



Sedimentary Microfacies and Favorable Area Prediction of Xiaganchaigou Formation in Paleogene, Western Qaidam Basin

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Abstract. In order to clarify the sedimentary facies characteristics and favorable reservoir facies zones of Xiaganchaigou Formation in the west of Qaidam Basin, the sedimentary facies marks are determined by detailed core observation, and the logging facies model is established by combining logging data. Field geological outcrops provide high-precision three-dimensional sedimentary body display characteristics. Based on this, the sedimentary microfacies and distribution characteristics are analyzed. The results show that the main sedimentary facies types of Xiaganchaigou Formation are alluvial fan, river, delta, fan delta, lake and sublacustrine fan. Alluvial fan (fan delta), braided river, meandering river and lacustrine facies are developed in the margin of the basin. Delta front, fan-delta front, shallow lake, beach bar and carbonate deposits are favorable reservoir facies belts in Xiaganchaigou Formation. According to the superimposed relationship of source-reservoir-cap assemblage, it is pointed out that Altun Mountain front, Yuejin-Dongchaishan and Dafengshan area are favorable oil accumulation zones.

Keywords: Tsaidam Basin, Ganchaigou Formation, depositional facies, favourable facies belt.

1 Introduction

The Paleogene in the west of Qaidam Basin is a typical inland salt lake deposit, and it is also one of the horizons with the largest oil and gas reserves and the highest production in the basin at present (Figure 1). A number of geological basic studies have been carried out in this area^[1-9]. Sedimentary facies is the key geological factor for oil and gas accumulation in the Kunlun piedmont^[5-7]. A great deal of research has been done on the reservoir of the lower member of Xiaganchaigou Formation in Qaidam Basin, but systematic sedimentary facies analysis is rarely reported. At present, because the Paleogene oil and gas in Qaidam Basin are mainly located in the west and southwest of the basin, the study of Paleogene sedimentary facies is mainly focused on these two areas, the west is composed of alluvial fan-fan delta-lake sedimentary

system, and the southwest is composed of alluvial fan-braided river-braided river delta-lake sedimentary system^[7-10]. Based on the cores of 12 wells and logging data of more than 50 wells in the study area, this paper analyzes the types and characteristics of sedimentary facies, and clarifies the distribution law of favorable sedimentary facies belts in the study area, in order to provide geological basis for oil and gas exploration of west Qaidam Basin.

