

Geochemical Characteristics on the Upper Triassic Xujiahe Gases in Fluid Inclusions and in Tight Sandstone Gas Fields of the Middle Sichuan Basin

Shizhen Tao, Zhenglian Pang

Research Institute of Petroleum Exploration and Development

9.29.2020 - 10.1.2020 – AAPG Annual Convention and Exhibition 2020, Online/Virtual

Abstract

The Sichuan basin has stable structures with areas up to $18 \times 10^4 \text{ km}^2$. The exploration on the Xujiahe formation of middle Sichuan has nearly 60 years, and large gas fields have been found with proved reserves over $0.6 \times 10^{12} \text{ m}^3$. The Upper Triassic sand-mudstone-dominated Xujiahe formation of Sichuan basin is a typical terrestrial coal-series clastics deposited on the Middle Triassic Leikoupo erosion surface. Our research is based on the comparative geochemical analysis of gas samples from inclusions and gas fields, integrated with geologic conditions, intend to clarify geochemical characteristics of Sichuan Xujiahe gas formation and evolution. The Xujiahe reservoir rocks have large amount of gaseous hydrocarbon inclusions formed at different geologic time, little liquid hydrocarbon inclusions, indicating coal series type generates mainly gas but less oil. The Xujiahe natural gases are dominated by methane, with higher concentration of heavier C_2+ hydrocarbons, belonging to kerogen-degraded gas, and most gas dryness ratios ($\text{C}_1/\text{C}_{1-5}$) less than 0.95, main wet gas. The content of methane in the inclusions is low, rather lower for those of C_2+ hydrocarbons, while that of non-hydrocarbons (CO_2) is higher. The gas composition in gas fields does not include H_2S ; the gas $\delta^{13}\text{C}_1$ ranges from -45.5‰ to -36.5‰ and $\delta^{13}\text{C}_2$ from -30‰ to -25‰ , and those two values in fluid inclusions are similar to those of gas fields, but slightly heavier totally, with the $\delta^{13}\text{C}_1$ of -36‰ ~ -45‰ and $\delta^{13}\text{C}_2$ of -24.8‰ ~ -28.1‰ , characterized as coal-type gas (Dai et al., 2012). The $\delta^{13}\text{C}$ CO_2

of gas fields ranges from -15.6‰ to -5.6‰, and that of inclusions is totally lighter, from -16.6‰ to -9‰, as organic origin gas. The CO₂ captured in the inclusions, a relatively closed system, was derived from source rocks, and abiogenic CO₂ was mixed less, therefore, characterizing as heavier carbon isotopic composition for alkane gas and lighter for that of CO₂. The gases captured in fluid inclusions reflect the primitive state that source rocks generated gas during the ancient time, and rather weak isotopic filtration for gases in a closed system, thus it is characterized as heavier carbon isotopes for alkane gas and lighter for non-hydrocarbon CO₂. The study results have some indicative maker significance for gas-generating evolution and characteristics identification of transportation and accumulation.