New progress and recognition of structural characteristics in Lianmuqin area of Turpan-Hami Basin

Chunjing Zan [1], Zhongbo Zhao [2], Shangming Shi [1, *]

[1] School of Geosciences, Northeast Petroleum University, Daqing 163711, China
[2] No. 1 Oil Production Plant, PetroChina Daqing Oil & Gas Company, Daqing 163711, China

Abstract. Based on the study of geological conditions in Lianmuqin area, Turpan-Hami Basin, the structural characteristics of upper Shanshan Group, upper Sandili Dadun Formation, and the top of Kalaza Formation from the bottom to the bottom in the study area are analyzed. According to the structural morphological characteristics of the fault interpretation, comprehensive description of the size and length of the fault, the new fault interpretation. The interpretation process is more logical under the guidance of sedimentary and tectonic theories.

Key words: Turpan-Hami basin; Lianmuqin Area; Tentonic characteristics; Fault interpretation; Comparison of old and new faults.

1. Introduction

Lianmuqin oilfield anticlinal fault system is developed, the stratum structure is complex, fault structure is difficult to accurately determine. At present, the known fault interpretation is difficult to satisfy the development of Lianmuqin oilfield, so accurately implementing the fault structure in the oilfield area is a crucial step to adjust the development strategy of this oil area [1]. Compared with previous results, the results of this tectonic interpretation show that the stratigraphic undulation trend and fault distribution characteristics are basically the same in The Lianmuqin area, but this interpretation is more detailed and reasonable, and divides the time stratigraphic interface more carefully and has a higher degree of closure. Based on the accurate fault structure map and a large number of seismic data, combined with previous research results, this study described the scale and extension length of the fault to make the fault interpretation of lianmuqin oil field more accurate.

2. Geological survey

Turpan-hami Basin is one of the three major sedimentary basins in Xinjiang. The basin is located in the eastern part of Xinjiang, extending in east-west direction, with a length of about 660km from east to west and a width of 60-130km from north to south, covering an area of about 53000km2[2-3]. Located at the intersection of tarim plate Siberia plate and Kazakhstan plate. It is surrounded by the Harrik, Bogda and Balikun Mountains in the north, the Jolotagh Mountains in the south, the Wutong Wozi Spring in the east and the Kalau Cheng Mountains in the west [4-5].

From bottom to bottom, the qalaza Formation, Sandili Dadun Formation and Shanshan Group are developed (Figure 1). The formation characteristics are summarized as Figure 1. Lianmuqin area was in the sedimentary position of fan delta front subfacies during tertiary oil layer [6-7]. Subaqueous distributary channel, subaqueous distributary channel, front sheet sand and other sedimentary microfacies are developed in the area. Lianmuqin area was in front of braided river delta depositional system during cretaceous oil layer. Subaqueous distributary channel, subaqueous interdistributary channel, mouth bar, front sheet sand and other sedimentary microfacies are developed in the area. The underwater distributary channel extends from south to north, and the mouth bar is scattered sporadically inside the channel. The most northern part of the work area is front sheet sand. The interaction between faults of different ages and levels plays a decisive role in the interpretation of faults.

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* Corresponding author: ssm@nepu.edu.cn

Figure 1 Tectonic zoning and study area of Turpan-Hami Basin

Erathem	System	Series	Stage	Lithology
Cenozoic	quaternary	Pleistocene	xiyu formation (Qx)	Xiyu Formation is mainly composed of gray-black and gray-green gravel layers, Grapevagou Formation is mainly composed of brownish red mudstone interbedded with variegated fine conglomerate, and Taoshuyuan Formation is composed of brown sandy mudstone interbedded with sandstone and gypsum. The drilling thickness is 1045~1418 meters.
	Neogene	Miocene-Pliocene	Putaogou formation (N₂q)	
			Taoshuyuan formation (N₁t)	
	Paleogene	Oligocene-Paleocene	Shanshan formation (Esh)	Large sections of brownish red mudstone interbedded with thick glutenite contact unconformably with the underlying strata. Drilling thickness 252~338 m.
Mesozoic	cretaceous	Late cretaceous	Lianmuqin formation(K₁l)	Brownish red and brown mudstone interbedded with fine sandstone bands. The penetration thickness is 221~385 meters.
			Shengjinkou formation (K₁sh)	Light grey and grey-green mudstone interbedded with thin sandstone. The drilling thickness is 44~63 meters.
			Sanshilida formation (K₁s)	Gray, dark purple argillaceous siltstone, siltstone, fine sandstone with thin mudstone. Drill thickness 388~416 meters.
		Early cretaceous	Kalazha formation (J₃k)	Dark brown, brownish red mudstone, silty mudstone sandwiched thin siltstone, fine sandstone, the lower part of thick fine conglomerate, fine sandstone. Residual thickness of drilling is 54~571 m.
			Qigu formation (J₃q)	Dark brown mudstone intercalated with fine sandstone and siltstone. Drill thickness 435~666 m.

