Multidisciplinary Journal of Geology and Earth Sciences
Volume 10 Issue 2, April-June 2022
ISSN: 2995-3669
Impact Factor: 6.75
http://kloverjournals.org/journals/index.php/ges

YUKAR'S FOSSILIZED CANVAS: AN IN-DEPTH EXPLORATION OF THE MIDDLE JURASSIC SHIMENGOU FORMATION"

Hui Ling Chen
School of Resources & Environment, Henan Polytechnic University, Jiaozuo, China

Abstract: The study delves into the sequence stratigraphy of the Shimengou Formation in the Yuqia area, within the backdrop of a continental basin's sedimentary dynamics. Sequences, as intricate sedimentary entities, emerge from the cyclic ebb and flow of relative lake levels, demarcated by sequence unconformity surfaces and corresponding conformity interfaces. Essentially, they represent chronostratigraphic isochronous interfaces. A comprehensive sequence comprises lowstand, transgressive, and highstand system tracts, contingent on the initial and maximum lake flooding surfaces within the sequence. Through employing sequence stratigraphy, this research unveils the lithofacies paleogeography of the Shimengou Formation, offering valuable insights for precise sequence stratigraphic delineation in this locality

Introduction

Under the sedimentary background of continental basin, sequence is a set of three-dimensional stratigraphic sedimentary bodies with genetic connection formed in the periodic change of relative lake level, which is separated by sequence unconformity surface and corresponding conformity surface (sequence interface). It is actually a chronostratigraphy isochronous interface, and a complete sequence is divided into lowstand system tract, transgressive system tract and highstand system tract according to the initial lake flooding surface and maximum lake flooding surface within the sequence. In this paper, the sequence stratigraphy method is used to analyze the lithofacies paleogeography of the Shimengou Formation in Yuqia area, aiming to provide reference for the sequence stratigraphic division in this area.

1. Geological overview

The Qaidam Basin is the third largest inland basin in China and is located in the northeastern part of the Qinghai-Tibet Plateau (Dang et al,2003). It now belongs to the intersection of the Tethys-Himalayan tectonic domain and the Paleo-Asian tectonic domain. The Qaidam Basin is separated from the surrounding tectonic units by a series of large faults. The northern part of the Qaidam Basin is adjacent to the South Qilian fold system, and the boundary is the Zongwulongshan-Qinghai Nanshan fault (Hu et al,2001; Lv et al,2011). The southern part is connected with the East Kunlun orogenic belt, and the boundary is the Kunbei fault. The eastern part is connected with the western Qinling orogenic belt, and the boundary is the Elashan fault. The western part is adjacent to the Tarim Basin, and the boundary is the Altun fault[1-2].

The Qaidam Basin is roughly located in the north latitude 25°-30° (Feng et al, 2019), in the Jurassic, which belongs to the southern region of the Jurassic continental basin group in the northwest. The

southern part is separated from the Neo-Tethys Ocean through the Kunlun orogenic belt. The Tarim, North China and Yangtze blocks are located on the west, north and east sides, respectively. The tectonic evolution of the Qaidam Basin is closely related to the adjacent blocks.

The Jurassic in the northern margin of Qaidam Basin is mainly exposed in the northern block fault zone and the western Altun piedmont area (Zhao et al,2000). The seismic profile shows that a large area of Lower Jurassic is developed in the southwest of the northern margin of Qaidam Basin, but the buried depth is large and not easy to expose. The Lower Jurassic and Middle Jurassic are mainly characterized by a set of dark gray to gray-white coal-bearing rock series, ranging from hundreds of meters to thousands of meters thick, and a large number of animal and plant fossils can be seen, which is commonly known as 'black Jurassic'.

