
Characteristics of Lower Cretaceous sedimentary facies and high-quality source rock of Tonghua basin

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Abstract

In order to study the sedimentary facies and source rock characteristics of the Lower Cretaceous in Tonghua basin and their factors, this paper has carried out a field investigation of petroleum geology and geochemistry tests of source rock in Tonghua basin. The result shows that the Lower Cretaceous in Tonghua basin sedimentary environment is mainly coastal shallow-lake subfacies, deep and semi-deep lacustrine subfacies and braid delta facies. As the deposition time later and later, the braided river delta gradually extended to the center of lake. Combining with the measured geochemical data, its organic matter abundance reaches secondary standards and types of organic matter are all II-III type. So, the basin develop high-quality source rock.

Keywords

Tonghua basin, Lower Cretaceous, sedimentary facies, geochemical characteristic

1. Introduction

Tonghua basin is located in the east of Jinlin province, which is from Daquan Yuan Village of Tonghua Country in the south to Sanyuan Pu Town of Liuhe Country in the north and from Wangqing Men Town of Liaoning Province in the west to Tonghua City in the east^[1]. The area of Tonghua Basin is about 1417km² (Fig. 1). So far, the region has been completed basic geological work, such as regional geological characterization and magnetoelectric^[2], which has the characteristics of low degree of prospecting and unclear resource potential. Moreover, drilling well of TongD1 has been seen good oil and gas in the siltstone of Hengtong Shan group of Lower Cretaceous and shales fracture of Xiahua Pidianzi group. So, at the beginning of the exploration, it is particularly important to study the sedimentary facies characteristics of the Lower Cretaceous Tonghua Basin affecting petroleum and gas generated, which will provide scientific basis for further study of petroleum and gas exploration.

2. Regional Geological Survey

Tonghua basin basement is Archaean-Proterozoic Erathem metamorphic rocks^[3-4]. The sedimentary cover of Tonghua basin is belong to Upper Paleozoic and Mesozoic-Cenozoic formation. Tonghua basin evolution went through four stages, including the middle Jurassic chasmic stage, lava filling of early Cretaceous, volcanic eruption sedimentary stage and again lava filling^[5]. At the stage of two, the basin formed small lakes. At the stage of three, the climate of the basin was gradually damp after a massive volcanic eruption. The tension of the basin is characterized by a steady subsidence, formed the Cenozoic strata. From bottom to top, Sedimentary strata of Lower Cretaceous develops Guosong group(K_{1g}), Yingzui Lazi group(K_{1y}), Linzi Tou group(K_{1l}), XiaHua Pidianzi group(K_{1x}) and Hengtong Shan group(K_{1h}) in Tonghua basin. The type of rocks is conglomerate, fine sandstone, mudstone and volcanic rock and so on (Table. 1)^[6-7]. Existing research shows that sedimentary water

is deep in the eastern of Jilin province sedimentary. Source rocks of Tonghua basin is lacustrine dark mudstone and shale^[8-9].

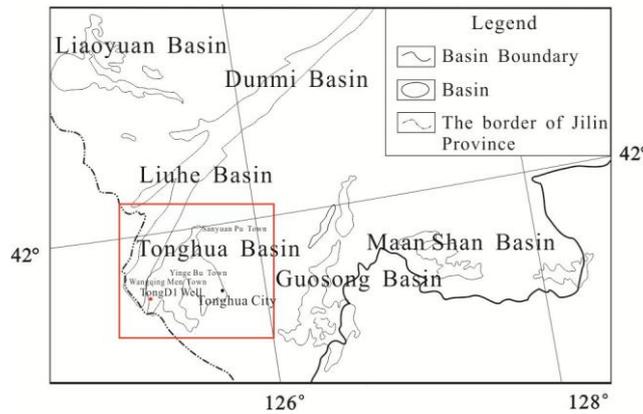


Fig.1 The location of Tonghua Basin

Table 1.The profiles of Lower Cretaceous strata in Tonghua basin

Formation	Lithology
Hengtong Shan group(K _{1h})	Fine sandstone and siltstone, shale tuffaceous sandstone powder fine sandstone and siltstone, shale tuffaceous sandstone
Xiahua Pidianzi group(K _{1x})	Black mud shale powder sandstone
Linzi Tou group (K _{1l})	Conglomerate, sandstone, basalt, andesite and small amounts of mud shale
Yingzui Lazi group(K _{1y})	Dark mudstones and argillaceous siltstone
Guosong group(K _{1g})	Volcanic breccia and volcanic agglomerate, dacite, tuff

3. The characteristics of vertical sedimentary facies of Lower Cretaceous and high-quality source rock

By observing to Yingzui Lazi group(K_{1y})formation of Lower Cretaceous in the Hongmiao Zi village of Tonghua basin, the types of rock mainly contains micropsammite and clay shales, with a small amount of plant fossil(Table 2). Due to the development of flat upper sand body, extending better, therefore, vertical sedimentary environment of Lower Cretaceous Yingzui Lazi group(K_{1y})is lake facies and fan delta facies.

