Research on sequence division and Sedimentary characteristics of Shahezi formation in Xu Dong of Xujiaweizi fault depression

Jiaxiang Di 1, Yuanchang Zhang 2

1 Daqing Oil Field Co exploration and Development Research Institute, Daqing, Heilongjiang 163712
2 BGP INC ., China National Petroleum Corporation, Zhuozhou, Hebei 072750
2712872@qq.com

Abstract. In view of the unclear division of sequence stratigraphy and the unclear understanding of sedimentary characteristics of Shahezi Formation in Xu Dong of Xujiaweizi fault depression, a detailed study on the division of sequence stratigraphy of Shahezi Formation in Xu Dong area of Xujiaweizi fault depression was carried out by using the data of Vail sequence stratigraphy. The sedimentary facies types and plane distribution characteristics of Xu Dong area were analyzed in combination with single well facies and material source supply, etc. The study showed that Shahezi Formation in Xu Dong area could be divided into a second-order sequence, and the interior could be further divided into four third-order sequences. At the early stage of sedimentation, the lake water was relatively deep and fan delta sedimentary system was mainly developed. In the middle period, the lake basin became wider and fan delta and braided river delta sedimentary systems developed. In the late period, the lake basin was basically stable and braided river delta sedimentary system was developed.

1. Geological survey
Xu Dong Sag generally presents a structural pattern of high in the east and low in the west. The eastern gentle slope belt starts from Song Station in the north and goes to Chaoyanggou in the south. It is spread from the north west to the south east, with the Xu Zhong fault on the west, the settlement center of Xujiaweizi fault depression in the middle, and the Xu Dong slope zone on the east. The structural pattern of the eastern slope belt uplifting from west to east is favorable for the natural gas formed in the central area of the fault depression to migrate and accumulate along the Xu Dong fault to the high part of the slope.

2. Sequence stratigraphic division

2.1. Sequence boundary
According to Vail’s theoretical knowledge, we can divide the Shahezi formation into three third-order sequences in Xudong area, which are $T_4^{4c}$, $T_4^{4b}$ and $T_4^{4a}$. There are two secondary sequences at the top and bottom. (Fig. 1).

$T_{42}$ is the bottom boundary of Shahezi Formation. The strata below $T_{42}$ are obviously truncated. Huoshiling Formation of xudong is the envelope surface of disordered reflection strata. Obviously different reflection structures can be seen above and below the interface. The strata above the interface
have obvious superfeatures. T41c is between the sequence of SQ1 and SQ2. The reflection below the interface is characterized by medium-high frequency and medium-strong amplitude, which is continuous. The reflection above the interface is characterized by low frequency and weak amplitude, which is discontinuous. T41b is between the sequence of SQ2 and SQ3. The reflection below the interface is characterized by low frequency weak amplitude and discontinuity, while the reflection above the interface is characterized by medium frequency medium weak amplitude and discontinuity. T41a is between the sequence of SQ1 and SQ2. The reflection below the interface is characterized by medium-frequency medium-weak amplitude and discontinuity. The reflection above the interface is characterized by medium-high frequency medium-strong amplitude and continuity.

Fig. 1 Seismic characteristics of Shahezi formation in XuDong

2.2. Sequence stratigraphic characteristics

The Formation of Shahezi in Xu Dong Sag can be divided into SQ1, SQ2, SQ3 and SQ4.

SQ1 is characterized by interbedding of gray glutenite and gray-black mudstone, coal-bearing line, and curve features of high resistance, low sound wave, low gamma, and seismic reflection features of a group of mat-like parallel medium-frequency strong amplitudes.

SQ2 is a large set of thick glutenite. The curve is characterized by high resistance, low sound wave and low gamma. Seismic reflection is characterized by a group of low-frequency weak amplitudes.

SQ3 is mainly sandstone with thin layers of mudstone. The curve is characterized by high resistance, low sound wave and low gamma. Mudstone is gray. The seismic profile is characterized by medium frequency and weak amplitude reflection.

SQ4 is mainly composed of mudstone, with black and grayish black color and thin sandstone. The curve is characterized by low resistance, high sound wave and low gamma. The seismic profile is characterized by continuous reflection with medium-high frequency and medium-strong amplitude.

3. Sedimentary system analysis

According to the core and its scanned image data, combined with mud logging, logging and seismic data, the main sedimentary facies types and characteristics in the study area are analyzed, and it is determined that fan delta sedimentary facies, braided river delta sedimentary facies is mainly developed in Shahezi Formation of Xu Dong Sag. They are mainly lacustrine deposits. Fan delta deposits are developed in the lower part of the eastern slope belt.

3.1. Braided river delta facies

The fan delta in Xu Dong area can be divided into the fan delta plain and fan delta fron. The glutenite in the fan delta plain phase is moderately rounded, poorly sorted, low in compositional maturity, massive in structure, supported by particles between gravels, locally supported by
miscellaneous bases, with different angles of gravels and no directional arrangement. The single well is thick glutenite with thin mudstone, and the seismic profile is characterized by weak amplitude-medium continuous-low frequency reflection.

