Provenance Characteristics of Nantun Formation in Baer Depression and its Dominate of the Depositional System

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Abstract. Fine depicting of antiquity source environment is of great significance of depositional systems restoration, finding the dominant sandstone development zone and forecasting exploration target areas. This paper uses data such as palaeo-geomorphology, seismic attributes, heavy minerals and sandstone present, to analyse and depict the source system of Nantun Formation sedimentary period from different angles and levels. It shows that the provenance of Nantun period in Baer Depression is mainly from the slope zone around the depression and low bulges in the basin, converging from the basin to the center. The direction of the main source of N1 and N2 sedimentary period have obviously inheritance. There are 9 major source systems in Nantun formation of Baer depression which is developing sedimentary environment such as fan dalta and sublacustrine facies.

1. Introduction

Source analysis is one of the most important researching content to analyze petroliferous basin. It's important evidence to restore archetype of sedimentary basin, and to ensure the paleoenvironment of the sedimentary period. Nowadays the methods to analyze provenance is increasing, the accuracy of prediction is gradually improving, and the complement between each other is becoming more and more perfect [1-2].

The heavy mineral analysis, sedimentology, clastic rock analysis, seismic analysis, geochemical or isotopic methods are used in the study of the predecessors, while its main developing direction to analyze provenance with a variety of means, and reducing the one sidedness of single method analysis. The predecessors have done a lot of work on Baer Depression formation and deposition, while the research on provenance is relatively weak. It influences the understanding of the distribution characteristics of the depositional system to some extent; furthermore, it restricts the exploration deployment of oil and gas [3-6].

This paper uses data of palaeogeomorphology characteristics, seismic attributes, heavy mineral and sandstone percent, to study the sedimentary period of Nantun Formation in Baer Depression from different angles and different levels systematically. It laid the foundation for the fine description of the main sedimentary system of Nantun Formation, and it also has important guiding significance for the future exploration deployment of oil and gas in Baer Depression.

2. Geological background

Baer Depression locates in the southern part of the central fault zone in Hailar Basin, which is one of the largest depression full of oil in the basin. It borders on Mongolia south Baer Depression in the south, joins Wuerxun Depression in the west, overlaps on Cuogang uplift in the west, links to Bayan

Mountain uplift in the east, which is a typical east fault west overlapping dustpan-like depression and its square is about 3010km^2. The mainly depression is in control of basement fracture in the NE and NEE, the structural pattern can be divided into 'three concave, two uplift, one slope', from east to west it is Beidong secondary depression, Bulehongbusi uplift zone, Beizhong secondary depression, central uplift zone, Beixi secondary depression, Beixi slope zone, having the characteristics of 'east and west zoning' and 'north and south partitioned' (Figure1).

The evolution of Baer depression goes through fault stage, rift-depression transformation stage and depression stage, the basement of the basin consists of the Hercynian and Indosinian granites and Budate Group. The mainly formation of the basin is Cretaceous, from down to up can be divided into the lower Cretaceous Cupomiao Formation(K_1t), Nantun Formation(K_1n), Damoguaihe Formation(K_1d), Yimin Formation(K_1y), and the upper Cretaceous Qingyuangang Formation. Nantun Formation is the main exploration layer, and the thickness of it is 450-800m, which can be divided into N1 Formation and N2 Formation. It is the sedimentary products of fan delta, lake bottom fan and lake environment.
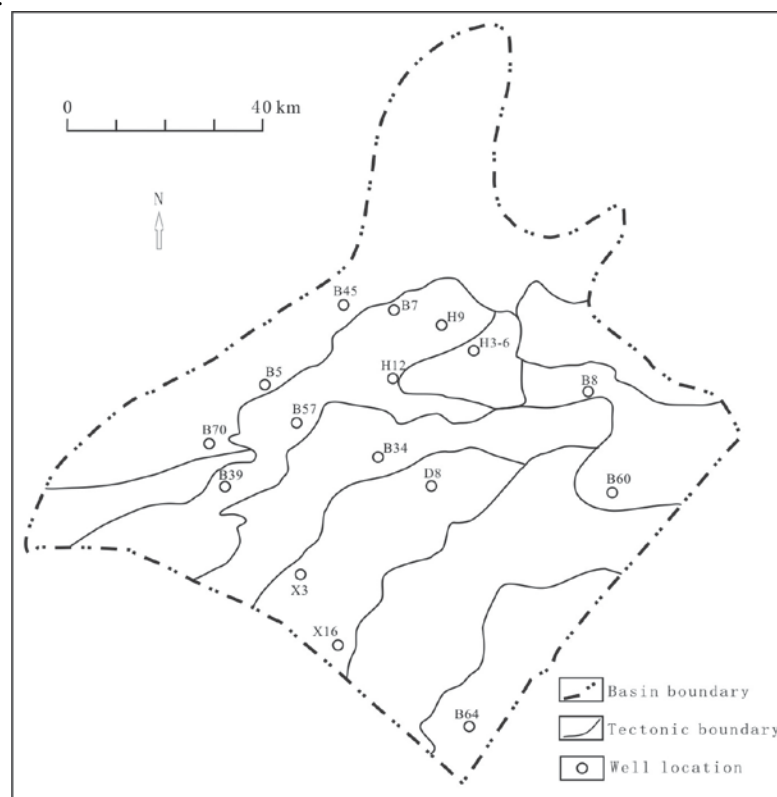