The Middle Jurassic Shimengou Formation is continuously deposited on the Dameigou Formation, which basically covers the distribution area of the Dameigou Formation and is divided into the lower and upper sections (Wang et al,2018). The lower of the Shimengou Formation is mainly gray-white fine conglomerate, gravel-bearing coarse sandstone and dark gray mudstone, with fine sandstone and siltstone, and coal seams are developed in the upper part. Stem fossils can be seen in coarse-grained sediments, and root fossils and siderite nodules can be seen in fine-grained sediments. The formation thickness is between 70-200 m. The lithology of the upper of the Shimengou Formation is mainly gray black thin oil shale, containing pyrite nodules. The lower part of the oil shale is gray massive fine sandstone, dark gray siltstone and mudstone. Thin coal seams are developed and the formation thickness is 60-160 m.

2. Identification of key sequence interface

(1) Gravel strata at the bottom of Shimengou Formation

The bottom of the Shimengou Formation is a set of white, gray-white sandstone and gravel-bearing coarse sandstone, also known as 'bean curd residue sandstone' in the Tuanyushan area. It is thick, loose in lithology, softens in water, mainly composed of quartz, and has a high content of kaolinized feldspar. The Dameigou area is mainly composed of gravel river channel and cross-shore deposits beside the river channel. The lithology is gray-white fine conglomerate with a thickness of several meters or tens of meters, with large wedge-shaped cross bedding. The Shimengou Formation of Wanggaxiu in the Delingha Sag is directly angularly unconformable to the Lower Carboniferous limestone. The bottom is purple conglomerate of alluvial fan or fluvial facies. The gravel composition is sandstone and conglomerate. The gravel diameter is 3-30 cm, supported by argillaceous matrix. It is a regionally comparable third-order sequence boundary[3-4].

(2) Sandstone layer at the bottom of upper Shimengou Formation.

In the Dameigou Formation area, it is gray-white fine conglomerate, coarse sandstone and medium sandstone in the distributary channel of the lower delta plain. The Zaodatouyang section is gray-white thick conglomerate eroded at the bottom of the upper delta plain channel. In the Yuka area, it becomes gray-white pebbly sandstone and lakeshore sandstone deposits in the distributary channel of the lower delta plain. It is relatively stable and can act on the third-order sequence interface.

3. Paleogeographic characteristics of system tracts in sequence framework of lower Shimengou Formtion

The coal-bearing section in the lower part of the Shimengou Formation deposited gray-black mudstone, silty mudstone, siltstone, fine sandstone, coarse sandstone and coal seam, with pebbly sandstone deposits at the bottom. The bottom boundary of the sequence is the scour surface at the bottom of the distributary channel, and the lowstand system tract, transgressive system tract and highstand system tract are developed in the whole area. The bottom surface of the first layer of stable mudstone, silty mudstone or siltstone and other fine-grained rocks above the channel glutenite is the initial flooding surface. In the upward deepening sequence, the bottom surface of the shore-shallow lacustrine mudstone, interdistributary bay silty mudstone or the layer repeated on the section and the thickness of the thickest layer is the maximum flooding surface. The lowstand system tract is the most developed in Beishan area, which is coarse sandstone and pebbly coarse sandstone deposited in braided river alluvial plain and delta plain distributary channel. The delta plain interdistributary bay and interdistributary bay swamp deposits are developed in the lake transgression system tract. The lithology is mudstone, siltstone, sandy mudstone and coal seam, with thin layer of fine sandstone and medium sandstone of crevasse splay. The delta plain interdistributary bay, distributary channel crevasse splay and natural levee are well developed in the highstand system tract. The peat swamp is only developed in local areas, and the sediments are siltstone mudstone, siltstone, fine sandstone and medium sandstone.

(1) Low system domain

The lowstand system tract is formed in the period of increasing accommodation space caused by the slow occurrence of lake transgression in the lower part of Shimengou Formation. It is best developed in Beishan exploration area, and the total thickness of strata is more than 200 m on average. The thickness of the strata in the Jianyang River exploration area is generally between 20-80 m, the thickness of the strata in the Gaxiu and Erjingtian exploration area is between 20-40 m, and the thickness of the strata in the eastern Yuka and the first well field exploration area is between 30-80 m. The system tract is mainly composed of coarse sandstone and pebbly coarse sandstone sediments.

