

County in Southwest Ordos Basin Block 1 Period of Sand Body Distribution Characteristics of Mountains

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Abstract: Huanxian block is one of the key oil and gas exploration and development blocks in Longdong Gas field of Changqing Oilfield Company. The Mesozoic exploration is about to enter the saturation state, and it is urgent to explore new fields. Therefore, the seismic characteristics, reflection structure characteristics and reservoir sand body distribution characteristics of Shan-1 member of Permian Shanxi Formation of Upper Paleozoic in this block are studied comprehensively. By using the data of drilling core, well logging curve and 3D seismic interpretation, the regional small beds are finely divided and correlated, and the unified stratigraphic framework of the area is established. The structural characteristics of the bottom of Shan-1 member of Shanxi Formation are studied, and the distribution characteristics of reservoir sand bodies and effective sand bodies of Shan-1 member are analyzed and studied.

Keywords: Ordos basin, Central county block, Shanxi group, Tectonic characteristics, Sand body characteristics.

1. Introduction

Ordos Basin is rich in oil and gas resources. Since the first oil well was drilled in 1907, this basin has had a history of oil and gas exploration for more than 100 years [1], during which several oil and gas fields such as Jing bian Gas field, Yu lin Gas field and Su li ge Gas field were discovered, greatly increasing the proved oil and gas resources. The Permian natural gas resources reached 1.568*10¹³m³ [2]. Due to complex geological conditions in the southwest of the basin, the reservoir is characterized by compact, low porosity, low permeability, low abundance and low pressure [3], which has become an important factor restricting the exploration and development of this block.

Based on the analysis of outcrops, drilling cores, well logging data and other data, previous studies on the provenance and deposition equality of Shan-1 member in the southwest Basin have shown that the sedimentary facies of Shan-1 member in Huan xian Block is composed of delta deposition and coastal shallow lake deposition [4,5,6], but there is a lack of research on the distribution characteristics of reservoir sand bodies of Shan-1 member in Huan xian Block. This study uses logging data, 3D seismic interpretation and other data to finely divide and contrast the strata of Huan xian block, and establish a unified stratigraphic framework. On this basis, it studies the distribution characteristics of reservoir sand bodies of Shan-1 member, defines the distribution law of sand bodies, and then analyzes the distribution characteristics of effective sand bodies of Shan-1

member. This is of great significance to the fine development of gas formation in this area.

2. Geological Background

Ordos Basin is located in central and western China, with an area of 3.7*10⁵km². It is a large polycyclic craton basin [7]. The Huan xian block is located in the southwest of Ordos Basin, and structurally straddles two secondary structural units, namely Tian huan Depression and Yi shan Slope. The sedimentary strata of Upper Paleozoic in this area can be divided into carboniferous Shang ben xi Formation, Permian Lower Taiyuan Formation, Permian Lower Shanxi Formation, Permian Middle Shi he zi Formation and Permian Upper Shi qian feng Formation from the bottom up. The Lower Shanxi Formation of Permian is divided into two members, Shan 1 member and Shan 2 member, with Chuanwo sandstone as the boundary. The gas reservoir of Shan 1 member of Huan xian block is widely distributed, but the reservoir is tight, heterogeneous, effective sand body connectivity is good, and single well production is low. The Shan-1 member is a meandering river delta front deposit, and the main sand belt strikes from southwest to northeast. On the background of the region's westward dip, the sandstone becomes thinner to the east. As a whole, the bottom structure of the 1st member of the Shan Formation presents the characteristics of a west-dipping monocline with high east and low west, and mainly developed multiple rows of nose-shaped uplift structures, see Fig 1.