Figure 1. Partition map of Baer depressionsource analysis

3.   Analysis of the characteristics of paleoggeomorphology

The restoration of paleogenomorphology is the most direct way to study the distribution characteristics of the source system. It can reappear depression-uplift distribution of the target layer of the basin before deposition, in order to indicate location of the source area directly and show the main source direction. This time we uses technology of deposition peeling analysis, after the correction of compaction, ancient water depth and sediment gravity equilibrium settlement on the basis of high resolution sequence stratigraphic framework foundation and by computer simulation, we restore the ancient landform of Nantun Formation in Baer sag, in order to have a macro understanding of the main source direction and location of Nantun Formation in Baer Depression.

It can be concluded that the palaeogeomorphology of Nantun Formation in Baer Depression is in control of basement NE, NNE trending fracture from Figure2. It has characteristics of 'east and west zoning' and 'north and south partitioned'. Cuogang uplift in the northwest and Bulehongbus uplift in the south is around Baer Depression, these two uplift areas is the main source areas of sedimentary

period in Nantun formation in Baer Depression. The distribution pattern of depression-uplift in the depression is clear. The sediments move forward from the source area along the groove in the basin edge, the transition zone between faults or the saddle between low uplift, until the trough area of the basin gradually deposited. To analyze the recovery of paleoggeomorphology at the early stage of deposition in Nantun formation, it is thought that the slope zone around the basin is the mainly source direction, while to some parts of the area in the depression, the low bulge in the basin also plays an important role of providing source, which is the secondary source direction.
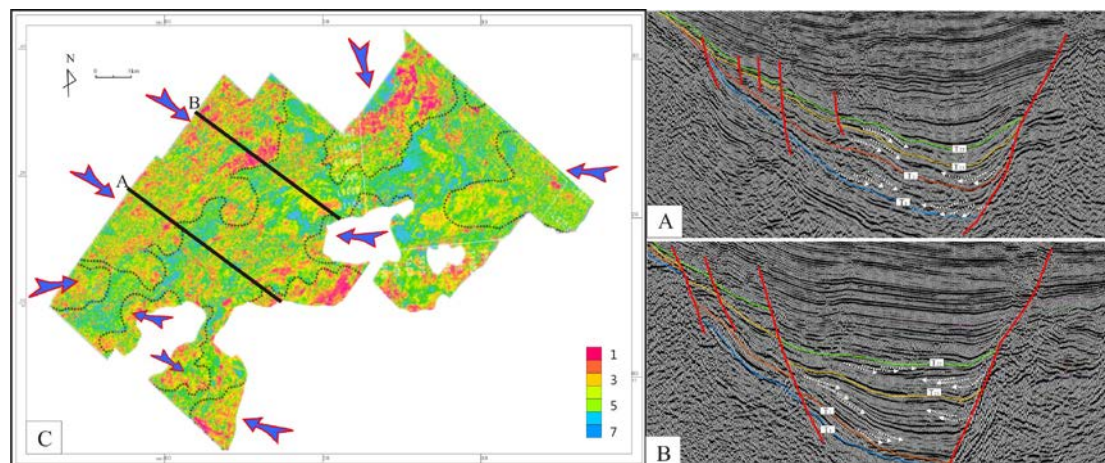

Figure 2. The multi-attribute fusion and progradational reflection map of Nantun Formation in Baer Depression

4.   Plane distribution characteristics of heavy mineral combination

There is inherent connection between the various heavy minerals in the same parent rock region. Each well points belonging to the same parent rock area often have the same heavy mineral assemblage characteristics. Therefore, we can judge kinds of parent rock by percent of heavy minerals and divide source system by distribution characteristics of heavy mineral combination.

