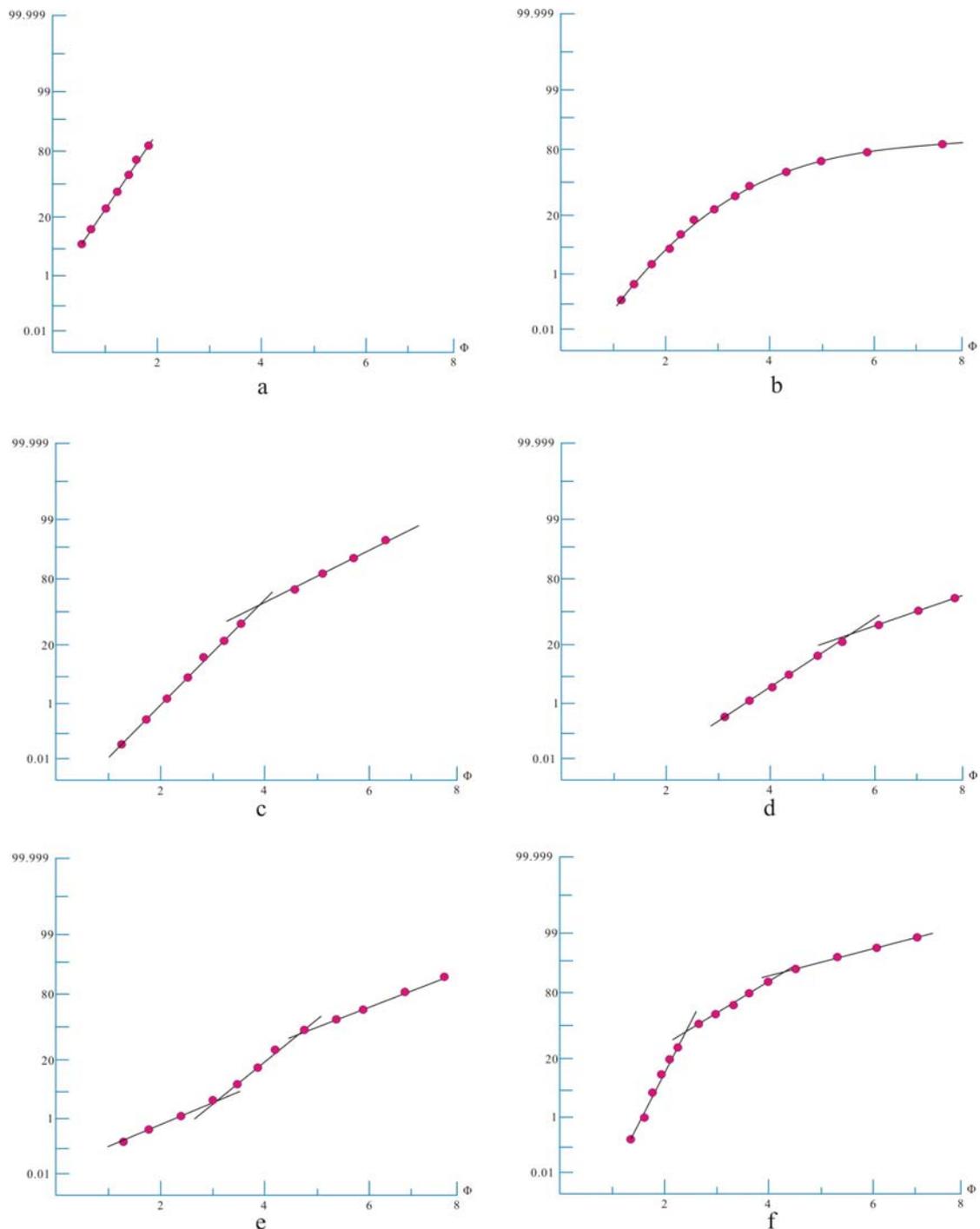


Figure3. Grain-size accumulated probability curve of delta in Baer Depression

4. Logging Facies Characteristics

Different sedimentary bodies have different characteristics and reactions in logging data. Therefore, sedimentary facies of non-core section can be studied based on more abundant logging curve data on the basis of establishing rock-electricity correspondence relationship, which can make up for the lack of core data and restore Paleo-sedimentary environment better. Commonly used logging curves are natural gamma, spontaneous potential, bilateral resistivity, and acoustic time difference and so on. Logging responses are often box-shaped, toothed box-shaped, bell-shaped, toothed bell-shaped, funnel-shaped and finger-shaped, and show different amplitudes of low, medium and high.

In this study, based on the study of sedimentary facies types, combined with rock types, lithologic associations, sedimentary structures and logging curves, log facies recognition charts of 10 main sedimentary microfacies in fan delta sedimentary system, such as fan delta plain distributary channel microfacies, are established, which are characterized by thick heterogeneous layers in lithology. The sandy conglomerate sandwiched with thin mudstone shows low gamma-high resistivity and high bell-shaped or box-shaped in electrical properties, and the sandy conglomerate with gray-green or variegated lithology, thick layer, good sorting and grinding circle, and mainly supported by granules, and low-to-medium gamma and medium-to-high resistivity in the front underwater main channel. The whole is a medium high gear toothed box or bell type.

5. Conclusion

There are typical fan delta depositional systems in Nantun Formation of Baer Sag, which can be divided into 3 types of subfacies and 11 types of microfacies. Three types of microfacies are developed in fan delta plain subfacies, namely plain distributary channel microfacies, plain distributary channel interfacies and plain natural levee microfacies. Channel microfacies, front underwater distributary channel microfacies, front sheet sand microfacies, estuary bar sandstone microfacies, distal bar sandstone microfacies and front underwater distributary interfacies; front delta subfacies developed two types of microfacies, namely front delta siltstone microfacies and front delta mudstone microfacies.

6. References

- [1] Holmes A. Principles of Physical Geology [M]. London: Nelson, 1965.
- [2] Ji Youliang, Li Qingshan, Wang Yong, et al. Fan delta sedimentary system and facies models of Dainan Formation of Paleogene in Gaoyou sag [J]. Journal of Earth Sciences and Environment, 2012, 34 (1): 9-19.
- [3] WangTong, Jiang Zaixing, Zhang Yuanfu, et al. Sedimentary characteristics of transgressive fan delta of Shahejie Formation of Eocene in LuoJia area [J]. Petroleum Geology and Recovery Efficiency, 2008, 15 (1): 47-49.
- [4] SunYu, Ma Shizhong, Jiang Hongfu, et al. Sedimentary mode of shallow lacustrine fluvial-dominated delta of Putaohua reservoirs in the Sanzhao depression, Songliao Basin [J]. Acta Geologica Sinica, 2010, 84 (10): 1502-1509.
- [5] FENG Youliang, ZHOU Haimin, REN Jianye, et al. Paleogene sequence stratigraphy in the east of the Bohai Bay Basin and its response to structural movement [J]. SCIENCE CHINA Earth Science, 2010, 40 (10): 1356-1376.