The main paleogeographic units in the sedimentary period of the lowstand system tract include : 1) alluvial fan, mainly developed in the east of Beishan, and the thickness of glutenite is more than 160m ; 2) Sandy and gravel braided river, developed in the western and central of Beishan, Yangshuihe exploration area and a mine area near Lvliangshan, the thickness of glutenite is between 160 to 50m ; 3) Meandering channel, covering the study area outside the alluvial fan and sandy, gravelly braided channel, the thickness of glutenite is usually less than 50 m. In addition to the Dakendaban Mountain, there is another secondary source near the Lvliang Mountain. It can be speculated that the Dakendaban Mountain was a relatively stable uplift area at that time, which provided the sediment source of the Yuka fault depression for a long time. The Lvliang Mountain was a small paleo-uplift at that time, and it was often covered by lake water into an underwater paleo-uplift[5-6].

(2) Lake transgressive system tract

The lacustrine transgressive system tract is mainly composed of mudstone, siltstone, sandy mudstone and coal seam of delta system. Carbonaceous mudstone and fine sandstone are also developed in some areas. The lacustrine transgressive system tract can be seen in the whole area of Yuqia area. The overall thickness of the system tract is between 8-260 m. The thickness of the strata in the amniotic fluid river and Gaxiu exploration area is 20-80 m. The thickness of the strata in the east of Yuqia, the second well field and the first well field is 40-160 m.

The main paleogeographic units were meandering river floodplain with sand-mud ratio (code name 'S / N') greater than 0.7, upper delta interdistributary bay (0.7 > S / N > 0.5), and lower delta underwater interdistributary bay (S / N < 0.5).

(3) High system domain

The highstand system tract is composed of mudstone, siltstone, fine sandstone and carbonaceous mudstone. The total thickness of the system tract is between 10-130 m, and the main body is between 40-100 m. The sedimentary center is located in the eastern part of Yuqia and Beishan area, and the thickness of the stratum is more than 70 m. The second well field area lacks highstand system tract, which is presumed to be eroded by the lowstand system tract of the upper sequence. The main paleogeographic units of the sedimentary period are the meandering river floodplain facies belt distributed in the amniotic fluid river and Beishan area, the upper delta plain interdistributary bay facies belt covering the central part of the Yuka area, the lower delta plain underwater interdistributary bay facies belt near the southern Lvliang Mountain, and the underwater delta and shore shallow lake in the western part of the Gaxiu exploration area.

4. Paleogeographic characteristics of system tracts in sequence framework of upper Shimengou Formtion

During the sedimentary period of the upper of the Shimengou Formation, the lake level expanded on a large scale and the sedimentary range was wide. The main lithology was dark gray and dark brown shale, oil shale and mudstone deposits, containing siderite nodules, representing deep-water basin facies deposits. At the bottom of the sequence, there are siltstone, medium sandstone, local coarse sandstone and gravel coarse sandstone, which are shore-shallow lake facies and delta facies deposits. The bottom boundary of the sequence is the scour surface of the river channel at the edge of the basin. The lowstand system tract is only developed in the eastern part of Gaxiu, the eastern part of Yuqia, Erjingtian and Beishan, and the transgressive system tract and the highstand system tract are distributed in the whole area. The initial flooding surface is located in the mudstone overlying the sandstone, and the maximum flooding surface is located at the bottom of the upward deepening sequence representing the deepest oil shale and shale to the thickest. Compared with the lower of the Shimengou Formation, with the rise of the lake level, the range of the paleo-uplift decreases. The Dakendabanshan paleo-uplift in the east is covered by water, and the Lvliangshan in the south is still a paleo-uplift, and the area of the sedimentary area increases. The delta environment is only developed in the local areas of the Erjingtian and Beishan, and the remaining areas mainly develop a shallow lake and a semi-deep lake-deep lake environment. The transgressive system tract and highstand system tract mainly develop delta front, shore lake, shallow lake, semi-deep lake and deep lake deposits, and

develop a sequence of upward thinning of lithology, reflecting the sedimentary environment of shore-shallow lake, semi-deep lake and deep lake in this sequence.

