Sequence Division and Sedimentary characteristics of Shahezi formation in Northwest Xujiaweizi fault depression

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Abstract. In the light of the unclear current conditions of the sequence stratigraphic framework division and sedimentary for Shahezi Formation in Northwest Xujiaweizi fault depression. Based on single well, well logging and seismic data, the stratigraphic sequences of the formation are confirmed with the help of Vail sequence stratigraphy theory. Based on the single well facies and source supply, the sedimentary facies types and the distribution characteristics of the Northwest of Xujiaweizi are analyzed. The studies show that Northwest Shahezi Formation can be divided into one second-class sequences and furthermore it can be classified into four third-class sequence: Fan delta sedimentary facies is developed in the west of study area, braided river delta sedimentary facies is developed in the east of study area, lacustrine facies is developed in the central sag; In the Northwest of the Shahezi formation, the area of the lake basin in the early stage of the sedimentary basin is small, and the latter is gradually enlarged, lake facies is the main one and the fan is mainly developed in the East and the West in this area.

1. Geological survey
Sequence stratigraphy is the most effective way to search for deep oil and gas traps. At present, there is no uniform standard for Shahezi sequence of Xujiaweizi depression. In this paper, the stratigraphic and sedimentary characteristics of the Shahezi Formation in Xuxibei area are studied by using the three-dimensional seismic data re-processed and interpreted in order to lay a foundation for reservoir prediction and well location optimization in this area. The Xujiaweizi fault depression underwent three stages of structural evolution, namely, inoculation, development and atrophy. The sedimentary period of Huoshiling Formation is the gestation stage of fault depression, the sedimentary period of Shahezi Formation is the development stage of fault depression, and the sedimentary period of Yingcheng Formation is the shrinking stage of fault depression. The northwestern part of Xujiaweizi Fault Depression in the Northern Songliao Babin consists of three parts from west to east: the central paleo-fault-uplift zone in the west, Xuxi Depression zone in the middle and Shengping Uplift zone in the east, connecting to the main body of Xuzhong Uplift. Within this deep framework are developed such geologic processes as stratigraphic overlaps and denudations, which have formed some types of traps.

2. Sequence stratigraphic division
2.1 Sequence boundary
Recognition of sequence boundary and system tract interface is the key to sequence stratigraphic division and correlation. According to Vail sequence stratigraphy theory, the Shahezi Formation can
be divided into three third-order sequence boundaries, which are $T_4^{1c}$, $T_4^{1b}$ and $T_4^{1a}$ from bottom to top. Shahezi top $T_4^3$ and Shahezi sub $T_4^2$ are two second-class sequences interfaces. (Fig. 1)

$T_4^2$ is the bottom boundary of the Shahe formation, usually below the volcanic rock deposit of the Huoshiling formation. A large number of overlying deposits can be seen above the eastern interface, and the Western interface terminates at the XuXi fault. $T_4^{1c}$ is the sequence boundary between SQ2 and SQ1 of Shahezi Formation. Most of them are scattered reflections above and most of them are parallel continuous reflections below. The reflective interface is greatly influenced by basement morphology. The depression and Eastern gentle slope zone are parallel to $T_4^2$, and the steep slope in the West terminates at fault.$T_4^{1b}$ is the sequence boundary between SQ3 and SQ2 of Shahezi Formation. Both the upper and lower boundaries are scattered reflections. The reflection characteristics of the lower boundaries are stronger than those of the upper boundaries, and the reflection boundaries are parallel to the lower boundaries. The reflection interface is greatly influenced by the basement morphology.

$T_4^{1a}$ is the boundary of sequence SQ4 and SQ3 of Shahezi Formation, and the reflection feature above the boundary is medium amplitude parallel reflection, below the interface is medium amplitude chaotic reflection, and the reflection interface is parallel to the lower interface; $T_4^1$ is the top boundary of Shahezi Formation, and above the interface. It is mainly the volcanic rock of Yingcheng Formation and the clastic rock of the target layer below it. The interface is mostly eroded by the underlying strata on the surface of the seismic section.

![Fig. 1 Contact relation of sequence boundary of Shahe sub group in XuXi Weizi fault depression](image)

2.2 Sequence stratigraphic characteristics
The Shahezi Formation in the northwestern Xujiawei formation can be divided into four fourth-order sequences through the stratigraphic reflection interface, from bottom to top are SQ1, SQ2, SQ3 and SQ4.

SQ1 is composed of glutinite with thin mudstone. The curves are characterized by high resistivity, low acoustic wave, low gamma ray and a series of continuous weak-medium strong reflection.

