P131-TU

CLASSIFICATION AND GAS SOURCE CORRELATION OF NATUREAL GASES IN THE LISHUI SAG, EAST CHINA SEA BASIN

Jianping CHEN[1,2], Heping GE[3], Chunping DENG[1,2], Zhixuan WU[3], Yongge SUN[4] and Digang LIANG[1,2]

1. Research Institute of Petroleum Exploration & Development, PetroChina, Beijing 100083, China.
2. Key Lab. of Petroleum Geochemistry, CNPC, Beijing 100083, China.
3. Shanghai Branch of CNOOC China Limited , Shanghai, 200030, China.
4. The State Key Laboratory of Organic Geochemistry, Guangzhou Institute of Geochemistry, Chinese Academy of Sciences, Wushan, P.O Box 1131, Guangzhou, 510640, China.

East China Sea Basin on the continental shelf is the biggest Meso-Ceno sedimentary basin on the offshore of China and rich in hydrocarbon sources. However, at present its hydrocarbon exploration remains at the primary stage and the most hydrocarbons discovered up to now are concentrated mainly in the Xihu sag and Lishui sag. There are 5 exploration wells in the Lishui sag in which natural gases are discovered and among them the LS36-1 structural oil-gas field is of commercial value. Different from other natural gases, the gas from the Lishui sag is a mixing gas composed mainly of gaseous hydrocarbons and CO_2, and their mixing proportions differ greatly depending on different structures or wells. For instance, the content of gaseous hydrocarbons varies from 2% to 94% while CO_2 is the dominant non-hydrocarbon gas.

There exist three suits of different source rocks in the Lishui sag, which are the lower Paleocene lacustrine Yueguifeng Fr., upper Paleocene marine Lingfeng Fr. and paralic coal-bearing Mingyuefeng Fr. deposits (Chen Zhiyong et al., 2000; Chen Jianping et al., 2005). The kerogen of the Yueguifeng Fr. source rock has H/C ratios ranging from 1.0 to 1.2, carbon isotopic values varying from -27‰ to -28‰ and HI between 300 ~ 400mg/gTOC, indicating an oil-prone or gas-prone organic matter mixed by aquatic and terrigenous organic substances. The kerogen of the Lingfeng Fr. source rock has H/C ratios commonly less than 0.9, carbon isotopic values heavier than -26‰ and PI less than 180mg/gTOC, suggesting a gas-prone organic matter mainly composed of terrigenous higher plants. The organic matter of the Mingyuefeng Fr. coal-measures source rock consists mainly of higher plants and belongs to the gas-prone organic substance.

The gaseous hydrocarbons in the natural gas from the Lishui sag are characteristic of a wet gas that has under 90% of methane and over 10% of C_2^+. Their $\delta^{13}C$ values are less than -44‰ for methane, under -29‰ for ethane and lighter than -26‰ for propane, respectively. The difference in carbon isotopes between methane and ethane is comparatively big, indicating a biogenic oil-type gas that is produced by the mixed organic mater at mature stage.

The $\delta^{13}C$ values are all over -10‰ for CO_2, indicating a typical abiogenic gas and the $^3He/^4He$ ratios of its noble gases are over 5×10^{-6}, suggesting a mantle-derived gas or a gas mixed with mantle gases.

The simulation of hydrocarbon generation within a gold sealed tube shows that under the same simulated conditions, methane generated from the Lingfeng Fr. marine-deposited terrigenous organic matter is obviously more than that from the Yueguifeng Fr. organic matter mixed by both lacustrine aquatic and terrigenous substances. In the product generated from 250˚C to 450˚C at a 2˚C/h gradient, the carbon isotopic composition is heavier than -33‰ for the methane generated from the Lingfeng Fr. organic matter or should be around -36‰ for methane, over -23‰ for ethane and heavier than -19‰ for propane, respectively, even if the differentiation of 3‰ is accounted for. If the terminal temperature of simulation is higher, carbon isotopic compositions for varieties of gaseous hydrocarbons produced should be heavier (Cramer, 2004). The carbon isotopic composition of the natural gas produced by the Yueguifeng Fr. organic matter before the peak generation is around -37‰ for methane, -30‰ for ethane and between -26.8‰ ~ -29.6‰ for propane, respectively, while that during the peak generation varies around -42‰ for methane. In a word, the natural gas generated from the Lingfeng Fr. marine-deposited terrigenous organic matter has $\delta^{13}C$ values that are 5‰ heavier for methane but over 9‰ for both ethane and propane, respectively, than those of the natural gas derived from the Yueguifeng Fr. mixed organic matter.

Since carbon isotopic compositions for varieties of gaseous hydrocarbons in natural gases from the LS36-1 oil/gas field are greatly different from those of the natural gas simulatively generated from the Lingfeng Fr. organic matter but very similar to those of the natural gas artificially derived from the Yueguifeng Fr. organic matter, it can be concluded that natural gases from the LS36-1 oil/gas field originate mainly from the Yueguifeng Fr. lacustrine source rock instead of the Lingfeng Fr. marine and Mingyuefeng Fr. coal-measures source rocks.

REFERENCES

Cramer B., 2004. Methane generation from coal during open system pyrolysis investigated by isotope specific, Gaussian distributed reaction kinetics. *Organic Geochemistry,* **35**, 379-392.

Chen Jianping, Liang Digang, Zhang Chaojun, Zhang Bin and Tu Jianqi, 2005. Geochemical characteristics of source rocks from the Lishui sag, East China Sea Basin and its appraisal on the hydrocarbon generative potential, *Research Report*, 1-208(in Chinese).

Chen Zhiyong, Wu Peikang, Wu Zhixuan, 2000. Petroleum geology and exploration potential of Lishui Sag. *China Offshore Oil and Gas (Geology)*, **14**, 384-391(in Chinese).