This study selects 77 wells with core of Nantun Formation in Baer Depression, and collects a large number of heavy mineral sample to deal with and analyze. The statistical results show that the content of heavy mineral relatively high in Nantun Formation is zircon, black mica, leucoxene, garnet, epidote and tourmaline. To study the relativity of the combination characteristics of heavy mineral of each well points, and group well points with the same characteristics into one area. There is 8 kinds of combination ways of heavy mineral in Baer Depression.

5.   Trending analysis of index changing of heavy minerals ZTR

Heavy minerals ZTR is one of the most important parameter to study source direction, which refers to the percentage of the three stable mineral combination of zircon, tourmaline and rutile. ZTR index can indicate effectively the direction of source: when ZTR is low, it shows a close range to the source area, when ZTR is high, it shows the opposite. From Fig 3, low index of Nantun Formation in Baer Depression is mainly concentrated in the slope zone and the low uplift of basin around depression. The high index of ZTR is mainly concentrated in the south and north of Beixi secondary depression. Their characteristic is that the percentage of the stable mineral is over 80%, while the content of the unstable mineral is low. Taken together, low index of ZTR mainly locates in the slope zone around depression, and the high index mainly locates in the trough area of the center in the lake basin, and the source direction has obvious characteristics of 'edge pointing to the lake basin'.
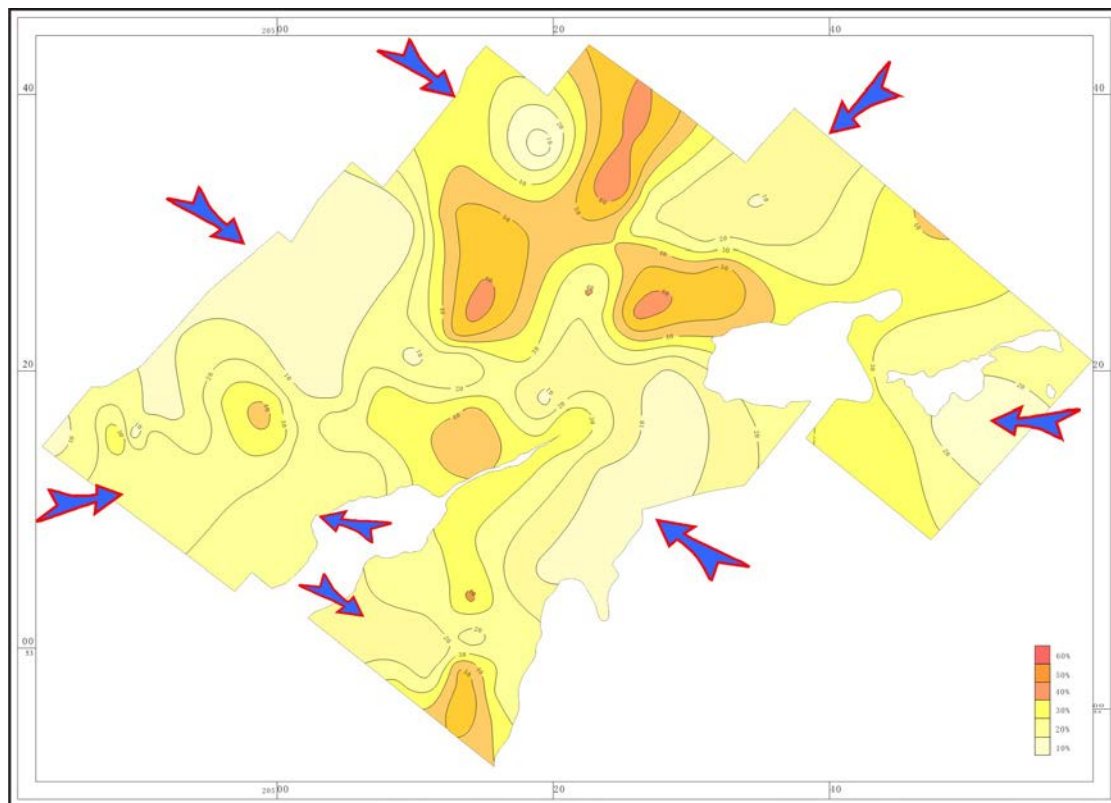
Figure 3. ZTR index contour map of Nantun Formation in Baer Depression

6. Conclusions

This article has done fine depiction about source system of deposition in Nantun Formation of Baer depression, and the result shows that the sedimentary source is mainly from the slope zone around the depression and the low uplift in the basin. It can be further divided into 9 major source systems. The source of N1 sedimentary period is from the slope zone around the depression and the low uplift in the basin, the northwest and the southeast is its main source direction. In the N2 period sedimentary period, the expansion of the lake basin leads to the extraction of the source area. Only northwest keeps the high strength to provide source, some of the low uplift become weak or disapper.

7. References

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