The Kalaza Formation is a set of coarse clastic rock formations, mainly composed of thick bedded sandy conglomerate and fine sandstone. It is in pseudoconformable contact with the underlying Qi Paleoformation and unconformable contact with the overlying Cretaceous strata [8]. The relative thickness of the stratum is reduced from north to south, and lianmuqin is about 364m. The Kalaza Formation is mainly composed of coarse clastic formations of fluvial facies in oxidized environment. The lithology is mainly purplish red, variegated conglomerate and brownish red mudstone, with local calcareous nodules.

Sandun Formation is a set of clastic rocks mainly composed of alluvial fan-fluvial facies. The main lithology is brownish red, gray and purple massive thick sand-bearing conglomerate, interbedded conglomerate and brownish red sandstone, interbedded with purple and brown mudstone. This formation is a set of good reservoirs with a sedimentary thickness of 350-426m. From north to south, the grain size of sediments becomes fine and the stratum becomes thin.

The sandi - li Dadun Formation can be further divided into two sections from top to bottom. The lithology of the first member of Sandili Dadun Formation is thick gray siltstone, thick brown siltstone, gray glutenite and gray mudstone. The lithology of the second member of Sandili Dadun Formation is mainly purple mudstone, brown mudstone and brown-red mudstone, with a small amount of gray siltstone. The lithology of Shanshan Group is coarse at the bottom and fine at the top: gravelly sandstone in the lower part, fine sandstone in the middle part and argillaceous siltstone in the upper part.

3. Description of structural characteristics

3.1 Structural morphological characteristics

Hongshan and throughout the two regicide impact fault zone, the effect of the wood this whole work area structure in NW - SE direction, overall influenced by back thrust and pressure anticline, mainly NW trend fault development, structural belt main faults slip under large fluctuation, section steep Angle on the slow, deep incised section along the ShuiXiGou group of coal measures strata slippage, break up to cretaceous gradually disappear, Active stage is a good migration channel for oil and gas. Structural layer tectonic style each different, shanshan group of upside for low-amplitude anticline, three miles large pier group upper dome anticline, north and south wing, something flanks is relatively slow, simple form, reservoir types, of course, also with bottom water block anticline and fault boundary layer is given priority to, kara firm set off on the background of the nasal dorsal percussive broken clamp block as the characteristic, fault development, structure is complex. From the point of view of the formation period, the paleogene and Cretaceous faults are mainly the result of the revival and superposition of the old faults controlling the Jurassic structure and the succession development. Faults are the main migration channels for oil and gas and are critical to reservoir formation.

3.2 Fracture characteristic analysis

The tectonic zone of the study area is located in the transition zone of hongshan and Huoyanshan thrust fault zones, and the tectonic stress field is very complex. During the Middle Yanshan Period, with the strong uplift and southward compression of bogda Mountain in the north of the basin, imbricate faults along the slippage of the middle and lower Jurassic coal measures occurred in the Hongshan-Hongnan area, and the hongshan, Hongnan 1 and Hongnan 3 faults were successively formed from north to south. Westward Hongnan no.2 backthrust fault-fold structure was thrust up from the middle and lower Jurassic sedimentary slope fold belt. Lianmuqin No. 2 fault-fold structure is oriented NNW by the NNW to SE

direction yubei-Lukeqin compound fault-fold structure. Hongshan, Hongnan 1, 2, 3 and Lianmuqin 2 structures were roofed before the deposition of tugulu Group in the Lower Cretaceous. The late Yanshan fault-fold movement was weak, and only the Hongshan and Yubei structures had synsedimentary draped fault-fold. Extrusion late Himalayan tectonic stress is concentrated in the volcano and hong shan fault zone, intense activity to form the middle and lower Jurassic rushed out of the earth's surface low mountains, at the same time the south - even wood ooze of red old fault formed in yanshan period in life, in the south of red 1, 2, 3, and even the wood ooze 2 bald structure not only on the upper Jurassic cretaceous - Cenozoic faulted anticline low amplitude.