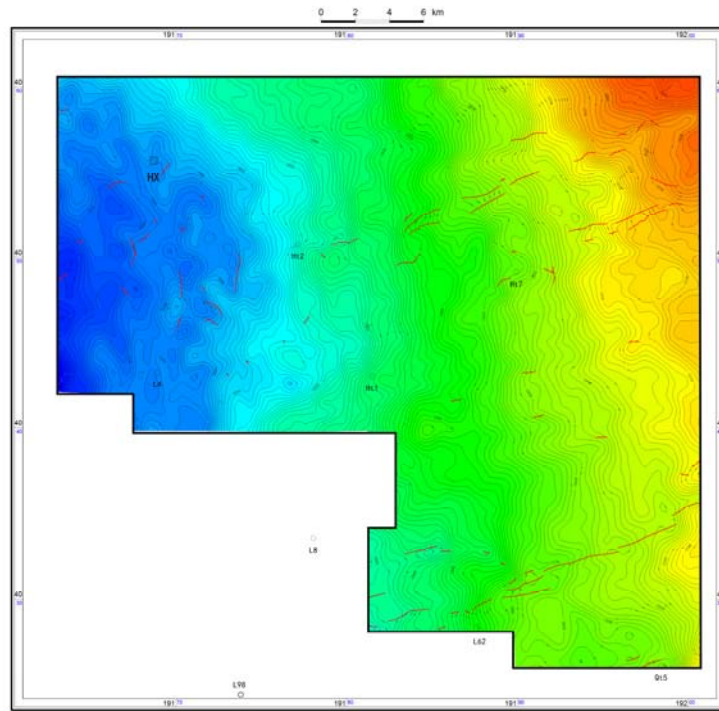


Figure 1. The bottom structure map of the 1st member of the Shan Formation

3. Stratigraphic Characteristics

The target layer of this study is Shan-1 member of Shanxi Formation of Permian system, and the sand body of Shan-1 member is the main gas-producing interval in this area. According to the stratigraphic division mark, Shan-1 member of Shanxi Formation, the main gas-bearing stratum, is divided into three sub-segments, namely Shan-11, Shan-12 and Shan-13 [8]. The burial depth of the 1st member of the target layer mountain in the study area is generally within the range of 4000-5000m [9], and the strata burial depth has a large transverse span. There is an interlayer of yellowish-green sandstone and mudstone at the top of Shan-1 member of Shanxi Formation. The natural gamma value is high, and the natural gamma curve shows finger undulation resistivity. The resistivity curve shows mountainous undulation on the background of high value. Shan-1 member is mainly delta front deposition, and shallow lake deposition occurs in the

east. The lithology is mainly gray and white medium-fine quartz sandstone and lithic quartz sandstone, and contains a few coal seams [10,11]. The thickness of the strata in Shan-1 Member is 38.8-45.3m, with an average thickness of 42.4m, and the sandstone thickness is 0-16m, with an average thickness of 6.8m. This area has high sandstone content, mainly mudstone and sandstone, without coal seam and thin layer limestone deposition.

In Huan xian area, the thickness of Member 1 of Shanxi Formation decreased along the southwest to northeast direction. The thickness of the Windows near L4 is 30-45ms, and the thickness of the Ht7 Windows is only 15-20ms. The layer change of thickness can indicate the change of sand body deposition. The seismic reflection characteristics of this seismic profile gradually changed from continuous in medium-weak amplitude to continuous sub-parallel reflection in medium amplitude, see Fig 2.

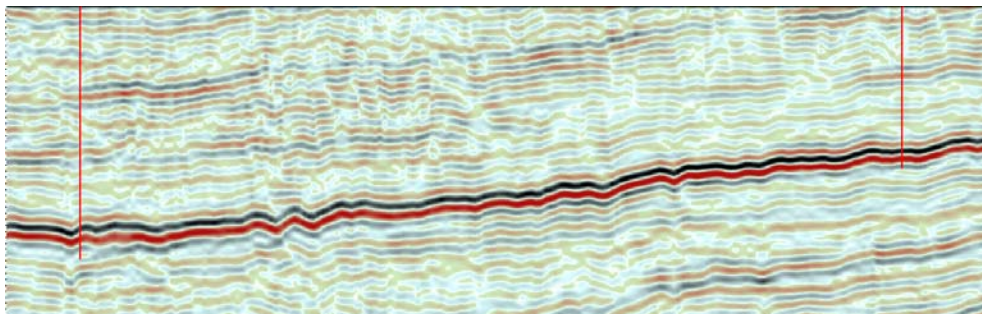


Figure 2. Seismic profile of the L4 - Ht7 well

4. The Plane Distribution Characteristics of Sand Body

The Shan1 member of Huan xian Block in Ordos Basin reflects the sedimentary characteristics of delta front and shore-shallow lake. Sand bodies are distributed along the

channel from southwest and northeast to the middle [12,13,14]. The sand body of Shanshan Member 1 is relatively large, but the distribution scale of thick sand body is limited.

Under the control of delta deposition, the sand body of the 1st member of Shan Formation is generally distributed in a

strip. In Huan xian block, there are five main sand belts, including four in the southwest and one in the northeast. The well-developed sand bodies of Huan xian block are located in the southwest. The thickness of sand bodies of Shan 1 member is obviously small, and the thickness of sand bodies of Shan 1 member mainly ranges from 7 to 10m, and some Wells have a thickness of more than 13m with an average

thickness of 6.8m, see Fig 3. Sandbodies of the first member of Shan Formation are mainly distributed in the delta front, and the underwater distributary channel is the main favorable reservoir. The analysis shows that the sand body of Member 1 of Shanshan Formation in Huan xian block is relatively developed.

