

## THE GEOCHEMISTRY AND ORIGIN OF THE NATURAL GAS FROM HUTUBI GAS FIELD IN JUNGGAR BASIN

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The Junggar Basin is the second petroleum-containing great basin in the west of Chinese with area of  $13 \times 10^4 \text{ km}^2$ , and mainly producing oil. At present, the Hutubi gas field with the gas-bearing area of  $15.2 \text{ km}^2$  and the proved reserves of  $126.12 \times 10^8 \text{ m}^3$ , is the largest gas field in the Junggar Basin. Therefore, the research on the geochemistry characteristics and origin of natural gas in Hutubi gas field is important guiding significant to the natural gas exploration in this basin. Four sets of source rocks are developed in the southern margin of Junggar Basin, respectively Anjihaihe formation( $E_{3a}$ ), Paleogene, Tugulu Group( $K_{1tg}$ ), Lower Cretaceous, Xishanyao formation( $J_{2x}$ ) and Badaowan formation, Middle-Lower Jurassic, Lucaogou formation( $P_{2l}$ ) and Hongyanchi formation( $P_{2h}$ ), Middle Permian.

The organic matter abundance of Paleogene Anjihaihe formation source rocks is high relatively, but the maturity is immature, and has little hydrocarbon-generating potential. Lower Cretaceous has developed low-matured to matured source rock, also has little contribute to oil-gas resources. But the maturity of Middle Permian source rock is mainly in a matured to highly-matured stage and the Middle-Lower Jurassic source rock is mainly in a matured to post- matured stage, are the two most oil-gas contributors in the southern of Junggar Basin.

The strata in Middle Permian developed shallow lake - deep lake deposits, its' thickness range from 200m to 400m. Lucaogou formation oil shale exposed on the surface in front of Bogeda mountain. The quality of organic matter is mainly of sapropel and humic types, the other is mix-typed, belong to the hydrocarbon- generating rock with good organic matter quality and high abundance. The maturity is in a low-matured to matured stage. Hongyanchi formation composed of grey-green and grey-black mudstone, shale, limestone and a few dolomite. The quality of organic matter is the humic type and combination type, is a normal hydrocarbon-generating rock in a matured stage.

The strata in Middle-Lower Jurassic developed coal measures. The grey-black and black mudstone distributed mainly in Badaowan formation, Sangonghe formation and Xishanyao formation, the thickness ranges from 100m to 500m. The coal measure developed in the Badaowan formation and Xishanyao formation, The coal measure thickness of Badaowan formation can be reached from 20m to 30m and Xishanyao formation can be reached to 50m.

The gas-generating rock has high organic abundance, but has poor quality of organic matter, mainly of the humic type, have little hydrocarbon-generating potential. Its maturity in a matured to high-matured stage.

The natural gas of Ziniquanzi formation in Hutubi gas field is predominant of methane, its average content range from 89.56% to 94.02%, and the dryness coefficient is between 0.93 and 0.95. The heavy hydrocarbon content range from 4.46% to 6.59% , 5.25% on average. The content of non-hydrocarbon is little, from 1.1% to 2.5%, with 0.42% on average. In the Hutubi gas field, the average  $\delta^{13}\text{C}$  values of methane, ethane and propane are -31.3‰, -22.08‰ and -21.28‰ respectively, the  $\delta^{13}\text{C}$  value is very high. The general carbon isotope pattern from methane to propane is  $\delta^{13}\text{C}_1 < \delta^{13}\text{C}_2 < \delta^{13}\text{C}_3$ . The value of  $\delta\text{D}_{\text{CH}_4}$  in Hutubi gas field range from -198‰ to -200‰, with -199‰ on average, indicated that the sediment environment of the source rocks in the area is land-fresh water lake. In addition, the  $\delta\text{D}_{\text{CH}_4}$  value is heavy, indicated that the gas is from source rock at the mature to post-mature.

The composition of light hydrocarbon in the natural gas in Hutubi gas field is predominant of  $\text{C}_6$ - $\text{C}_7$  branched and straight chain paraffin, the relative content range from 50% to 65%, the second is the cycloalkane, its relative content range from 25% to 30%, the content of light aromatic, such as benzene and toluene is little, only about 15% ~ 25%.

The carbon isotope values of hydrocarbon molecular series are heavy, the carbon isotope values of benzene, toluene and methylcyclohexane are -21.1‰, -18.9‰ and -21.6‰ respectively. In the carbon isotope sequences from methane to butane, the  $\delta^{13}\text{C}_2$  value is one of the most important indicators to identify the type of natural gas, It has been thought that while the  $\delta^{13}\text{C}_2$  value more than -28‰ is coal-formed gas, the  $\delta^{13}\text{C}_2$  value of oil type gas is less than -29‰. The  $\delta^{13}\text{C}_2$  value of Hutubi gas field is -22.08‰, so it is coal formed gas. The means of  $\text{C}_7$  light hydrocarbon system indexes have been used to identify coal formed gas and oil type gas. In the ternary diagram of  $\text{C}_7$  light hydrocarbon of toluene,  $\text{C}_7$ -cycloalkane and  $\text{C}_7$ - paraffin, the relative content of toluene is little, less than 25%, the  $\text{C}_7$ -cycloalkane content range from 35% to 50%, have typical characteristics of coal formed gas. In addition, the  $I_{\text{MCC6}}$  (methylcyclohexane index) value range from 49.6% to 59.4%, and 55.3% on average, also indicated that the gas of Hutubi gas field is mainly of coal formed gas.

The carbon isotope values of hydrocarbon molecular series of the natural gas of Ziniquanzi formation in Hutubi gas field are heavy, belong to coal formed gas. The Jurassic Badaowan and Xishanyao formation coal measures have an extensive distribution in this area, therefore, it indicated that the natural gas of Ziniquanzi formation come from Jurassic

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coal measures.