The faults can be divided into four groups of NNW, NNE, NEE and NWW trending faults according to strike. The NNE trending faults are the main faults in this area with early formation time, long active time and large scale. A total of 7 faults with an extension length of more than 1km were explained in this target layer, and there were 5 faults with an extension length of 0.5 to 1km, most of which were within 0.5km. In addition, in order to maintain the integrity of faults and structural space, more than 10 interlayer and non-target layer faults have been interpreted.

3.2.1 Esh fault characteristics

Number of faults: the number of faults is small, with a total of 6 faults explained so far. The faults are mainly medium and small faults, and the number of large faults is few.

Fault properties: The faults are mainly reverse faults, and the characteristics of fault inheritance and development are obvious. All faults of medium size and above can cut Esh reflector from bottom to top. Most of the small and medium faults are associated faults or later developed faults of large faults.

Fault size: from the perspective of horizontal fault distance, the fault distance is small, usually less than 30m. There are only one fault with a fault distance of more than 30m, and the maximum fault distance is 32m. The plane extension length of the fault is small, all faults are less than 2km, and the maximum extension length is 1.8km of the boundary main fault. The dip Angle of the fault is large.

Fault plane: It can be seen from the K1S1-1 top boundary structure map that the faults are relatively scattered in plane, and the faults generally strike NW-SE. There is no obvious combination pattern on the fault plane.

Fracture section: in the seismic section, the fault assemblage is mainly domino-type, and the structural style is not obvious.

3.2.2 Fracture characteristics of KYC

Number of faults: there are a large number of faults, with a total of 16 faults explained so far.

Fault nature: The faults are mainly reverse faults with obvious inheritance and development characteristics. All the faults above medium size can cut the Kyc reflector

from bottom to top. Most of the small and medium size faults are associated faults or later developed faults of large faults.

Fault size: from the perspective of horizontal fault distance, the fault distance is small, usually less than 30m. There are only 2 faults with a fault distance of more than 30m, and the maximum fault distance is 38m. The plane extension length of the fault is small, most of which are below 2km, and the maximum extension length is 2.7km of the boundary main fault. The dip angles of faults are mostly between 70 and 80 degrees.

Fault plane: It can be seen from the KYC structure diagram (Figure 2) that faults are densely developed in the northwest direction on the plane, and the faults generally strike in NW-SE direction. In the plane, the combination mode is mainly parallel (Figure 3).

Fault section: in the seismic section, the fault combination relationship is mainly "anti-Y-shaped", "multi-stage recoil fault" and "Y-shaped" oblique fault [9]. The large boundary fault forms the back thrust structure style, and the common hanging wall uplift forms the thrust structure.
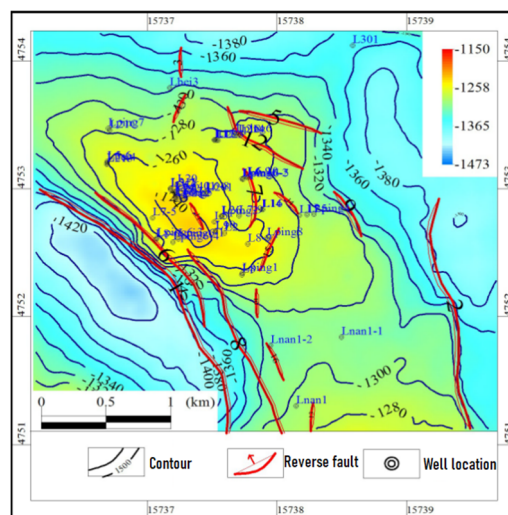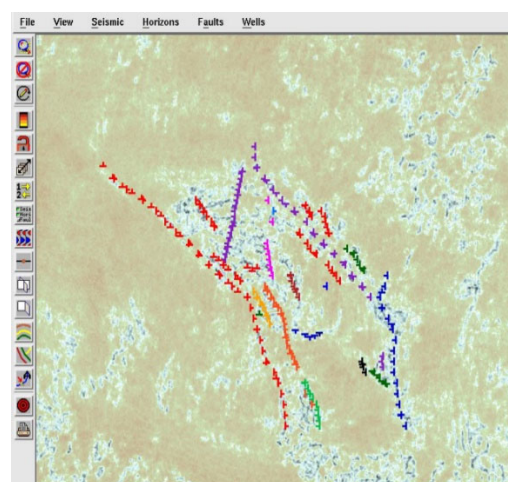

