High Resolution Sequence Stratigraphic Division and Isochronous Framework Establishment in Wuexun-baer Sag

Qi Wang
Exploration and Development Research Institute, Daqing Oilfield Company Limited, Daqing 163712, China
E-mail: 147998431@qq.com

Abstract. High-resolution sequence stratigraphy and related technical methods have been widely used in the analysis of complex and changeable continental petroliferous basins in China in recent years. At present, the main fields of oil and gas exploration in Hailaer Basin have been transferred to lithologic reservoirs, so it is very important to find lithologic traps and analyze the favorable formation conditions of lithologic traps. The tectonic evolution, sequence stratigraphic framework and tectonic control over the sedimentary system of Nantun Formation have been studied in depth by predecessors. However, the division accuracy of Nantun Formation can only reach the level of system tract, and the distribution characteristics of sand bodies and source-reservoir allocation under high-resolution sequence framework are seldom studied. Therefore, on the basis of predecessors' research, the author synthetically uses the related technology and methods of high-resolution sequence stratigraphy, and according to the sequence boundary characteristics reflected by drilling, core, seismic and logging data, establishes the high-resolution sequence stratigraphic framework through fine division and correlation of base-level cycles at various levels. The distribution law of sand body under its control and the source-reservoir allocation relationship favorable to lithologic trap formation are studied in order to have important guiding significance for further tapping the potential of lithologic reservoir.

1. Introduction
The study area has typical continental faulted lake basin sedimentary characteristics, that is, multiple provenances, short provenances, rapid phase transformation, well developed faults and lack of stable correlation markers; stratum correlation is difficult [1-3]. At present, the Nantun Formation is divided into eight sand-bed groups in the vertical direction, of which the Beier sag is 2 in the second member and 6 in the southern member, the Wuerxun sag is 3 in the second member and 5 in the southern member. The stratigraphic systems of the two sags do not correspond. Within the single depression, the stratigraphic division criteria of different tectonic zones are not uniform (Fig.1). In addition, the existing stratification scale is too large, most of them are 100-meter sedimentary cycles, which can neither delicately depict sand bodies, nor effectively identify subtle reservoirs such as strata and lithology, and can not effectively guide the fine exploration and evaluation of oil and gas [4-5].
In the course of this study, the author finds that the special lithologic section in the lower part of the first member of the southern section proposed by predecessors not only extensively develops in the Bell Sag, but also extensively develops in the Bayantala structural transition zone and the Wuerxun Sag. Because this special lithologic section was formed in the largest lake flooding period in Nantun Formation, a set of reverse-cyclic sedimentary bodies formed during regression generally developed on it. The author thinks that it is more accurate and convincing to use this special lithologic section together with regression stratigraphic structure as a correlation marker. Based on this discovery, the stratigraphic system of the Wuerxun sag was adjusted. Since the marker layer is in the original stratification N1-5 of the Bell sag, while the Wuerxun sag is mostly in the N1-2, the top boundary of the southern section of the Wuerxun sag was moved as a whole. Taking the Wu34 well in the Wunan trough as an example, the top boundary of the southern section of the Wuerxun sag was approximately moved up. It is about 300 meters, so that the seismic, lithological and electrical characteristics of Wubei depression are consistent, and the stratigraphic division is unified, and the Nantun Formation is refined from 8 to 14.

### 2. Sequence Boundary Characteristics

Recognition of sequence boundaries is an important basis for sequence division and establishment of
regional high-resolution isochronous stratigraphic framework. High-resolution sequence stratigraphy theory suggests that a complete sequence should consist of two semi-cyclic time units, i.e. ascending half-cycle on the base level and descending half-cycle on the base level, with the boundary line rising behind the highest point on the base level. The former is a lake flooding surface with important isochronous significance, of which the most comparable is the largest lake flooding surface in the middle and long-term base-level cycles, and the latter is a sequence interface, often showing erosion scour surface or texture of different scales and causes. In the high frequency and short period base level cycles, the isochronism is weakened and the time span is enlarged with the increase of cycles. In the low frequency and long period base level cycles, the diachronism is often larger. Referring to the classification criteria of sequence boundaries by predecessors, class II and class III sequence boundaries mainly controlled by tectonic factors and class IV, V and VI sequence boundaries mainly controlled by astronomical cycles and climatic fluctuations were identified in Nantun Formation. In addition to the type II and type III sequence boundaries characterized by regional structural unconformities at the top and bottom of the Nantun Formation, the type IV to VI interfaces with decreasing size are mainly developed in the Nantun Formation, and their occurrences are mainly eroded and scoured surfaces (Fig.2).

Figure 2. All levels of sequence boundaries characteristics on seismic section

3. Sequence Division Scheme

In the course of this study, first of all, a number of exploration wells with well-developed sequence were selected in the study area. Because the study area has the characteristics of complex structural characteristics, multiple provenances, short provenances, and rapid phase transformation, the distribution of well selection in different structural belts should be made as far as possible, so as to facilitate the correlation of formation development characteristics among the next structural belts. And district level work. Next, according to the sedimentary response characteristics produced by the base-level cycles of different orders, a set of preliminary plan for sequence division is worked out, and then the traceability and comparability of the divided sequences are determined by cross-well seismic horizon tracing and fine correlation of wells in the development area. The last eight points are refined to 14, which corresponds to three long-term base-level cycles (LSC1-LSC3) and fourteen medium-term base-level cycles (MSC1-MSC14) (Fig.3).
4. Conclusions
After experiencing the initial rifting of Tongbomiao Formation, the study area officially entered the basin deep depression expansion period in Nantun Formation. While inheriting the structural pattern formed in the initial rifting stage, the depositional range of the lake basin began to increase gradually. Throughout the sedimentary period of Nantun Formation, the study area has undergone the evolution process of initial subsidence-rapid subsidence-subsidence rate weakening to shrinkage, forming three long-term base level cycles corresponding to it. The change of base level is closely related to facies type, facies sequence and facies combination characteristics.

5. Reference
[1] L. L. Sloss. Sequence in the cratonic interior of North America. Geol. Soc. Am. Bull. [J]. 1962, p.
93–113.

[2] P. R. Vail, et al. Seismic stratigraphy and global changes of sea level [J]. AAPG, 1977, Memoir 26.

[3] P. R. Vail, et al. Sequence stratigraphy workbook fundamentals of sequence Stratigraphy [A]. AAPG, P. R. Vail, J. b. Sangree. Annual Convention short course: Sequence stratigraphy interpretation of seismic well and outcrop data [C]. March19, 1988 Houston, Texas.

[4] Vail P R, Audemard F, Bowman A et al. The stratigraphic signatures of tectonics, eustasy and sedimentology-An overview[A].Einsele G,Ricken W, Seilacher A Cycles and Events in Stratigraphy[C]. Berlin: Springer-Verlag, 1991, 617- 659.

[5] Cross T A. High – resolution stratigraphic correlation from the perspective of base – level cycles and sediment accommodation. In: Proceedingd of Northwestern European Sequence Stratigraphy Congress, 1994, 105 ~ 123