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The formation mechanism and control function of reservoir forming of transfer structure in Kuqa Basin

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Abstract: *The transfer structure widely developed in the foreland thrust belt, closely related with the distribution of oil and gas, is the favorable area of oil and gas exploration. Differences movement is the main formation mechanism of transfer structure, mainly show is segmented growth and tear fault. Comprehensive consideration of fault structural pattern、fault plane combination characteristic, throw-displacement profile and field observations, transfer structure in foreland thrust belt is divided into fore types: approaching, relay ramp, transfer fault and tear fault. Combined with reservoir profile show that: (1) due to differential deposition, transfer structure is relatively low potential area, is the channel of sand into the basin;(2)the stress in transfer structure is very concentration, which is the beneficial to fracture development, reform reservoir property, as well as the advantage of oil and gas vertical conducting channel.*

Keywords: *foreland thrust belt, transfer structure, segment growth, tear fault*

I. Differences movement mechanism and the formation of transfer structure

With the long-term tectonic activities, the stress field of the formation is changing and the stress Concentration or weak area characterized by difference movement, transfer structure must be formed during the fault development[2,5], mainly embodies in horizontal or vertical fault displacement adjustment. So differences movement is the formation mechanism of transfer structure, specific performance for segmented growth and tear fault.

1. Fault segment growth

Earthquake is the main reason causing fault slip and displacement cumulation. Nowadays, the ratio of max displacement and length of the maturity fault in the nature is between10^{-1}-10^{-2}[7,8], the ratio of single earthquake is just between10^{-3}-10^{-6}, this shows that today's mature large fault is caused by cumulative earthquake activity of hundreds of times. Combining with physical simulation and field observations[5,8-10], further confirmed that the fault segmented growth is pervasiveness. Faults segmented growth has three steps(Figure 1): (1) Because of formation stress, an independent fault begin to gradually formed;(2) with the accumulation of displacement, fault lateral spread and connect with the neighboring fault;(3) the adjacent faults transfer displacement by transfer structure and gradually connected to be a new large fault. Therefore, fault segmented growth must accompany transfer structure development.

2. Tear fault

Tear fault mainly appears in folding activity stronger or weaker areas[11], from the formation mechanism, tear fault is also due to strong difference stress in the thrust fault block with different rate of movement, and then cause the differences movement to make the strike-slip fault(figure 2), its often vertical to the thrust fault and let the thrust fault abruptly terminate[12].

II. The types of transfer structure and its identification method

In 1970, Dahlstrom for the first time put forward the concept of transfer zone[2], and then domestic and foreign scholars studied transfer structure in foreland basin and raise the different views. On the basis of previous studies, starting from the formation mechanism of transfer structure, combined with the development、distribution and geometry characteristic of transfer structure in Midwest foreland basin, divide into four types transfer structure: approaching、relay ramp、transfer fault and tear fault.

1. Approaching transfer structure

During the development of faults, the independent faults has a certain trend of connection but not overlapped will interact and construct the accommodation structure. The identification method of this style structure is relatively singularity, only can judge through the plane of the fault combination characteristic.

2. Relay ramp

Relay ramp is a main structure in foreland basin, develop in the middle stage of fault segmented growth, two unconnected but overlapped faults interact and induce the strain[14,15], make the two fault between the hanging wall and foot wall keep continuous and has the same method to identify the structure with approaching.

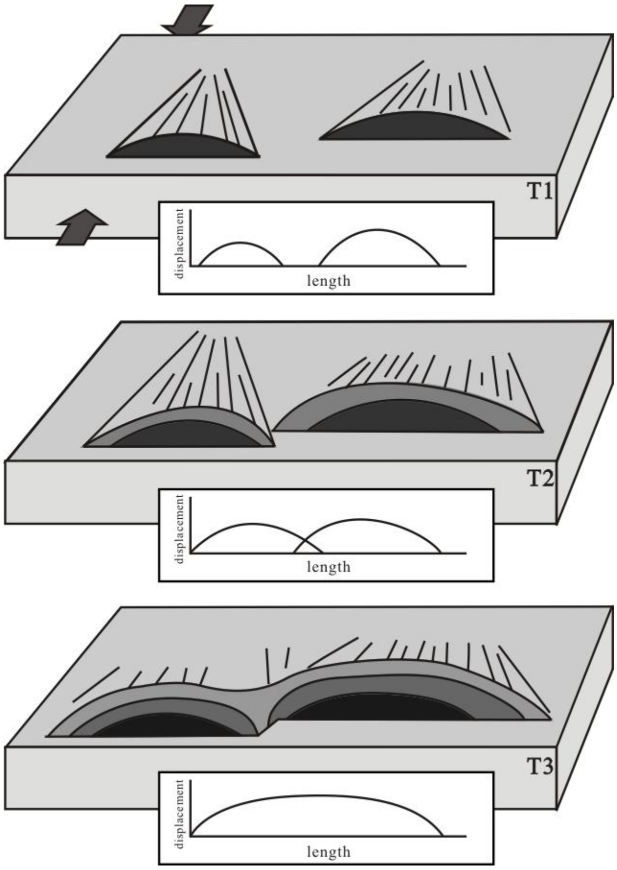

Fig 1 The evolution pattern of fault segmented growth.