Figure 2 KYC top construction diagram

Figure 3 Interlayer coherence

3.2.3 Fracture characteristics of K1S2

Number of faults: there are a large number of faults, with a total of 23 faults explained so far.

Fault nature: The faults are mainly reverse faults with obvious inheritance and development characteristics. All the faults above medium size can cut the K1S2 reflector from bottom to top. Most of the small and medium size faults are associated faults or later developed faults of large faults.

Fault size: from the perspective of horizontal fault distance, the fault distance is large, generally greater than 30m, and the maximum fault distance is 97m. The plane extension length of the fault is small, most of which are below 51km, and the maximum extension length is 3.4km of the boundary main fault. The dip angles of faults are mostly between 60 and 70 degrees.

Fault plane: It can be seen from the K1S2 structural map that faults are densely developed in the northwest direction on the plane, and the faults generally strike in the NW-SE direction. On the plane, the combination mode is mainly "parallel".

Fault section: in the seismic section, except for the secondary small faults, the fault combination relationship is "reverse Y-shaped", "multistage recoil fault" and "Y-shaped oblique fault". The large boundary faults form the back thrust structure style and form the "fault interaction area", and the common hanging wall uplift forms the thrust structure.

4. Comparison of old and new structures

Compared with previous results, the structural interpretation in this paper shows that the trend of stratigraphic undulation and fault distribution are basically the same, but this interpretation is more accurate. Specifically, there are the following three points:

The purpose for the district the upper layer of shanshan group, three miles on top of the pier top and kara group a total of seven explain strata, old and new horizon of relief, the overall trend is consistent, but this explanation is more detailed and reasonable, to differentiate time stratigraphic interface more detailed, the closure is higher, to the guidance of the sedimentary and tectonic theory, the explanation process more logical.

In order to maintain the integrity of the structure, the fault interpretation interpretation process is not limited to the objective layer, and on the basis of respect for seismic profile, reasonable application of geological, has been clear about the back flush tectonic style and rising public plate produced by the secondary structure of the development of fault block and anticline may make a strong theoretical basis for interpretation result. A total of more than 50 large and small faults were explained, including nearly 7 faults extending over 1km in length. Most faults are between 0 and 0.5km.

The explanation by analyzing stress field, using the data of seismic data volume and coherence data, and combining the curve and well production data carefully identify the fault distribution in detail analyzed the change law of tectonic style, fault displacement and fault profile

plane alignment (parallel type, oblique type), conform to the contract variation characteristics of stress field, add some small fault, Some small faults with insufficient evidence and little significance are discarded, and individual faults of predecessors are modified.

4.1 Fault of insufficient evidence

The previous interpretation did not explain the fault that intersects well Lian 20 near the north-south strike. Firstly, the location of the fault was found from the seismic profile and it was found that the in-phase axis was relatively continuous and there was no obvious fault phenomenon. In addition, in the extension direction of this fault, another thrust fault consistent with the contraction stress field was found, so this fault was abandoned (Figure 4).
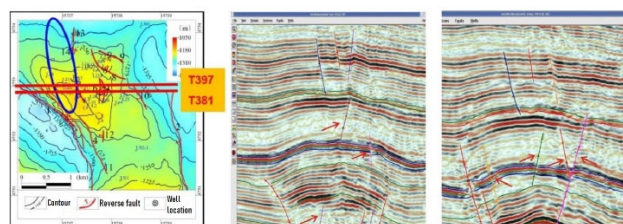

