

CO-EXISTING FORMATION OF MULTI-ENERGY MINERAL DEPOSITS IN THE ORDOS BASIN:ANALYSIS FROM COAL SYSTEM

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Introduction

Coal systems are generally defined as one or more coal beds or groups of coal beds that have had the same or similar genetic history from their inception as peat deposits, through their burial, diagenesis, and epigenesis to their ultimate preservation as lignite, bituminous coal, or anthracite. Coal system models would describe the geologic process that impact carbon rich sediments from their initial deposition as peat to the ultimate utilization of coal resources[1].

The Ordos Basin is rich in the abundant and multiple energy sources such as coal, petroleum, natural gas and uranium deposit and so on, and the Jurassic coal resources are 1487.66Gt, accounting for 75.32% of the total coal resources of the basin. The coal resource is used a part of coal system, During the formation process the abundant coal resources produce a lot of gas, and by the solution state, free state, adsorption state and solid-solution state it exists in the coal seams and surrounding rocks. Of which, the gas as the adsorption state and solid-solution state exists mainly in the micropores of the coal matrix [2]. In this paper the coal is taken as research object, on the basis of analyzing the organic matter features and Hydrocarbon-generating potential of the Yan'an Formation coal, through the isothermal adsorption features of the Yan'an Formation coal, to calculate the maximum adsorption capacity of the coal under the ideal state, and then, according to the relationship between the adsorption quantity of coal and the gas production of various coal ranks in the thermal simulation of coal, to discuss the contribution of the Jurassic Yan'an Formation coal to the conventional natural gas.

Material Composition and Abundance of Coal

According to the quantitative analysis of the coal petrology, as to the Yan'an Formation coal of the Ordos Basin, the features of the microscopic component (maceral) are the vitrinite group is the dominant, and the content of the inertinite group is relatively higher; its organic matter abundance is 88.6%~99.7%. According to the analysis results of coal chemistry, the organic matter abundance of the coal is 79.7%~95.1%.

Organic Matter Type and Hydrocarbon-Generating Potential of Yan'an Formation Coal

The hydrocarbon-generating capacity and type of three large maceral groups which constitute the coal have the

obvious difference. Of which, the exinite group has the strongest hydrocarbon-generating capacity, and it mainly generates the liquid hydrocarbon; the vitrinite group has the stronger hydrocarbon-generating capacity, and it mainly generates the gaseous hydrocarbon; the inertinite group has the weak hydrocarbon-generating capacity, and the generated hydrocarbon almost all is the gaseous hydrocarbon. In fact, the hydrocarbon-generating capacity of the different macerals in the same group also is differentiated largely. For example, in the exinite group, the hydrocarbon-generating capacity of the alginite, resinite, bituminite and fluorinite is stronger than that of the cutinite, sporinite and suberinite. Therefore, as to the coals with the different macerals, although they all belong to the scope of the humic type kerogen, their hydrocarbon-generating capacity and features are differentiated mutually.

The double parameter triangular coordinate diagram is one of the methods distinguishing the gas-generating capacity of the organic matter in coal [3]. Using this method, the macerals quantitative results of 361 coal samples of the Yan'an Formation are conducted. The analysis indicates that the Yan'an Formation coal of the Ordos Basin belongs to the weak ~ moderate gas-generating organic matter(Fig.1).

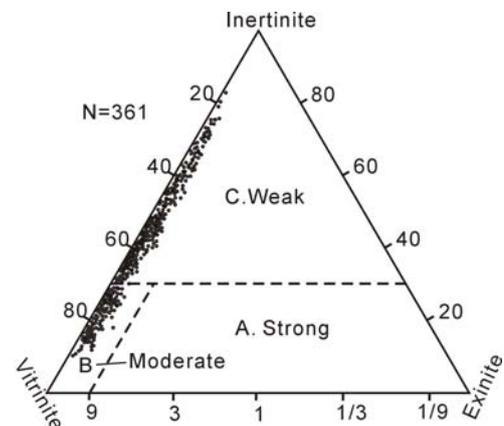


Fig.1 Hydrocarbon-generating type of organic matter in main coal seams of the Yan'an Formation

In order to further determine the organic matter type of the Yan'an Formation coal, the macerals quantitative results of the above-mentioned 361 coal samples are conducted, respectively, the calculations on the hydrocarbon-producing index and oil-producing index; the peak value interval of the hydrocarbon-producing index is 100 ~ 128 (Fig.2a), and the peak value interval of the oil-producing index is 3 ~ 10 (Fig.2b). It is indicated that the Yan'an Formation coal of the Erdos Basin is dominated by the gas production. According to the hydrocarbon-producing index and oil-producing

index [6], it is determined that the organic matter type of the Yan'an Formation coal is II₂ ~ III type kerogen.

