Study on Segmental Growth Characteristics of Main Faults in Southern Aer Sag

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Abstract. The segmental growth of faults plays an important role in controlling oil and gas. This time, the southern part of the Aer sag is taken as the main research object to analyze the growth process of the faults. This paper uses the fault distance-distance curve, the fault distance-buried depth curve and the growth index to study the active stage of the segmental growth of the fault. The maximum fault distance subtraction method is used to strip back the faults, restore the ancient faults, and clarify the development characteristics of the main faults in each period. It is concluded that the Altala fault is a three-segment growth fault, and the fault continued to act during the depositional period of the A3 to Teng2 members, and the activity of the A4 was the most intense. The Hanwula fault is a two-segment growth fault. The faults continued to move during the depositional period of the A4 to Teng2 members, and the fault activity was most intense in the upper Teng1 sub-member. Hanwu Ladong belongs to a two-stage segmental growth fault, and the faults continued to be active during the strata depositional period from the first sub-member of Teng 1 to the second member of Teng 2, and the fault activity was most intense in the first sub-member of Teng. This study enriches the theory of the structure of the Erlian Basin's Aer sag and supports further breakthroughs in oil and gas exploration.

Key words: The southern part of the Aer Sag; fault segmental growth;planar growth;vertical growth.

1. Introduction

In the 1980s, Segall proposed the theory of segmental growth of faults by studying the mechanism of discontinuous faults, which means that with the increase of remote stress, a large number of smaller normal faults gradually interact and grow in segments. The process of forming a small number of large-scale faults [1]. With the research by Peacock and Trudgill et al. through a large number of field investigations, physical experiments and other methods, it is proposed that the segmental growth of faults is universal . Fossen believes that a large amount of seismic activity affects the segmental growth mechanism of the fault, and the main mechanism of the fault growth also includes accumulation and displacement at a constant rate[2]. Wallsh believes that the fault growth mainly goes through three stages[3], namely the isolated fault stage, the "soft connection" stage and the "hard connection" stage. Peacock and Sanderson et al. believed that when the fault is in the soft connection stage, the transformation zone often develops at the overlapping position of the fault layer. When the fault enters the "hard connection" period, the transformation zone will be completely ruptured[4-5].

Previous studies on the segmental growth of faults in the Aer Sag are rarely studied. This paper starts with the study of the main faults in the southern part of the Aer Sag, the Altala Fault, the Hanwula Fault and the East Hanwula Fault, and analyzes the evolution process of the fault segmental growth in different periods from the horizontal and vertical directions. The fault growth research in the area provides a reference for further oil and gas exploration in the Aer Sag and Erlian Basin.

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2. Regional Geological Profile

The Erlian Basin belongs to the Mesozoic rifted lake basin and is located on the Xingmeng orogenic belt. It is a basin group developed on the folded base of the Hercynian trough and consists of several scattered small rifts. The strike of the Aer sag is NE-SW. The sag is about 80km long from north to south and 15-20km wide from east to west, with a total area of about 2000km^2, and the Lower Cretaceous (K1) depositional area is about 1500km^2.

The Alshan Formation and Tengger Formation in the Aer Sag are two major structural layers, which were double-faulted in the early stage, and gradually turned into a single-faulted pan-like structure in the late stage. The northern part of the Aer sag has a high degree of exploration and rich data, while the southern part has a low degree of exploration and less data.

3. Main fault characteristics

This time, 107 faults were interpreted, and the interpretation accuracy was 4×4. Among them, there are 36 faults with an extension length of more than 2km, 35 faults with a length of 1-2km, and 36 faults with a length of less than 1km, with an average of 1.6km. All of them are normal faults, the strike is mainly NS direction, the dip angle is generally about 50°, the average maximum horizontal fault distance is about 235m, and the average maximum vertical fault distance is about 77m. On the section, the shallow part is mostly straight with a medium angle, and the deep part is mostly low-angle shovel shape, and the strike is mainly in the NS direction. The faults have been continuously active for a long time, and the main strike of the active faults has always been NS from T9, indicating that the extension direction is NW westward in the A3 member, and NW direction after the A3 member.

There is a third-order fault system in the southern part of the Aer Sag, which is mainly composed of NE-trending eastern boundary faults, basement faults and synsedimentary faults. The third-order faults include: first-order faults, such as the Altala fault on the eastern boundary, which belong to the faults that control the sag; second-order faults, such as the Hanwula fault and the Hanwula East fault, belong to the faults that control the structural belt; the third-class faults are large. Part of it is the fault that controls the trap,as shown in fig 1.

