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# Geochemical Comparisons of Natural Gas in Inclusions and Reservoirs of the XuJiaHe Formation, Sichuan Basin, China

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The Sichuan Basin in China is one of the most prolific areas of tight sandstone gas, which covers an area of 180,000km$^2$. The petroleum exploration indicates a reserve of over 600 billion m$^3$. Based on the comparative geochemical analysis of gas samples from fluid inclusions and reservoirs, this paper is to stress the geochemical characteristics of the formation and evolution of the gas of the XuJiaHe (XJH) Formation.

An Agilent 6890N gas chromatograph with flame ionization and thermal conductivity detectors was used for gas composition analysis. Gas carbon isotope was measured on a Delta Plus XL Gas Chromatography-Combustion-Isotope Ratio Mass Spectrometry (GC-C-IRMS), using a 30m × 0.32μm PLOT Q column. The measurement was made under electron impact (EI) mode with electron energy of 120 eV and acceleration voltage of 5 KV. Carbon isotope values are reported at $\delta^{13}C$ and calibrated to the Vienna Peedee belemnite (VPDB) standard.

The results indicate that the gas from inclusions and reservoirs exhibits great difference. The reservoir rocks of the XJH have large amount of gaseous hydrocarbon inclusions and little liquid hydrocarbon inclusions formed at different geological times, indicating that coal series may have generated gas mainly [1]. The XJH natural gas is kerogen-degraded and dominated by methane, with high concentration of heavier $C_{2+}$ hydrocarbons and gas dryness ratios ($C_1/C_{1-5}$) less than 0.95. While the non-hydrocarbons ($CO_2$) are quite high, the methane in the inclusions is low and the $C_{2+}$ hydrocarbons even lower. Isotopic features show that tight sandstone gas of the XJH is typical coal-derived with $\delta^{13}C_1$rangingfrom -45.5‰ to -36.5‰ and $\delta^{13}C_2$ from -30‰ to -25‰. The gases characterized as coal-type in inclusions are similar with that in reservoirs, but generally slightly heavier, with $\delta^{13}C_1$ranging from-36‰ to -45‰ and $\delta^{13}C_2$from-24.8‰ to -28.1‰, respectively [1]. The $\delta^{13}C_{CO2}$ of reservoir gas ranges from -15.6‰ to -5.6‰, and that of inclusions is lighter, ranging from -16.6‰ to -9‰, which is organic origin. The $CO_2$ captured in the inclusions was derived from source rocks consisting of rare abiogenic $CO_2$. The gas captured in fluid inclusions reflects the primitive state of source rocks generating gas, thus the source rocks are characterized as heavy carbon isotopes of alkane and light of non-hydrocarbon $CO_2$.

By the geochemical comparisons of natural gas in inclusions and reservoirs, the evolution history of natural gas during migration can be revealed, which is a new method in studying the migration history of natural gas.

*References:*

[1] Dai J. et al. (2012) Organic Geochemistry 43, 103-111