

Research Advances

Discovery of Oil and Gas Shows in the Lower Cretaceous of the Hongmiaozi Basin, Southeastern Songliao Peripheral Basin

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Objective

The Hongmiaozi Basin in the southeastern part of the Songliao peripheral basin is a new oil and gas exploration area with a very low exploration level. This basin covers an area of 795 km². It is adjacent to the Liuhe Basin and Tonghua Basin in the north, and to the Huanren Basin in the south. In order to identify the basic oil and gas geological characteristics, the deep structures and the potential of oil and gas resources in the basin, the Oil and Gas Survey of China Geological Survey carried out oil and gas geological investigation and exploration in this area, and deployed several geological survey wells.

Methods

In this study, comprehensive field geological survey, cross-section measurement and geological drilling were used to study the hydrocarbon geological conditions of the Hongmiaozi basin. Total organic carbon, rock pyrolysis, chloroform bitumen “A”, vitrinite reflectance, organic matter type identification and the other geochemical analytical methods were utilized to identify the hydrocarbon generation potential of source rocks in this basin.

Results

The multi-layer oil and gas shows with abnormal gas measurements were first discovered in the Lower Cretaceous of the Hongmiaozi Basin (Figs. 1a–e). The oil and gas shows in the Hongdi No. 1 well are 50 layers with an accumulative thickness of 24.42 m, a maximum single layer thickness of 3.65 m and with the gasometric abnormality maximum of 24.01%; and the oil and gas of the Liaoxindi No.1 well shows 39 layers with an accumulative thickness of 102.78 m and a maximum thickness of 16.8 m

and the gasometric abnormality maximum of 9.93%. The core of the oil and gas showed a bright yellow fluorescence and the dropping water color was milky yellow (Figs. 1b and d), and the core with oil and gas show drip slowly infiltrated and half-bead shape (Fig. 1e).

The thick dark mud shale with good hydrocarbon potential developed in the Lower Cretaceous of the Hongmiaozi Basin. The accumulated thickness of dark shale of Lower Cretaceous Xiahuapidianzi Formation was 317.65 m and the maximum single layer thickness was 24.85 m by the Hongdi No.1 well. According to the Liaoxindi No.1 well, the cumulative thickness and maximum single layer thickness of dark shale in the Yingzuilazi Formation are 167.73 m and 16.03 m, respectively. The organic geochemical testing shows that the TOC of Lower Cretaceous Xiahuapidianzi Formation in Hongmiaozi Basin ranges from 0.12% to 5.31% with an average value of 1.94%; the hydrocarbon potential lies between 0.09 mg/g and 9.17 mg/g with an average value of 1.46 mg/g; the content of chloroform bitumen “A” is between 0.003% and 0.2109% and the average value is 0.077% (Appendix 1); the TOC of the Yingzuilazi Formation was between 0.28% and 1.89%, with an average value of 1.12%. The hydrocarbon potential lies between 1.68 mg/g and 2.92 mg/g, with an average value of 2.098 mg/g. The chloroform bitumen “A” ranges from 0.086% to 0.5948% with an average value of 0.2342% (Appendix 1).

According to the evaluation criterion SY/T5737 of China’s source rocks, the Xiahuapidianzi Formation and Yingzuilazi Formation belong to medium source rocks and moderate-good source rocks, respectively, and both have good hydrocarbon generation material basis. Vitrinite reflectance (R_o) of the Xiahuapidianzi Formation ranges from 1.31% to 1.84%, with an average value of 1.53%, and the organic matter types are type II and III; the R_o of the Yingzuilazi Formation lies between 1.201% and 1.374%, with an average value of 1.291%, and the organic

