

Evaluation of Source Rocks in Sanjiang Basin of Nadanhada Terrane

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Abstract

Nadanhada terrane is the only marine Mesozoic stratum in northern China. In view of the discovery of light oil in its rock fissures, the evaluation of source rocks was carried out by geochemical method with organic matter abundance as the basic index. The average content of organic carbon in siliceous rocks in Fuyuan area was determined to be 0.64%, mainly distributed between 0.07% and 1.89%. The evaluation of organic matter abundance in terrestrial source rocks was compared. According to the criteria of classification and evaluation of marine source rocks abroad, it is concluded that the source rocks in this area are better source rocks.

Keywords

Source rocks, Nadanhada terrane, Organic matter abundance.

1. Introduction

Northeast China is situated between the Siberian plate, the North China plate and the Pacific plate. The geotectonic location belongs to the overlapping position of the eastern margin of the Central Asia-Mongolia mega-orogenic belt and the Pacific tectonic domain. It is a mega-orogenic belt with the longest history of development and the most complex tectono-magmatic activities known in China. This area involves the assemblage of small continental blocks in the Paleo-Asian Ocean tectonic domain, the accretion of terranes in the circum-Pacific tectonic region, and the mechanism and age of the transformation process between the two tectonic domains. It is the key area to study the process and mechanism of plate tectonic subduction. The Wandashan orogenic belt occurs in the eastern part of Northeast China and is located at the intersection of the eastern margin of the Central Asia-Mongolia mega-orogenic belt and the overlapping and accretion of the Pacific tectonic domain. Therefore, it is of great geological significance to reveal the overlapping and transformation of the two tectonic domains. The Wandashan orogenic belt is a typical accretive complex belt formed by subduction and collage of the Pacific plate, which is similar to the Nadanhada terrane or Wandashan terrane^[1].

2. Evaluation of Source Rocks

In recent years, the research and evaluation of source rocks have become an important tool for effective prediction and discovery of oil and gas resources. The evaluation of source rocks has very important guiding significance in oil and gas exploration. The evaluation of source rocks has become one of the important contents of oil and gas exploration and evaluation of major foreign oil companies. The abundance of organic matter is one of the important evaluation indexes^[2].

2.1 Abundance index of organic matter

The abundance of organic matter refers to the quantity of organic matter in a unit mass sample. In the similar geological conditions, the higher the abundance of organic matter, the stronger the hydrocarbon generation ability. A sufficient amount of organic matter in rocks is the basis of hydrocarbon formation. The abundance of organic matter mainly develops from total organic carbon (TOC), chloroform asphalt "A", total hydrocarbon (HC) and petroleum pyrolysis hydrocarbon

generation potential. In this paper, total organic carbon is discussed as the main index. As shown in Table 1 and Table 2.

Table 1 Evaluation Criteria for Organic Matter Abundance of Continental Source Rocks

indicators	types of lake basin water bodies	non-source rock	source rocks			
			poor	medium	good	best
TOC/%	Freshwater-brackish water	<0.4	0.4~0.6	>0.6~1.0	>1.0~2.0	>2.0
	Salt water-super saline water	<0.2	0.2~0.4	>0.4~0.6	>0.6~0.8	>0.8
Chloroform asphalt "A" /%		<0.015	0.015~0.05	>0.05~0.1	>0.1~0.2	>0.2
HC/ppm		<100	100~200	>200~500	>500~1000	>1000
S1+S2/mg·g ⁻¹			<2	2~6	>6~20	>20

Table 2 Classification and Evaluation Criteria of Marine Source Rocks Abroad
(Based on Early Oil Generation Window)

Hydrocarbon generating potential	shale			carbonate rocks
	TOC%	S1(mg/g)	S2(mg/g)	TOC%
Poor	0~0.5	0~0.5	0~0.25	0~0.2
Fair	0.5~1.0	0.5~1.0	2.5~5.0	0.2~0.5
Good	1.0~2.0	1.0~2.0	5.0~10.0	0.5~1.0
Very good	2.0~5.0	>2.0	>10.0	1.0~2.0
Excellent	>5.0			>2.0

2.2 Sample Organic Carbon Testing

In the process of hydrocarbon generation in source rocks, some hydrocarbons have been discharged. The residual carbon in rocks, also known as residual organic carbon content, has been measured in laboratory^[3]. Organic carbon is usually expressed by the percentage of organic matter to rock mass. Because C element is dominant in organic matter and its content is relatively stable, TOC is used to reflect the abundance of organic matter. The pyrolysis data of 184 drilling samples and 71 profiles in Liao Basin were analyzed, and the frequency histogram of organic carbon was obtained as shown in Fig. 1. The main frequency of organic matter in source rocks of the first member of Qingshankou Formation is 2-3%, which is consistent with relatively stable water environment; the distribution range of organic matter in the lower part of Nenjiang Formation 2 and upper part of Nenjiang Formation 1-5% and 1-3% respectively in the western slope area, which is similar to the evolution characteristics of water environment; the organic matter in the lower part of Nenjiang Formation 2 of overlap zone in the western slope area is mainly concentrated in 1-5%; the Qingjiatuozi section is Qingjiatuozi section. TOC in the lower part of the second member of Shankou Formation is mainly 1-4%; organic matter in the upper part of the first member of Qingshankou Formation in Bird River Section is mainly between 0-1%; organic matter in the lower part of Nenjiang Formation and upper

part of Nenjiang Formation in Houjinguo Section is between 4-6% and 0-1% respectively; organic matter in the lower part of Nenjiang Formation in Yaojia Station is between 0-3%.