3. Transfer fault

Transfer fault develop in the connection of segmented fault which has a large number of strike-slip component motion[3], is controlled by the main thrust fault. Transfer fault mainly for lateral ramp and oblique ramp. Both on a slight different geometry, lateral ramp is usually parallel to the direction of motion of the thrust fault, if the ramp is perpendicular to the formation, it will be tear fault or strike-slip fault. The oblique ramp is oblique to the motion of thrust fault, and the slope angle is between 10-30°[16,17]. According to the analysis of fault segmentation growth pattern, in segment of the connection parts, namely, the position of transfer structure development, the direction of faults change and the displacement of fault tent to be low, the turning points reflects the local intense stress and strain. Through the analysis of throw of the Kelasu fault in Kuqa basin, using fault strike and fault throw-displacement profile can identify four transfer structures.

4. Tear fault

Tear fault is a very special structure, due to the motion of the difference movement with characteristics of strike-slip fault and the strike-slip direction is consistent with the thrust direction of the basin thrust belt[2, 13,17]. According to tear fault scale and its effect on the regional tectonic and sedimentary, subdivided into regional tear fault and partial tear fault.

Regional tear fault generally deformation in the early stages of development in the basin, belongs to an integral part of the structural system, its tectonic style、deformation degree and the methods of deformation on each side of fault are completely different. The tear fault has a lot of strike-slip displacements, so on seismic section reflects the structure characteristics of the obvious flower shapes. In addition, in the process of tear fault development, strike-slip movement on the cross section remain obvious scratch and steps, the direction of the scratch and step is the direction of motion of the fault planes.

Partial tear faults mainly developed in the late deformation stages, relatively small and certainly regional limitation, displacement and extension length is shorter, tectonic style on both side of the structure is similar[18]. This kind tear fault is difficult to identify, can only be combined with the feature of fracture and field observations to determine.

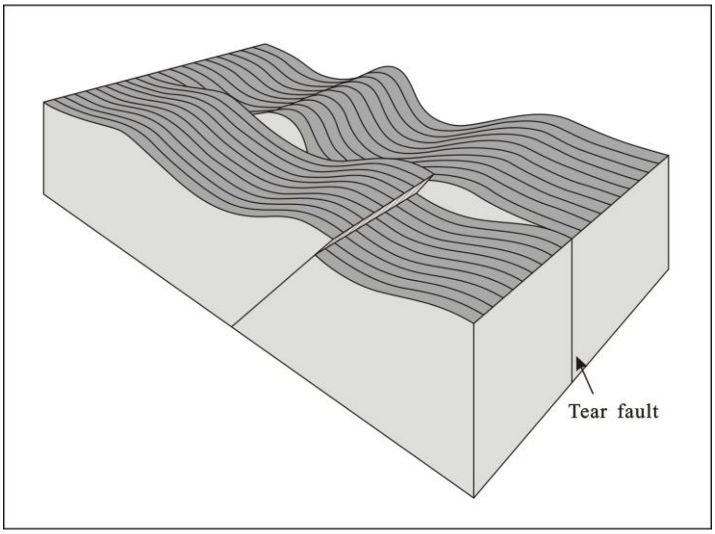

Fig 2 The pattern profile of tear fault(Scot W. Krueger, 2010)

III. Control function of reservoir forming of transfer structure

1. Transfer structure control sand body distribution

In the evolution process of fault, due to transfer structure has undertake part of stress and displacement of the fault development, make it in a relatively low potential area[19], drainage using this low area as a channel to carry detrital material into the basin and develop the fan delta along the steep slope[20]. According to the analysis of sedimentary facies and transfer structures distribution in Kuqa basin, there are four provenance in Dabei-Kelasu structure zone, three of them are matching with the sediment source. As a consequence, transfer structure is channel of sand body entering the basin, beneficial to the growth of high quality reservoirs. Transfer structure usually found in intersect or superposition area of different scale fault which stress is concentrated. Fault activities make the reservoir development in a large number of cracks and secondary fracture, improves the porosity of reservoir, effectively improve the performance of the reservoir[21].

2. Transfer structure control dominant migration pathway of reservoir

Frequent earthquake activity stimulates fluid migration, collect large earthquake all over the world show that earthquake seismogenic regions are usually located in transfer structures[22-25]. Under the long-term activity, the position of transfer structure has lots of secondary faults and fractures, they has high permeability, provide dominant migration pathway for reservoir vertical migration, resulting the today’s distribution of reservoir in foreland basin. For Dabei block, through the analysis of the throw and geometry characteristics of Kelasu fault, transfer structure was found near the DB201 well, and closer to transfer structure, the more fractures develop. Combined with the distribution of oil and gas in Dabei block, show that the reservoir enrichment in position of transfer structure. Therefore, it can be further proved transfer structure control dominant migration pathway of reservoir.

IV. Conclusion

1) The formation mechanism of transfer structure is difference movement, embodied in fault segmented growth and tear fault.
2) According to the formation mechanism、scale and geometry characteristic of transfer structure, it can be divided into four types: approaching、relay ramp、transfer fault and tear fault.
3) The identification method of transfer structure mainly include: the structure style on each side of the fault; the observation and so on.
4) Transfer structure control the distribution of sand body in basin and provides favorable conditions for dominant pathway for migration , prompted the hydrocarbon accumulation.

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