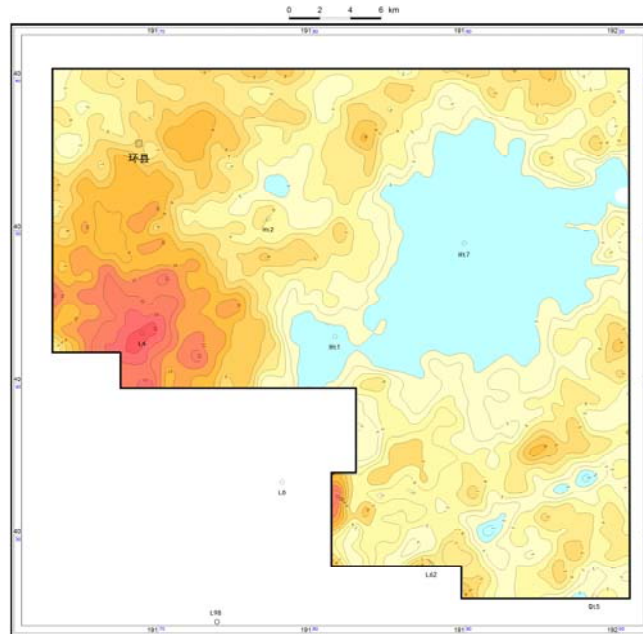


Figure 3. Sand body distribution plan of Shan 1 Member

5. Effective Sand Body Plane Layout

In Huan xian block, there are four effective sand belts from southwest to northeast and one effective sand belt from northeast to southwest. Sand bodies with effective thickness greater than 6m are rarely developed. Sand bodies with effective thickness greater than 5m are distributed in an elliptical, irregular and isolated manner, while sand bodies with effective thickness greater than 4m are distributed in an irregular and small area. Sand bodies with an effective thickness of more than 3m are distributed in large strips and irregularly outside the area with an effective thickness of more than 4m. Sand bodies with an effective thickness of 2-3m are connected with each other, and they are mainly surrounded outside the 3m area with a large strip distribution. Sand bodies with an effective thickness of 0-1m are connected with each other. It is mainly surrounded in the outer side of 2m area, showing a large area of continuous sheet distribution, accounting for more than 30% of this block area, see Fig 4.

According to the map of effective sand bodies of Member 1 of Shanshan Formation in Huan xian Block, the distribution

characteristics of effective sand bodies of Member 1 of Shanshan Formation are obviously controlled by sand bodies of Member 1 of Huan xian Block, and the distribution area of effective sand bodies is mainly located in the area with the thickness of sand bodies greater than 8m. Sand bodies with effective thickness greater than 2m are relatively developed in the study area, which are distributed in large contiguous strips. Sand bodies with effective thickness greater than 3m are distributed in the river channel, which are distributed in bands from southwest to northeast, accounting for more than 20% of the total area of the development block. Sand bodies with effective thickness greater than 6m have limited development, see Fig 4.

By compiling the effective sand body thickness plan of Gushan 1 member in Huan xian District, the distribution regularity of effective sand body of Shan 1 member in Huan xian District is analyzed. It is considered that Shan 1 member in the study area is a favorable reservoir sand body horizon in the study area. However, the effective sand body of Shan 1 member is small in overall thickness, concentrated in distribution and large in scale. The effective sand body has strong heterogeneity and good continuity and connectivity.

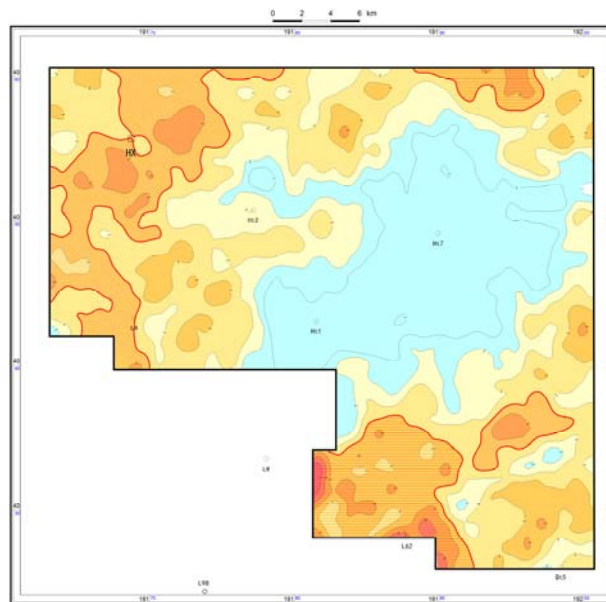


Figure 4. Plan of effective thickness of the 1st section of Mt

6. Conclusion

(1) On the basis of fine stratigraphic division and correlation, this paper compiled the structure map of the bottom surface of Shan-1 in the study area. As a whole, the bottom structure of Shan-1 in the study area is a wide and gentle west-dipping monocline, with the characteristics of high in the east and low in the west, and multiple rows of nasal uplift structures are developed.

(2) The connectivity of sandbodies in the southwest to northeast direction of Shanshan Member 1 in the study area is obviously good, and the effective sandbodies in the whole study area are obviously heterogeneous. The overall thickness of the effective sandbodies in Shanshan Member 1 is small, with concentrated distribution and large scale. Only the western part of the study area is thick, and the effective sandbodies have strong heterogeneity and good continuity and connectivity.

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