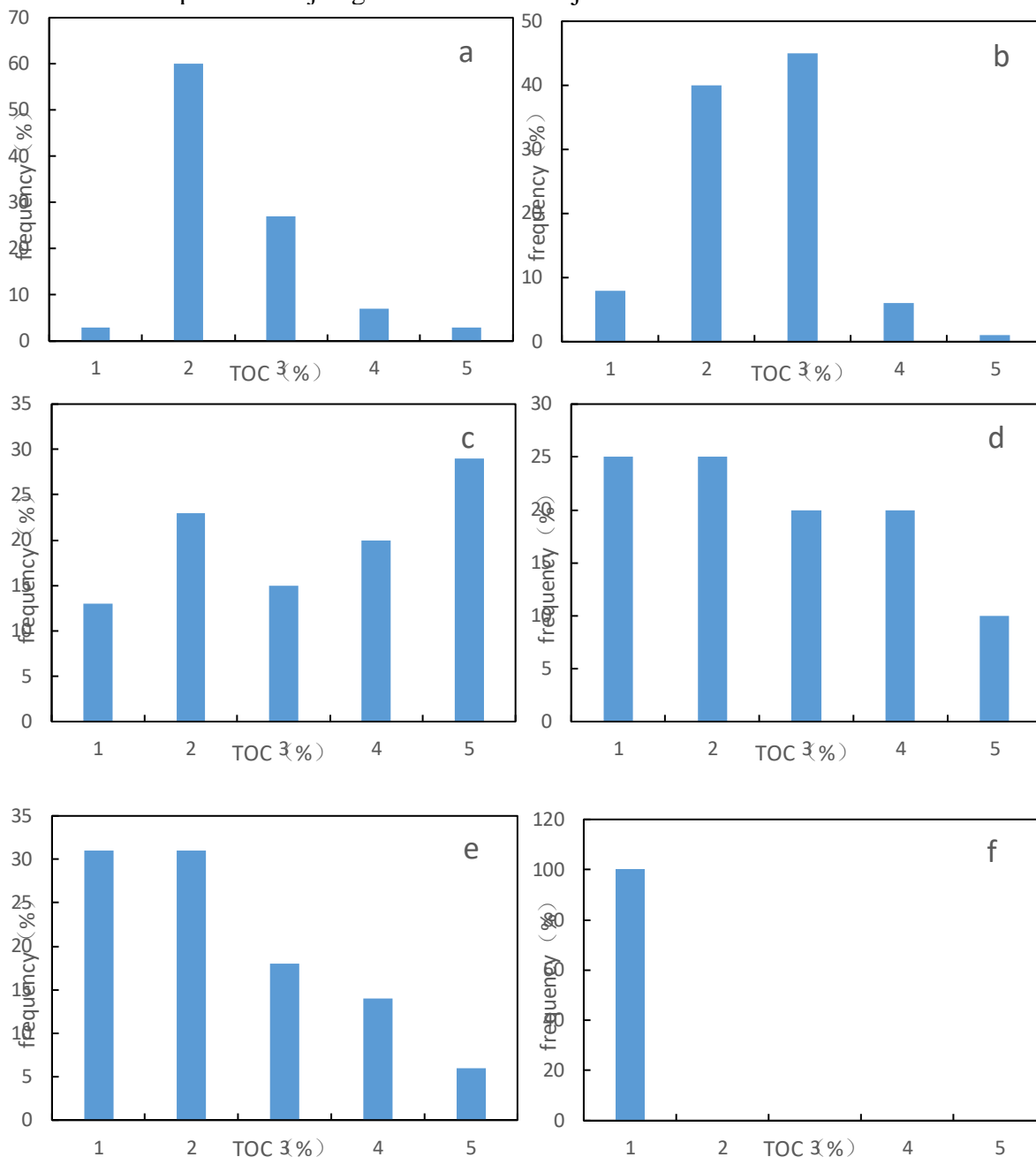


Fig. 1 Distribution of TOC from wells and sections

The above tests show that the organic carbon content in this area is better from the point of view of total organic carbon content and belongs to medium hydrocarbon source rocks.

3. Conclusion

The average organic carbon content of siliceous rocks in Fuyuan area is 0.64%, mainly distributed between 0.07% and 1.89%. At present, there is no evaluation standard for organic matter abundance of siliceous source rocks in China. According to the evaluation criteria of organic matter abundance of continental saline-ultrasaline source rocks in China, they belong to good source rocks. However, due to the low content of clay minerals in siliceous rocks, which are similar to carbonate rocks and have poor adsorption capacity for organic matter, the standard of organic matter abundance should be lower than that of mudstone. According to the standard of organic matter abundance of marine

carbonate source rocks abroad, it also meets the standard of good organic matter abundance of source rocks.

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