Table 2.The types of rock of Lower Cretaceous Yingzui Lazi group in the Hongmiao Zi village of Tonghua basin

Yingzui Lazi group(K _{1y})	Lithology
upper	Gray green fine sandstone, siltstone with black siltstone and shale
middle	Gray siltstone with black shale
lower	Green green, black shale with siltstone and a small amount of plant fossil

In term of the measured section of Xiahua Pidianzi group(K_{1x})(Fig. 2), in the north mountain of Yingge Bu mountain of Tonghua basin. The lower is coarse sediment, the sedimentary environment is braided river delta front subfacies and lake beach dam subfacies. Upper is fine grained sediment with Lycoptere fossils (Fig. 3). The sedimentary environment is coastal shallow-lake and semi-deep lake subfacies.

By observing to Hengtong Shan group(K1h)formation of Lower Cretaceous in the Laoxi Chang village of Xinbin country in Tonghua basin, its lithology is black thick silty mudstone and mudstone with thin layers of argillaceous siltstone and rich Conchostraca fossils, such as leaf segments interface fossils (Fig. 4)[10]. Quality of mudstone is pure, development horizontal bedding, which is a set of typical deep and semi-deep lake facies.

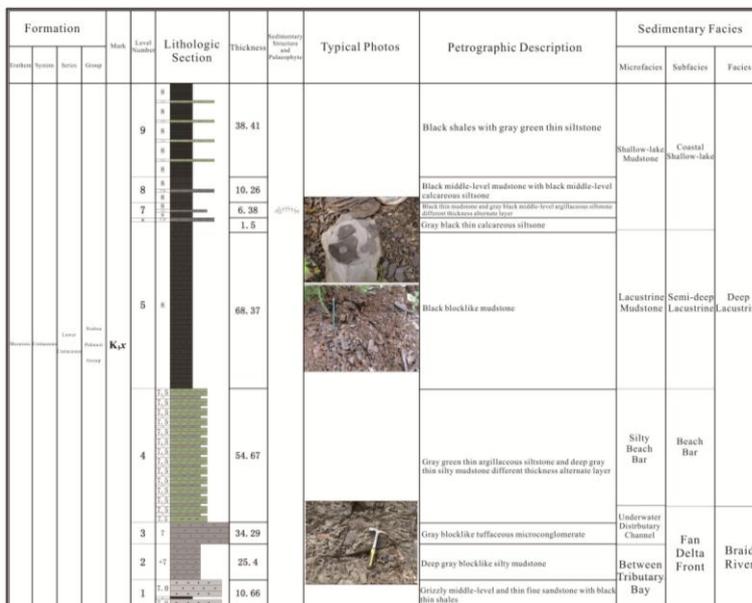


Fig.2. The integrated histogram of sedimentary facies of Xiahua Pidianzi group(K1x) in the north of Yinge Bu mountain of Tonghua basin



Fig.3. Lycopodium fossils



Fig.4. Conchostraca fossils

Table 3. The geochemical characteristics of Lower Cretaceous in the Tonghua basin

Basin	Formation	Source Rock	TOC/%	Organic Matter Abundance	Organic Matter Type	Origin
Tonghua	Hengtong Shan group(K1h)	Dark mudstone	<u>0.647~2.789</u> 1.1(33)	middle	II-III	TongD1 well
	Yingzui Lazi group(K1y)	Dark mudstone	<u>0.07~2.20</u> 0.98(20)	middle	II-III	Field outcrop

Through field geological survey and paleontological appraisal, the Tonghua of Lower Cretaceous is given priority to with terrigenous clastic sedimentary, mainly for coastal and shallow lake facies, sedimentary environment and semi-deep lake facies and braided river delta facies, mudstone shale content is higher, and found the animal and plant fossils, which is advantageous to the line into organic matter types for II-III high-quality hydrocarbon source rocks (Table 3). Due to the influence

of coastal and shallow lake subfacies, the silt content of mudstone of Xiahua Pidianzi group(K1x) is relatively higher. Conjointing the geochemical related data, confirmed that Yingzui Lazi group(K1y), Xiahua Pidianzi group(K1x) and Hengtong Shan group (K1h) of Lower Cretaceous are high-quality hydrocarbon source rock development. Organic carbon content is higher, the organic matter abundance medium to standard (Table 3). Because of dark mudstone samples of Lower Cretaceous Yingzui Lazi formation group(K1y) from the field outcrops, influenced by a certain weathering, so the organic carbon content is low.

4. The characteristics of transverse sedimentary facies of Lower Cretaceous

In the sedimentary period of Guosong group(K1g), it was the first time volcano eruption happened in Tonghua basin happened. Therefore, the sedimentary environment is volcanic rock facies (Fig. 5).

Tonghua basin is characterized by terrigenous clastic deposits in the time of Yingzui Lazi group(K1y). Detrital material mainly comes from the north of the basin, filling to the south of basin. Its sedimentary facies types, in turn, is the alluvial fan, braided river delta-lacustrine facies (Fig. 6). The south of Sanyuan Pu town developed braided river delta, entering the lake basin, Sanke Yushu town and Yinge Buzhen town are all mainly lacustrine depositional environment.