The lithology in the fan delta front is mainly gray-white gravel coarse sandstone with medium sorting, locally interbedded with conglomerate bands, subangular conglomerate, medium sorting and low compositional maturity. The single well is interbedded with medium-thick glutenite and thin-layer mudstone, with coal seams.

3.2. Braided delta facies
According to the characteristics of logging, lithology and core, the Xu Dong sag is mainly deposit braided delta plain and braided delta front.

Braided delta plain is interbedded of glutenite and mudstone on single well, with relatively high sand ground, coal seam, and strong amplitude-medium high continuous-medium high frequency reflection characteristics on seismic profile.

The braided delta front single well is interbedded with glutenite and thin mudstone, with coal seams, and has strong amplitude-high continuity-medium and high frequency reflection characteristics on seismic profile.

4. Plane Distribution Characteristics of Sedimentary Facies
According to well data and seismic data in Xudong area. The western part of the depression is mainly lake facies and the eastern part is fan delta (Figure 2).

During SQ1 development period, the lake water was relatively deep, and three fan bodies were developed under the supply of multiple material sources. The fan bodies had a small extension range and were mainly fan delta sedimentary systems.

During the SQ2 development period, the lake basin became wider and the fan body scale also expanded, developing fan delta and braided river delta sedimentary systems.

During the development of SQ3 and SQ4, the lake basin was basically stable, and braided river delta sedimentary system was mainly developed under the continuous supply of eastern provenance.

The early sedimentary strata are widely distributed in the north of xudong, due to factors such as material source and ancient water flow direction, the sedimentary range shrinks to the north and expands to the east and west.
5. Conclusions

In Xu Dong Sag, The Shahezi Formation can be divided into four third-order sequences, there are SQ1, SQ2, SQ3 and SQ4 respectively.

The Shahezi Formation in Xu Dong Sag has three sedimentary types: fan delta, braided river delta and lacustrine facies. Huxiang deposit is mainly developed in the western part of the study area, fan delta deposit is developed in the eastern part of the sag in the early period, and braided river delta
deposit is developed in the late period. Among them, fan delta developed fan delta plain and front deposit. Braided river delta develops braided river delta plain and front deposit.

The early sedimentary strata are widely distributed in the north and south, and in the later period, due to factors such as material source and ancient water flow direction, the sedimentary range shrinks to the north and expands to the east and west.

References

[1] Wu Yinye, Zhu Rukai, Luo Ping, Yuan Xuanjun, Hou Lianhua, Zhang Tianshu J 2011 Advance on Sedimentology and Sequence Stratigraphy: A Summary from 18th International Sedimentology Congress (Chinese: Acta Sedimentologica Sinica) 29(1): pp 199–206

[2] Jiang Zaixing J 2010 Studies of depositional systems and sequence stratigraphy: the present and the future (Chinese: Oil&Gas Geology) 31 (5): pp 535–541

[3] Hu Fei, Liu Zhaojun, Meng Qingtao, Cheng Yongcheng, Xu Jinjun, Cheng Lijuan J 2012 Cenozoic Sequence and Sedimentary Characteristics and Its Control on Source Rock in Dunhua Basin, Yanbian Area (Chinese: Jilin University: Earth Science Edition) 42 (Sup.2): pp 33–42

[4] Bu Tao J 1999 Sequence Stratigraphy Characteristics During the Faulting Period in the North of Songliao Basin (Chinese: Chengdu University of technology) 26 (4): pp 382–384

[5] Yin jingen, Liu Hefu, Chi Haijiang J 2002 Evolution and Gas Accumulation of Xujiaweizi Depression in Songliao Basin (Chinese: Acta Petrolei Sinica) 23 (2): pp 26–29

[6] Li Xia, Fan Yiren, Yang Liwei J 2006 An application of the wavelet transformation to sequence stratigraphy (Chinese: Petroleum Geology & Oilfield Development in Daqing) 25 (4): pp 112–115

[7] Gu Jiayu J 1995 Sequence stratigraphic modes of the terrigenous lacustrine basin (Chinese: Petroleum Exploration and Development) 22 (4): pp 12–17

[8] Liu Xihu, Dang Yimin, Yang Bo J 1998 Deep Layer Sedimentary Characteristics to the East of Daqing Placanticline in North part of Songliao Basin (Chinese: Petroleum Geology & Oilfield Development in Daqing) 17 (5): pp 16–18

[9] Luo Jiaqiang, Ren Yanguang, Wu Chaodong, Liu Wenlong J 2010 Research of Sedimentary Facies of Forth Member of Yingcheng Formation in Xujiaweizi Fault Depression in the Songliao Basin (Chinese: Petroleum Geology and Experiment) 32 (2): pp 140–146