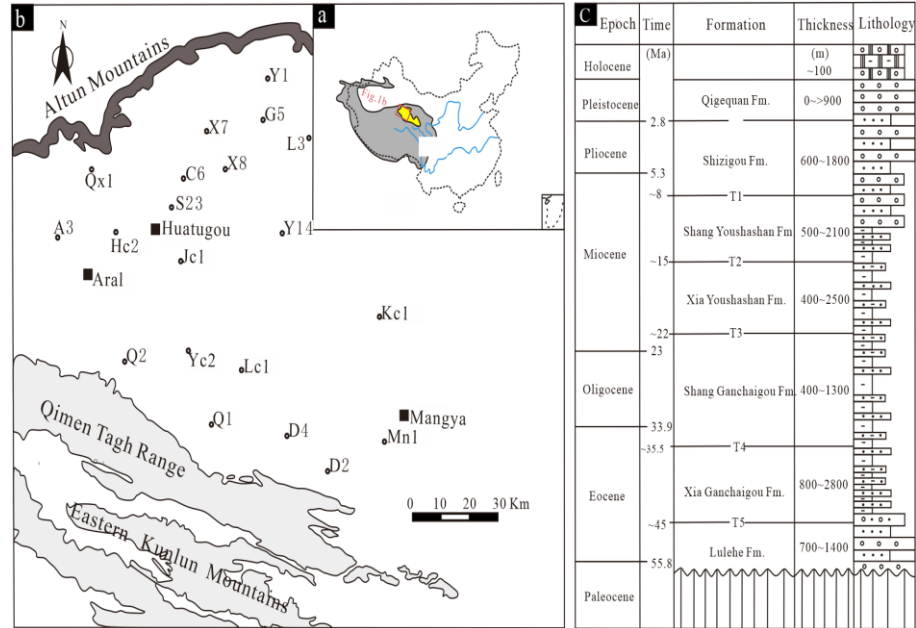


Fig. 1. Location of the study area and stratigraphic histogram

2 Geologic setting and stratigraphy

Located in the northeast of Qinghai-Tibet Plateau, Qaidam Basin is an important Mesozoic-Cenozoic continental oil-bearing basin in northwest China^[5-7]. In the Cenozoic, there was a long-term and large-scale ancient salinized lake in western Qaidam, and a set of extremely thick Cenozoic sediments were deposited. Therefore, Cenozoic is the main sedimentary sequence in western Qaidam. The Cenozoic in western Qaidam contains eight sets of strata from bottom to top: Paleogene Lulehe Formation, lower member of Xiaganchaigou Formation, upper member of Xiaganchaigou Formation, upper ganchaigou Formation, Neogene Lower Youshashan Formation, Upper Youshashan Formation, Shizigou Formation and Quaternary Qigequan Formation. The marginal area of the basin is greatly influenced by the land supply, and coarse-grained sediments such as alluvial fan facies and river-delta facies are developed, while the vast lakeside-shallow lake facies sediments are mainly fine-grained mixed rocks, showing strong mixed sediments of terrigenous debris and carbonate^[8-9].

3 Sedimentary facies types

Comprehensive analysis of a large number of cores, drilling and outcrop sections shows that several sedimentary facies types, such as alluvial fan, fluvial, delta, fan delta, lacustrine facies and sublacustrine fan deposition, are developed in the Xiaganchaigou Formation of Paleogene in western Qaidam (Figure 2).

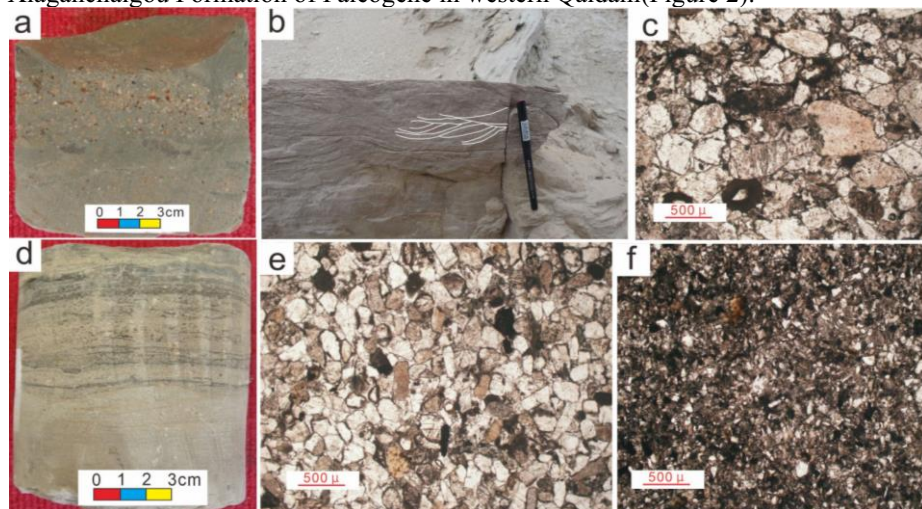


Fig. 2. Sedimentary characteristics of cores and field outcrops of Xiaganchaigou Formation in western Qaidam Basin. (a) Massive conglomerate, Y68; (b) Trough cross-bedding, Dongchaishan; (c) Coarse sandstone, Dongchaishan; (d) Fine sandstone, LV13; (e) Medium sandstone, Dongchaishan; (f) Fine sandstone, Dongchaishan^[9]

3.1 Alluvial fan

Alluvial fans are mainly distributed in the piedmont of Altun Mountain and Kunlun Mountain with steep slopes, with large scale and contiguous distribution. Rock types are mainly glutenite, argillaceous conglomerate and a small amount of sandstone and mudstone. Gravel rocks are mainly characterized by variegated colors, low rock maturity, clastic support structure, poor sorting and grinding. Large oblique bedding and cross bedding which are not obvious can be seen in coarse clastic sediments.