SQ2 is a thick layer of glutinite with thin mudstone. The curve features are high resistance, low sound wave and low gamma. Seismic reflection is characterized by a set of moderately strong reflections, and the top of the reflection has a strong amplitude-in-phase axis with clear characteristics and good continuity.
SQ3 is mainly composed of mudstone and thin sandstone. The curve features are low resistivity, Bagama; mudstone black. The characteristics of seismic profiles are continuous reflection of medium amplitude and ladder structure of logging curves.

SQ4 is a series of strata with great variation of sedimentary thickness. Because the top of the strata is eroded, the residual thickness of the present structure varies greatly from tectonic location to tectonic location. The lithology is dominated by thick mudstone with sandy conglomerate. The curves are characterized by low resistivity, high acoustic wave and low gamma. In the middle trench of the seismic section, the weak amplitude is more continuous reflection, and in the West overlap zone and the east slope break zone, the weak amplitude is more continuous seismic facies.

3. Sedimentary system analysis
According to the characteristics of well logging, seismic response, sedimentary sequence and sand body distribution, the fan delta sedimentary facies is mainly developed in the Shahezi Formation near the Xuxi fault zone in the northwestern Xujiaweizi fault depression, deltaic sedimentary facies is mainly developed in the eastern slope zone and braided fluvial deltatic (sedimentary) facies is developed in the middle sag zone.

3.1 Braided river delta facies
The Braided River Delta is a coarse clastic delta formed by braided water flowing into a stable water body and is one of the important sedimentary systems rich in oil and gas. According to the lithologic characteristics, the braided delta sedimentary facies can be divided into three subfacies, namely, the braided delta plain subfacies, the braided delta front subfacies and the braided delta front subfacies. The front braided delta in Northwest Xuzhou has entered the shore-shallow lake area, and the subfacies in this paper are divided into braided fluvial delta plain and braided fluvial delta front only.

3.2 Fan delta facies
Generally, fan delta sedimentary facies is divided into three subfacies, namely fan delta plain subfacies, fan delta front subfacies and front fan delta subfacies. Because the front fan delta in Northwest Xuzhou has entered the shore-shallow lake area, and its lithology is light-colored and dark gray mudstone with a small amount of sandstone and siltstone, it is difficult to distinguish from lacustrine deposits, the subfacies can only be divided into two types: fan delta plain and fan delta front.

3.3 Lake facies
Lakes are places where land is relatively low-lying and water is collected. The main lithology is mainly composed of black, grey black, dark purple massive mudstone and thin sandstone. Because of the complex hydrodynamic conditions, the strong scouring and screening of Lake waves, and the complex and diverse sedimentary structures, the conventional logging curves are mostly low amplitude dentate lines.

4. Sedimentary evolution characteristics of Shahezi development
The plane distribution characteristics of sedimentary facies in Northwest Xuzhou area are described by single well facies combined with seismic attributes analysis. Fan delta deposits in the west, braided river delta deposits in the East and lacustrine deposits in the middle sag (Fig. 2).

During the development period of SQ1, the lake basin was small, the water body was shallow, and the provenance direction came from East and West directions. Fan delta deposits were developed on the steep slope in the west, braided river delta deposits were developed on the East and West slopes in the west, and the plain deposits on the East and west sides were denuded because of the uplift and denudation of the late Shahezi Formation. Continental front deposits and braided river delta front deposits.

During the SQ2 development period, the basin controlled faults developed, the lake basin expanded and the water body deepened. The Western fan delta develops and the braided river delta develops in
the East. On the plain, the fan delta front and the braided river delta front have smaller and different sizes than SQ1. The fan delta plain is eroded completely, and the braided river delta plain distributes only a little in the northeast.

During the SQ3 development period, the lake basin continued to expand, the water body deepened, the depositional range of the Western fan delta expanded, and the depositional range of the braided river delta on the east side was further narrowed. The depositional range of the eastern side was smaller than that of the western side.

During the development of SQ4, due to the Xujiaweizi fault depression, the whole uplift of the eastern part of the stratum was subjected to weathering and denudation. In the eastern part of the area, only the lacustrine deposits remained, and the braided river delta plain deposits were completely denuded. Deposition.

5. Conclusions
The Shahezi Formation in the northwestern Xujiaweizi fault depression is a second-class sequence, which can be divided into four third-class sequences from bottom to top, namely SQ1, SQ2, SQ3 and SQ4.

Fan delta, Braided River Delta and lacustrine deposits are developed in the Shahezi Formation in Northwest Xujiaweizi. Delta deposits are mainly developed in the west, braided river delta deposits in the East and lacustrine deposits in the middle sag. Fan delta developed fan delta plain and front deposits, braided river delta developed braided river delta plain and front deposits.

The Lake Basin of Shahezi Formation in Northwest Xujiaweizi was small in the early stage, and gradually enlarged in the later stage. The lake facies deposits were dominant in the whole, and the fans were mainly developed in the eastern and Western margins.
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