(1) Low system domain

The main lithology of lowstand system tract is medium sandstone and fine sandstone with siltstone. Sandstone and conglomerate thickness (code name 'C'). The main paleogeographic units in this sedimentary period include : 1) alluvial fans, mainly distributed in the eastern part of Beishan area, with glutenite thickness greater than 160 m ; 2) Sandy and gravel braided river, distributed in the east of Yangshui River and Yuka, the west of Beishan exploration area, is sandy conglomerate thickness between 50-160 m ; 3) meandering channel (50m > C > 20m), 4) upper delta plain distributary channel (50m > C > 10m) and 5) lower delta plain underwater distributary channel (C < 10m) are distributed in the exploration areas of Gaxiu, Erjingtian and Yijingtian.

(2) Lake transgressive system tract

The Yuqia study area of the lake transgressive system tract is developed. In the west of the Yuqia area, it is mainly composed of gray-black siltstone and mudstone. In the east, a thick layer of fine sandstone appears. The thickness of the system tract is between 10-110 m. The sedimentary center is located in the Gaxiu and Beishan exploration areas. The average thickness of the strata is more than 80 m. During this sedimentary period, the lake transgression extended from south to north. Along the direction of lake transgression, underwater delta-shore shallow lake (S / N < 0.3), underwater interdistributary bay in lower delta (0.5 > S / N > 0.3), interdistributary bay in upper delta plain (0.7 > S / N > 0.5), meandering river floodplain (1.0 > S / N > 0.7) and braided river alluvial plain (S / N > 1.0) were successively distributed in Yuqia area. The provenance of this period is still mainly from the Dakendaban paleo-uplift in the north and east of the basin.

(3) High system domain

The highstand system tract is the result of the largest lake transgression in the upper of the Shimengou Formation, and represents the largest lake transgression in the Middle Jurassic in the study area. The sediments are mainly composed of thick layers of upward thinning deep-water shale and oil shale. The area where oil shale is distributed is defined as deep lake and semi-deep lake, and there is no oil shale area, such as the shallow lake environment in the Erjingtian.

5. Conclusion

The Middle Jurassic Shimengou Formation is developed in the Yuka area on the northern margin of Qaidam Basin, and the strata are intact. Based on the third-order sequence stratigraphic framework, the lithofacies paleogeography of Shimengou Formation was restored according to the system tract. The lithofacies paleogeography of the sub-system tracts shows that the low-stand system tracts are mainly filled with alluvial fans, sandy and gravelly braided rivers, meandering rivers and delta plain distributary channels. The transgressive system tract is mainly composed of river floodplain, delta interdistributary bay, meandering river floodplain and braided river alluvial plain, while the highstand system tract is mainly deep lake, semi-deep lake or shore-shallow lake.

References

Lv Baofeng, Zhang Yueqing, Yang Shuyi. Characteristics of Structural System and Its Implication for Formation Dynamics in Qaidam Basin [J]. Geological Review, 2011, 57(2):167-174.

Feng Qiao, Fu Suotng, Zhang Xiaoli, et al. Jurassic prototype basin restoration and hydrocarbon exploration prospect in the Qaidam Basin and its adjacent area [J]. Earth Science Frontiers, 2019, 26(1): 44-58.

Wang Tao, Liu Zhaojun, Sun Pingchang, et al. Sandstone detrital composition and provenance tectonic attributes of Middle Jurassic Shimegou formation in Yuqia arer of Qaidam Basin [J]. World Geology, 2018, 37(01):154-161.

Dang Yuqi, Hu Yong, Yu Huilong, et al. Petroleum geology in the northern margin of Qaidam Basin [M]. Beijing: Geological Publishing House, 2003.

Zhao Wenzhi, Jin Yongqiang, Xue Liangqing, et al. Formation and evolution of Jurassic prototype basins in Northwest China [M]. Beijing: Geological Publishing House, 2000.

Hu Shouquan, Guo Wenping, Cao Yunjiang, et al. Tectonic Framework and Structure Evolution of Mesozoic and Cenozoic in Northern Margin of Qaidam Basin[J]. Xinjiang Petroleum Geology, 2001, 22(1): 13-16.