3.2 Fluvial

Xiaganchaigou Formation in western Qaidam has two types of fluvial facies, meandering river and braided river. The braided river can be transformed into alluvial fan facies opposite to the basin edge, and it can be transformed into meandering river facies or delta facies downstream. The sediments in the meandering river are mainly glutenite, medium-coarse sandstone, silty sandstone and mudstone interbedded with unequal thickness, with a binary structure of typical fluvial facies deposition, and the fabric at the lower part of the binary structure is undeveloped. The vertical sequence

of braided river shows the characteristics of positive cycle from glutenite to medium coarse sandstone and silty sandstone from bottom to top. The main characteristics are coarse grain size, well-developed glutenite, thin fine-grained sediments in flood plain and coarse-grained debris accumulation in the heart beach.

3.3 Delta

After the Aral River system entered the Qaidam basin, a large delta was formed in Aral and Yuejin areas on the western edge of the basin. The sediments are mainly fine debris. Delta plain subfacies are mainly composed of sandstone and mudstone. The microfacies lithology of branch channel is mainly gray-white, light gray fine sandstone and siltstone, and parallel bedding, trough and plate cross bedding are common. The natural dike sand body is composed of fine to siltstone. Due to the strong scouring ability and frequent diversion of underwater distributary channels, the channels are often scoured and often exist in the form of interlayers.

3.4 Lacustrine

The Paleogene basin in Qaidam has the characteristics of large basin, slow bottom shape and shallow water body. Semi-deep lake-deep lake facies is mainly developed in Shizigou area, with fine grain size and deep color, mainly mudstone and shale, and thin interlayer of limestone and chemical rock is developed. From the shore to the center of the lake, the grain size changes from coarse to fine. Shallow lake sediments in western Qaidam can be divided into three types, namely muddy shallow lakes, carbonate shallow lakes and sandy beach bars. Shaly shallow lakes are mainly developed in areas with insufficient supply of terrigenous clastic materials. Rock types are mainly clay rock and siltstone, with a small amount of sandstone thin layer or sandstone lens. Sandy bars mainly developed in the middle period of deposition of Xiaganchaigou Formation with medium-fine sand and silty sand being the most common.

3.5 Sublacustrine fan

Sublacustrine fan is a fan-shaped clastic rock mass caused by deep-water gravity flow, which can be directly injected into deep-water area by flood gravity flow, or it can be formed by rapid accumulation of sediments in the delta front. The former is fine in particle size and small in scale; The latter is large in scale and coarse in particle size. Flood-type and sliding-step-type sublacustrine fans are developed in the strata of Xiaganchaigou Formation in western Qaidam, which are mainly controlled by paleostructure and paleotopography. The lithology is mainly gray thick layered fine conglomerate, sandstone mixed with calcareous mudstone.

4 Distribution of sedimentary facies

4.1 Lower member of Xiaganchaigou Formation

There are alluvial fans in front of Altun Mountain. Alar to Hongliuquan area, Yuejin area and Dongchaishan area in the north, and Huangshi, Nanwus and Jianfeng Mountain in the south mainly form delta facies belt. In other areas, the slope of paleotopography is more gentle, and the river alluvial plain is mainly developed. Shore-shallow lake subfacies are widely developed in the central depression zone, and relatively deep semi-deep lake-deep lake facies are distributed in Shizigou, Youquanzi, Beiwus and Xiaochaishan. In Shizigou area, there are transitional deposits of gypsum salt lake and carbonate lake, which alternate frequently with semi-deep lake facies vertically (Figure 3).