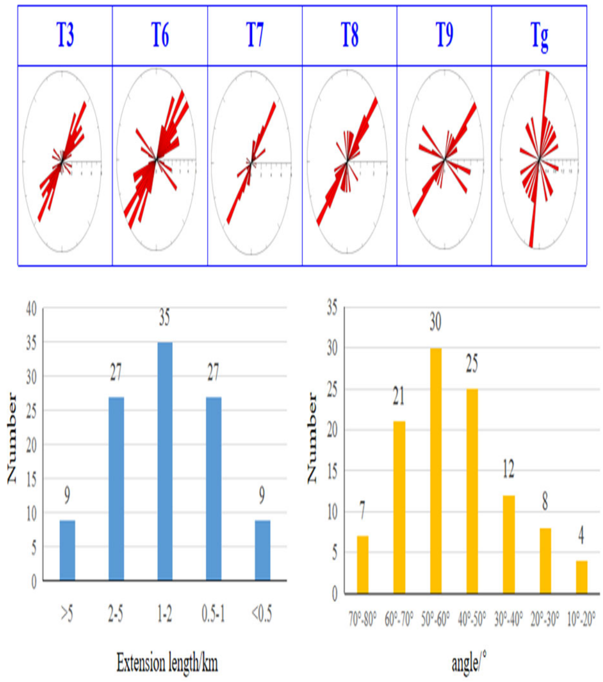

Fig.1 Fault rose diagram, extension diagram, dip Angle diagram

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4. Fault plane growth

There is a local minimum point in the fault distance-distance curve of Hanwula, indicating that it is formed by the segmental growth and connection of two NS-trending small faults. There is a minimum point in the fault distance-distance curve, which is consistent with the position of the fault strike inflection point, and the characteristics of the fault distance-buried depth curve on both sides of the inflection point are also inconsistent. There are two local minimum points in the fault-distance curve of East Hanwura, indicating that there are two transition zones with a slightly smaller angle, which are formed by the segmental growth and connection of NNS-trending, NEE-trending and NS-trending small faults , the minimum point is consistent with the fault strike inflection point, and the fault distance-burial depth curve characteristics on both sides of the inflection point are also inconsistent. There are two local minimum points in the Altara fault distance-distance curve, indicating that there are two transition zones with large angles, as shown in Fig 2.

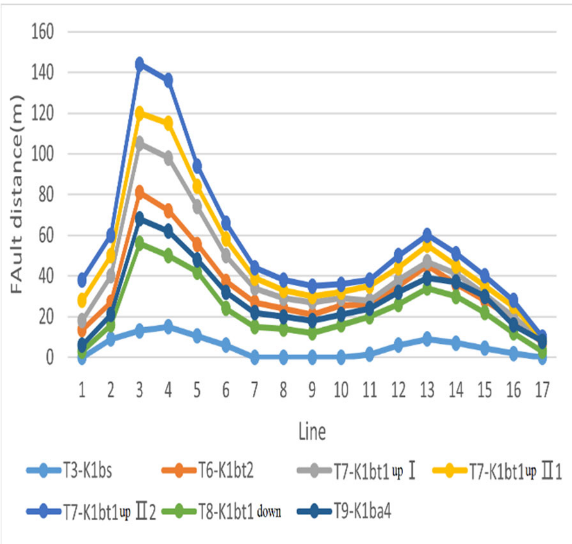

Fig.2 Fault distance-distance curve

5. Fault vertical growth

Vertically, the fault throw-buried depth curve of the Altala fault is a semi-C type, with a nucleation point, where the fault throw is the largest, and it belongs to an isolated growth fault. The curve shows that the fault has broken through 5 sets of strata from the bottom to the top of the third member of the A3 to Teng2 members. The fault throw increases first and then decreases from top to bottom. There is a maximum point in the fourth member of A4, indicating that the fault has a nucleation point, and the nucleation point is located before the deposition of the fourth member of the A4. The growth index is continuously greater than 1, and when the fault throw first increases and then decreases, it first increases and then decreases, indicating that the Altala fault continued to be active during the depositional period of the A3 to Teng2 members, and the fault activity increased first from bottom to top The fault activity is most intense in the fourth member of A4.

6. Conclusion

(1) Use the subtraction method of the maximum fault throw to restore the ancient fault throw of each period and analyze it. Combined with the distance-displacement curve and the combined geological profile, it is concluded that the Hanwula fault strikes in the NE-SW direction, the section dips eastward, and the fault throw is large vertically downward. The upper part is small, and the fault is a two-segment growth fault. The Hanwula East fault is a two-segment segmental growth fault, the strike is NE, the cross section is east-dipping, the fault throw is large in the longitudinal direction and small in the upper part, and the fault is large in the middle and small in the middle. The strike of the Altala fault changes from NE to NNE, and the section dips westward. The northern part of the fault is flat or micro-shovel type, and the southern part is sloping and flat type. The fault is a three-stage segmental growth fault. The three main faults eventually grew into a single fault in the second stage of Teng.

(2) Using the fault distance-buried depth curve and the growth index curve analysis, it is concluded that the three faults are all isolated growth faults in the vertical direction, all of which are semi-C-type, with one and only one nucleation point, and the fault at the nucleation point is broken. Maximum distance. There are slight differences in the active period and intensity of the faults. The Altala fault breaks through 5 sets of strata from the bottom to the top of the A3 member to the Teng2 member. The fault has a nucleation point, and the nucleation point period is before the deposition of the A4 member. , it continued to be active during the depositional period of the A3 to Teng2 members, and the fault activity was most intense in the A4 member.

(3) The Hanwula fault breaks through 4 sets of strata from the bottom to the top of the A4 member to the Teng2 member. The fault has a nucleation point. During the period of stratigraphic deposition, it continued to be active, and the fault activity was most intense in the upper sub-member of Tengyi. The Hanwu Ladong fault breaks through 3 sets of strata from the bottom to the top of the Teng 1st member to the Teng 2 member. The fault has a nucleation point. During the period of stratum deposition, it continued to be active, and the fault activity was most intense in the Tengxia submember.

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