Characteristics of Gas Reservoirs in Xingcheng Area of Xujiaweizi Fault Depression

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Abstract. The formation mechanism and distribution law of natural gas reservoirs in the Xujiaweizi fault depression in the northern Songliao basin are complex, which restricts the progress of natural gas exploration and development. Therefore, based on the analysis of reservoir forming characteristics of Yingcheng Formation gas reservoir in Xingcheng area, the deep gas reservoir types and reservoir forming patterns in this area are studied. Yingcheng formation is mainly divided into upper conglomerate gas reservoirs and lower volcanic gas reservoirs. The analysis shows that the conglomerate gas reservoirs in the 4th member of Yingcheng Formation in Xudong fault depression are lithologic gas reservoir, and the volcanic gas reservoirs are lithologic structural gas reservoir. The fluid distribution of volcanic gas reservoirs in Yingcheng formation has obvious characteristics of upward oil and downward flow. And there is no uniform gas water interface. The conglomerate and volcanic rocks are vertically superimposed. The accumulation mode is lower generation and upper storage type.

1. Regional geological characteristics
The Xujiaweizi fault depression is half graben rift controlled by Xu Xi and Xu Zhong faults, which is a large-scale fault depression in the Songliao basin. The fault depression is distributed near the north-south direction. The north south direction is 95km long. The central wide is 60km, and the area of the rift is 4300km². The Xingcheng area is located in Zhaozhou county and Anda City, Daqing, Heilongjiang province. The tectonic position is located on the Xuzhong tectonic belt of Xujiaweizi fault depression in Songliao Basin. The deep reservoirs of volcanic and sandy conglomerate have been found in the Yingcheng formation. The deep volcanic rocks and sandy conglomerate gas reservoirs in Xujiaweizi fault depression have become the focal point of deep gas exploration in Daqing exploration area. Because of the deep buried volcanic and sandy conglomerate reservoirs in this area, the lithology and rock facies are complex, the heterogeneity is strong, and the multi-layer gas is made up. The relationship between gas and water distribution is complex, and there are various types of gas reservoirs and [1].

2. Analysis of gas reservoir characteristics

2.1. Type of gas reservoir
The main exploration targets in the deep part of the Xujiaweizi fault depression include the lower Cretaceous Huoshiling formation, the Shahezi formation, Yingcheng Formation and the Denglouku formation. The analysis of natural gas accumulation conditions shows that the source rocks of Shahezi
and Huoshiling formations in Xujiaweizi fault depression are large in thickness, wide in distribution area and high in evolution. The reservoirs of Yingcheng Formation volcanic rocks and Yingying four member sandy conglomerate are stable, almost all over the Xujia weizi fault depression. The two section of the doutlouku formation and the one or two member of the Quantou Formation are mainly composed of dark mudstones, which are stable in distribution and become good regional cap rocks. "Source, Reservoir, Cap, Trap, Migration and Preservation" match well in time and space. The Xujiaweizi fault depression has good reservoir forming conditions [2-5]. There are different gas and water distribution rules and controlling factors in volcanic rock of Ying 1 member and sandy conglomerate of Ying 4 member, which are independent gas reservoirs.

According to the test results of sandy conglomerate reservoirs in the working area, there are 4 wells with industrial gas, and 5 of them have low production gas. The sandy conglomerate reservoir in the four member of Yingcheng formation is located on the upper part of the volcanic rock gas reservoir of Yingcheng Formation, which has favorable conditions for accumulation of natural gas. The sandy conglomerate reservoir in the four section of Yingcheng formation is massive, and the distribution of natural gas is controlled by reservoir property. The sandy conglomerate gas reservoir in Yingcheng Formation four is lithologic gas reservoir. The fluid distribution of volcanic gas reservoirs in Yingcheng formation has obvious characteristics of upward and downward flow. The gas reservoir is controlled by the lithology and structure. The type of gas reservoir is lithologic - tectonic gas reservoir.

2.2. Physical property analysis of reservoir
The gas reservoir types in Xingcheng area are mainly volcanic reservoir and sandy conglomerate reservoir [6]. The physical properties of glutenite reservoir are most affected by the original sedimentary condition (sand content) to the physical properties of sandy conglomerates, followed by late diagenetic alteration, and again the influence of buried depth. According to the analysis of 59 full diameter cores, the porosity distribution is from 0.8% to 10.1%, with an average of 4.7%, and the permeability is 0.04-5.88 mD. And the average permeability is 0.57 mD. Compared with volcanic reservoirs, Glutenite reservoirs are characterized by low porosity and high permeability (Fig. 1). Volcanic rocks in Xingcheng area are mainly pyroclastic rocks, and rhyolitic ignimbrite and rhyolite tuff are well developed. The total diameter core of the volcanic rock in Xingcheng area is 243. The porosity of the rock is 1.8-18.8%, the average porosity is 5.3%, the permeability is 0.01-13mD, and the average permeability is 0.35mD. The statistical results show that the physical properties of the
Ying 1 volcanic reservoir in Xingcheng area are large and heterogeneous. Lithology is closely related to physical properties (Fig. 2). The permeability of ignimbrite is generally greater than 1 mD, and the agglomerates and tuff which are not developed by cracks are generally less than 1 mD.

2.3. Characteristics of gas reservoir
Vertical migration is the main migration type of natural gas in Xingcheng area. Hydrocarbon source rocks of Shahezi group and Huoshiling group provide abundant gas source for the formation of upper Yingcheng Formation gas reservoir. The large fault is both a channel for magmatic eruption and a channel for natural gas migration, which is of great significance for the formation of volcanic gas reservoirs. The formation of volcanic structures is related to the formation of structural traps. The near fire belt is also a reservoir development zone, which can form good reservoirs.

3. Reservoir forming model
The gas wells in the Xingcheng area of Xujiaweizi fault depression revealed that the hydrocarbon accumulation pattern of the Shahezi formation and the Huoshiling formation. It was that gas migrated vertically through the fracture or the unconformable surface to the volcanic rock and the gravel reservoir of the upper Yingcheng formation. Yingcheng Formation gas reservoir is mainly formed by lower sources and upper reservoirs (Fig. 3).

4. Conclusions
(1) The two gas bearing systems of Yingcheng Formation in the Xingcheng area of Xujiaweizi fault are similar in physical properties and belong to low porosity and low permeability reservoirs. The reservoir in Ying 4 member is mainly affected by the original sedimentary condition (sand content), and later diagenesis is also very important. The reservoir of Ying 1 is mainly affected by diagenesis and later reformation. The lithology is closely related to physical property, and the development of fracture has a great influence on permeability.

(2) The sandy conglomerate gas reservoirs in Ying 4 member in the Xingcheng area of Xujiaweizi fault depression are lithologic gas reservoirs. The volcanic gas reservoirs in Ying 1 member are lithologic and structural gas reservoirs.
(3) The accumulation mode of natural gas reservoirs in the Xingcheng area of Xujiaweizi fault depression is mainly in lower sources and upper reservoirs. And the natural gas migrates vertically along the fault.

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