4.2 Upper member of Xioganchaigou Formation

The basin area of the upper member of Xiaganchaigou Formation is relatively wide, and the semi-deep lake area is widely distributed from Shizigou to Tulinbao. The fan delta and alluvial fan of coarse clastic deposits are in Altun slope belt. Delta facies is developed in Alar and Yuejin areas. In the late stage, due to the uplift of Kunlun Mountain, the lake basin began to migrate from south to north and from west to east, and the distribution of semi-deep lake subfacies in the western region was discontinuous, and the distribution area also decreased. Fan delta facies develops in the west Duan Yiran of Altun slope belt, and the delta in Yuejin area extends to the oil sand mountain area in the basin (Figure 3).

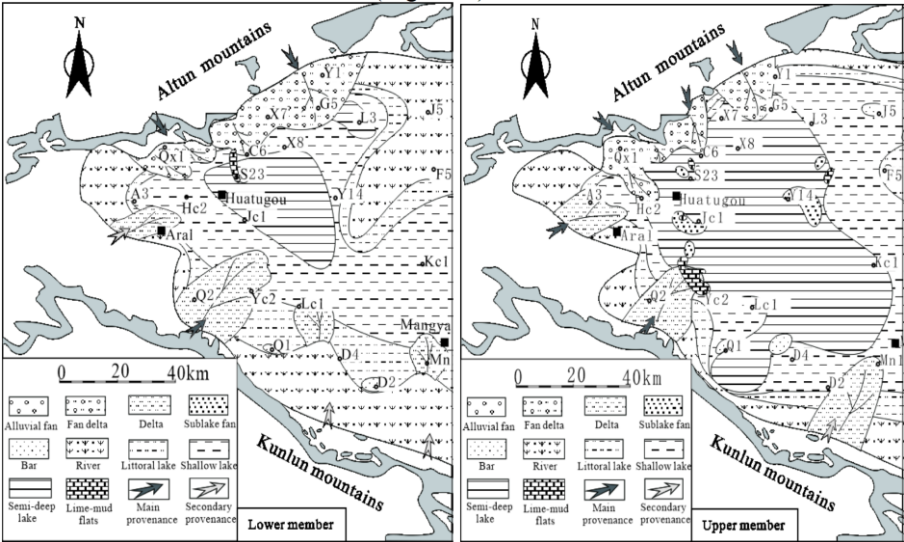


Fig. 3. Sedimentary facies of Xiaganchaigou Formation in western Qaidam Basin

5 Distribution of favorable reservoir facies belts

The research results of plane distribution of sedimentary facies of Xiaganchaigou Formation in western Qaidam show that there are abundant types of favorable reservoir rock facies belts in this area. The reservoir types mainly include delta front sand body, channel sand body, shallow lake beach sand body and lake bottom fan sand body. The reservoir of Xiaganchaigou Formation in Qaidam Basin has obvious mixing characteristics, mainly the mixing of clastic particles and carbonate. The favorable reservoirs are mainly in Shizigou-Ganchaigou area in the western segment of Altun slope. This area is located in the sedimentary background of semi-deep lake-deep lake facies, with good oil source conditions, mainly fan delta front sandstone and lake bottom fan facies glutenite reservoir and delta facies clastic rock. Secondly, Dongchaishan-Huangshi area, the reservoir is mainly delta front and beach bar sand body.

6 Conclusion

(1) Several sedimentary facies types, such as alluvial fan, fluvial, delta, fan delta, lacustrine facies and sublacustrine fan, developed in the Xiaganchaigou Formation in western Qaidam.

(2) The reservoir of Xiaganchaigou Formation in Qaidam Basin has obvious mixing characteristics, mainly the mixing of clastic particles and carbonate. The favorable reservoirs are mainly in Shizigou-Ganchaigou area in the western segment of Altun slope. It is mainly fan delta front sandstone and lake bottom fan facies glutenite reservoir and delta facies clastic rock. Secondly, Dongchaishan-Huangshi area, the reservoir is mainly delta front and bar sand body.

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