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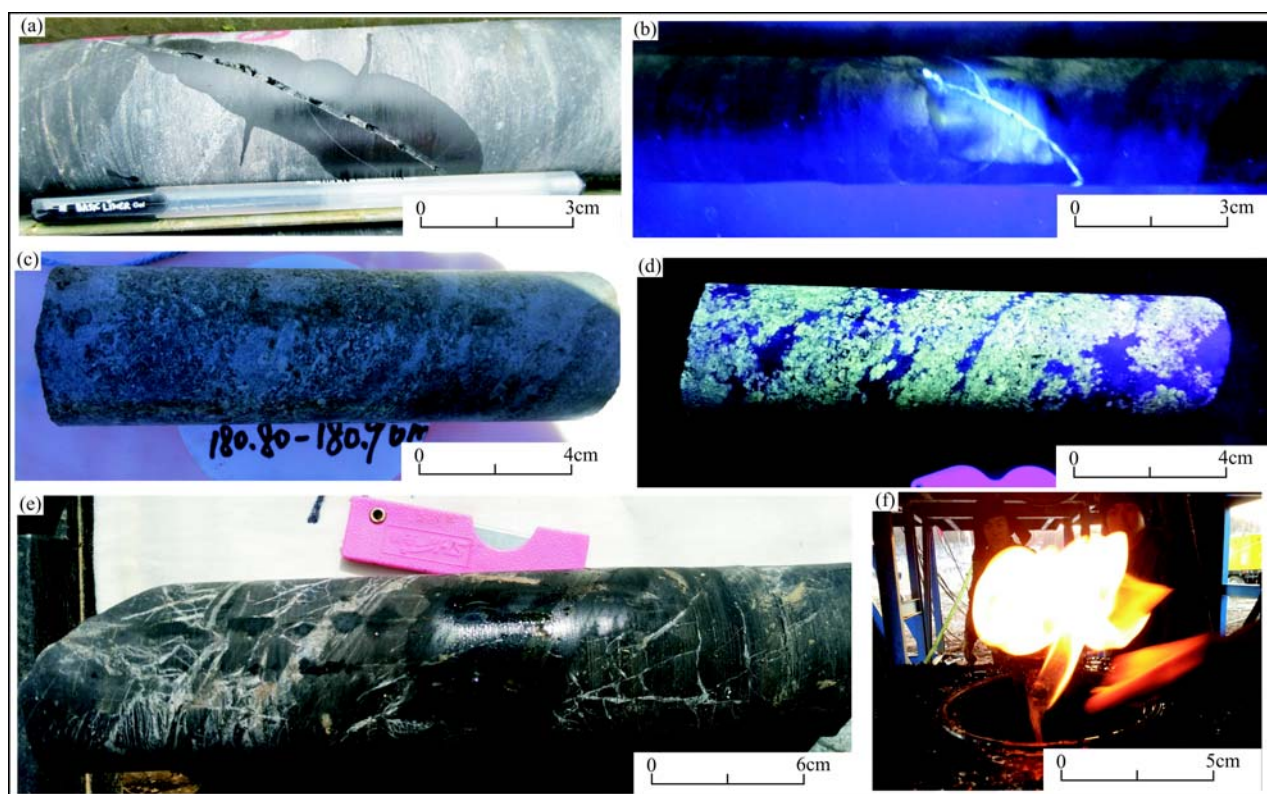


Fig. 1. Features of core sections with oil and gas show in the Hongmiaozi Basin.

matter types are type I and type II. Both fall into a mature-postmature stage. The two sets of source rocks can not only generate liquid hydrocarbons, but also have better ability to generate gas. The source rocks TOC of 12 discovered shale gas fields all over the world was 1.0%-24% and R_o values was 0.4%-1.8%. The TOC and R_o values of Hongmiaozi Basin falls within their ranges, suggesting that the Lower Cretaceous source rocks in the Hongmiaozi Basin also have the potential to generate shale gas. In addition, the Liaoxindi No.1 well head can be ignited at the well plugging. It also confirmed that the Lower Cretaceous source rocks in the study area have good gas generation ability.

Conclusion

The Lower Cretaceous thick dark mud shale was

developed in Yingzuilazi Formation and Xiahuapidianzi Formation of the Hongmiaozi Basin in the Songliao peripheral basin. The source rocks in the study area have high organic matter abundance, good type and at a mature-postmature stage, and are comprehensively evaluated as moderate and good source rocks with certain hydrocarbon generating material base. The drilling of multi-layers hydrocarbon shows that the Hongmiaozi Basin has the potential to generate conventional and shale hydrocarbons in the Lower Cretaceous.

Acknowledgements

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Appendix 1 Organic parameters of main source rocks in the Hongmiaozi Basin

Location	TOC (%)	S_1+S_2 (mg/g)	Chloroform bitumen "A" (%)	R_o (%)	Organic matter type	Evaluation
K_{1x}	1.94(56)	1.46(13)	0.077 (8)	1.53 (13)	II and III types	medium
	0.12–5.31	0.09–9.17	0.003–0.2109	1.31%–1.84%		
K_{1y}	1.12%(45)	2.098(5)	0.2342% (8)	1.291(5)	I–II type	Medium–good
	0.275%–1.89%	1.68–2.92	0.086%–0.5948%	1.201–1.374		

Notes: 0.12–5.31 is data range; 1.94 (56) is average value and data number.