Figure 4 Add and delete faults

4.2 Supplementary fault

This paper adds a boundary recoil fault and another thrust slip boundary fault to form an important back-thrust structure, which conforms to the basic structural style and seismic interpretation principle in oil areas (Figure 5).
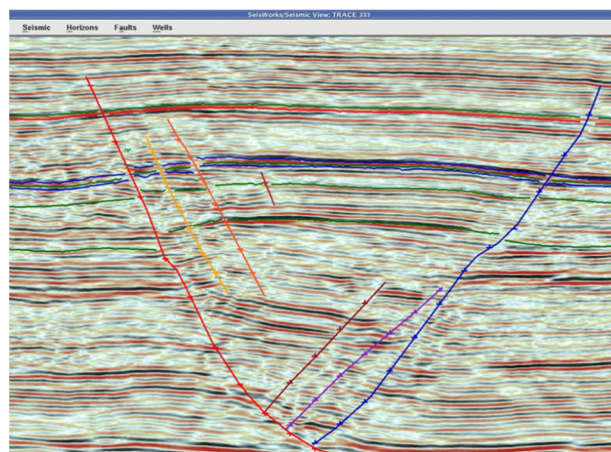

Figure 5 Added back thrust structure

4.3 Modify the fault

In this paper, the nearly east-west trending faults above Lianping 6 well explained by predecessors were modified, and the extension length and strike of the faults were modified by referring to section characteristics, fault plane combination and direction of tectonic stress field (Figures 6-7).
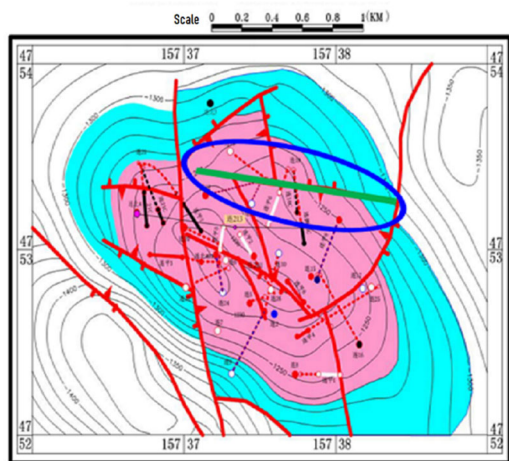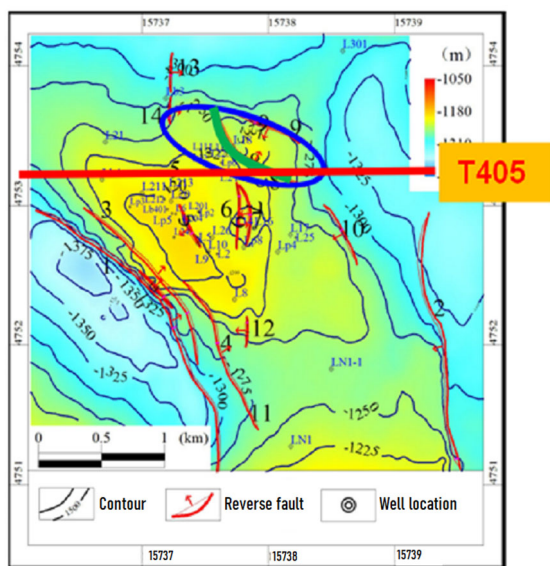
Figure 6 K1S1 old structural outline

Figure 7 K1S1 new structural outline

5. Conclusions

(1) The faults in the study area are well developed and complex in structure. Influenced by backthrust structure and compressive anticline, the faults are mainly nW-SE trending. In the study area, the fault distance is large in the lower part and the dip Angle is large in the upper part. The deep section in the lower part slides along the coal measure strata of Shuixigou Group and gradually disappears in the upper part until the Cretaceous system.

(2) In this study, the faults of the upper Shanshan Group, Sandi Dadun Formation and Kalaza Formation in the target layer of the region are reinterpreted to make the fault interpretation in the study area more detailed and reasonable with higher closure. The structural integrity is maintained, the geological law is applied reasonably, and the interpretation result has a strong theoretical basis. A total of more than 50 large and small faults were explained, including nearly 7 faults extending over 1km in length. Most faults are between 0 and 0.5km. In addition, some small faults were added, some faults with insufficient evidence and little significance were discarded, and individual faults of predecessors were modified.

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