In the Linzi Tou group(K1l) sedimentary period, the basin tectonic activity is relatively flat and the sedimentary pattern basically remain unchanged. Because of the filling and polishing affect of terrigenous clastic, braided river sedimentation developed near sanyuanpu town(Fig. 7).

In the Hengtong Shan group(K1h)and Xiahua Pidianzi group(K1x) sedimentary period, great changes have taken place of provenance direction in Tonghua basin. The river system that comes from the south of the basin sends lots of terrigenous clastic substance to basin. The braided river delta major developed in Wangqing Men town, Sanke Yushu town, Yinge Bu town and the south area. Tonghua county, tonghua city, Ermi town and Sanyuan Pu town are characterized by coastal shallow-lake facies (Fig. 8).

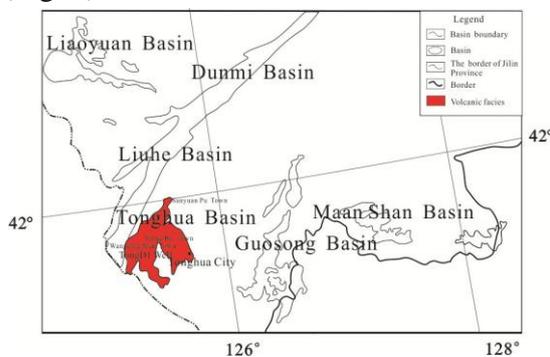


Fig.5. The sedimentary facies of Guosong group(K1g) in the Tonghua basin

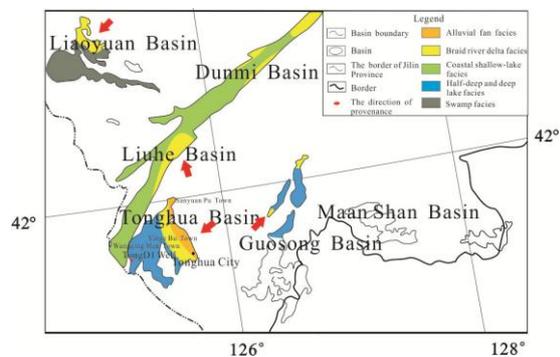


Fig.6. The sedimentary facies of Yingzui Lazi(K1y) group(K1y) in the Tonghua basin

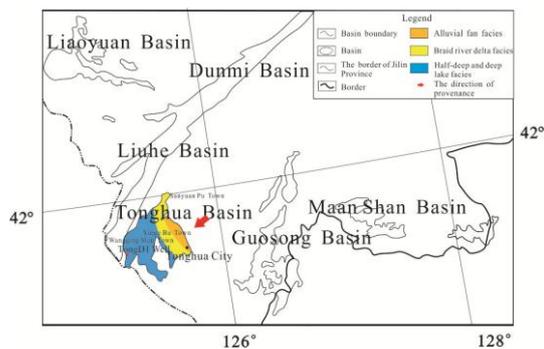


Fig.7. The sedimentary facies of Linzi Tou group(K1l) in the Tonghua basin

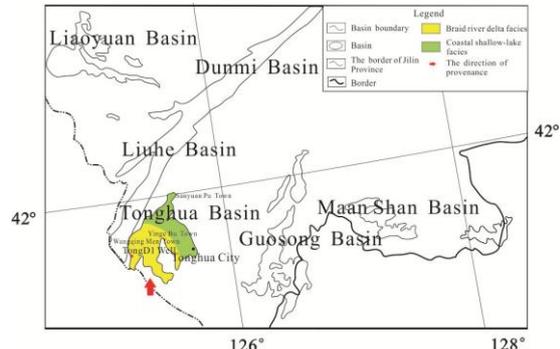


Fig.8. The sedimentary facies of Hengtong Shan group(K1h) in the Tonghua basin

In the period of Lower Cretaceous, mainly, coastal shallow-lake subfacies, deep and semi-deep lacustrine subfacies and braid delta facies are developing in the Tonghua basin. As sedimentary time later and later, braid river gradually extends to the center of lake and provenance gradually comes from the south of the basin.

5. Conclusion

Sedimentary environment of Lower Cretaceous in the Tonghua basin is mainly coastal shallow-lake subfacies, deep and semi-deep lacustrine subfacies and braid delta facies. The sedimentary water is deeper and the argillaceous content of mudstone is higher. The sedimentary period of Hengtong Shan group of Lower Cretaceous develops typical deep and semi-deep lacustrine facies. Due to the sedimentary environment effect, organic matter abundance of source rock in Tonghua basin reaches secondary standards and types are all II–III, which is characteristic of high-quality source rock in the basin. Provenance direction of Lower Cretaceous in the Tonghua basin mainly comes from the north of the basin. As sedimentary time later and later, braid river gradually extends to the center of lake and provenance gradually comes from the south of the basin.

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