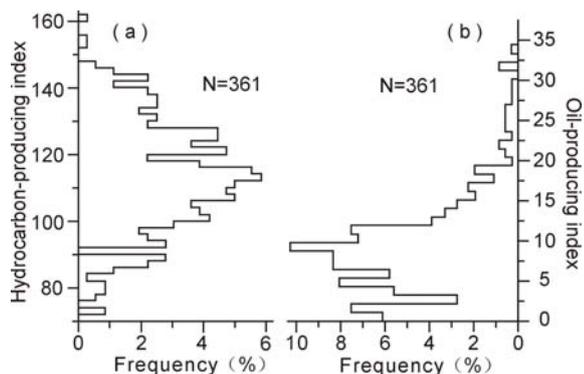


Fig.2 The histograms of the hydrocarbon(a) and gas (b)-producing index and gas-producing index of the Yan'an Formation coal

Adsorption Capacity of Yan'an Formation Coal and its Contribution to the Conventional Natural gas

Adsorption Capacity to Gaseous Hydrocarbon

The adsorption capacity of coal on the gaseous hydrocarbon determines the storage capacity and the production process of the coal seam, commonly, it is described by the adsorption constant and isothermal adsorption curve. Except that the adsorption of coal on the gaseous hydrocarbon is related to the temperature and pressure, it also is closely related to the physicochemical properties and metamorphic degree of coal. The metamorphic degree of the Yan'an Formation coal is lower, is dominated by the longflame coal, non-caking coal and weak caking coal.

The isothermal adsorption of the coal within the basin indicates that except of the Rujigou, in other areas the Langmuir volume as air dry basis of coal is 9.04~24.07m³/t, and the Langmuir pressure is 9.0~1.0MPa (Fig.3).

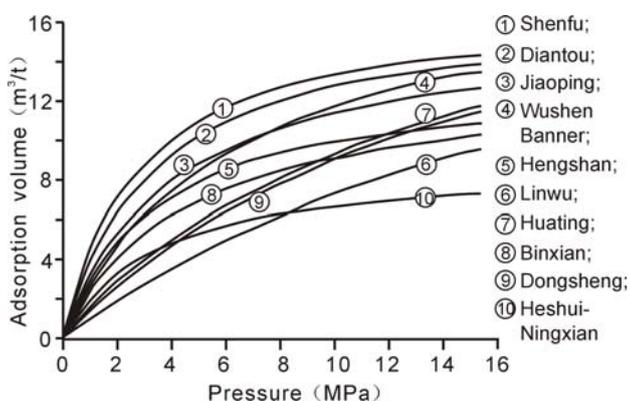


Fig.3 The isothermal adsorption curve as ad basis of the Yan'an formation coal in the Erdos Basin

Estimation on the Contribution to the Conventional Natural Gas

According to the thermal simulation test results, the gas yields of the coals with different ranks are differentiated very largely. The gas yield of the longflame coal in

China ranges in 38 ~ 68m³/t, the gas yield of the gas coal ranges in 41 ~ 93m³/t, and the gas yield of the anthracite can be high up to 270~510m³/t [4]. If it doesn't consider the anthracite in the Rujigou area, the average gas yield of the Yan'an Formation coal is roughly 45~102m³/t. According to the calculation by the isothermal adsorption test results, except the Rujigou area, under the ideal state, the largest adsorption capacity of the Yan'an Formation coal is 9~24m³/t. That is to say, under the ideal state, the Yan'an Formation coal only can store a small part of the generated gas, the surplus coalbed methane (36~78m³/t) had escaped to the sandstone layer adjacent to the coal seam, and had contributed to the conventional natural gas.

Conclusions

Through the above analysis it can obtain the following conclusions:

- (1) The coals are one of the contributor to conventional natural gas.
- (2) Adopting the double parameter triangular coordinate diagram, the hydrocarbon and oil-producing index, it is determined that the organic matter type and hydrocarbon-generating potential of the Yan'an Formation coal in the Ordos Basin is II₂ ~III type kerogen and weak ~ moderate gas-generating type.
- (3) According to the relationship between the thermal simulation and isothermal adsorption quantity of coal, deducting the largest adsorption quantity of coal under the ideal state, in this basin, as to the Mesozoic coal as the hydrocarbon source rock, the contribution rate to the conventional natural gas ranges in 36~78m³/t.

Acknowledgements

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