

BIOMARKER EVIDENCE OF SECONDARY MICROBIAL COALBED GAS IN LIYAZHUANG COAL MINE, WESTERN QINSHUI BASIN, CHINA

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Introduction

Microbial generation of coalbed methane (CBM) occurs in multiple coal-bearing basins worldwide (Ahmed and Smith, 2001; Kotarba, 2001; Strapoć et al., 2007). Microbial CBM accumulations have been discovered in several coal mines like Xinji, Panji, Liyazhuang, and Enhong, China (Tao et al., 2005; 2007). Biodegradation of organic matter and specific acyclic isoprenoid hydrocarbons for methanogens in coal rocks are evidence of microbial coalbed gas generation (Stefanova, 2000; Formolo et al., 2008; Strapoć et al., 2008, Gao et al., 2013).

The Liyazhuang coal mine, situated in Huozhou coal field, western Qinshui basin, is the only coal mine with high coalbed gas production in Huozhou coal field. The mainly mined coalbed of the Huozhou coal field is the No.2 coalbed of Shanxi group, lower Permian system, which is composed of a gas-fat coal with vitrinite reflectance (Ro) of 0.92%. Because of regional uplift, the burial depth of the coalbed is as shallow as 320m to 600m at present. The intensely deformed constructions and the developed fractures and uplift of the coalbed in the area provided geological conditions for the formation of secondary microbial coalbed gas.

Results

Coalbed gas desorbed from the No.2 coalbed in the Liyazhuang coal mine is composed of 94.72% CH₄, 0.02% C₂H₆, 4.63% N₂, 0.30% CO₂, 0.31% Ar and traces of He and SO₂. With carbon and hydrogen isotopic compositions of CH₄ ranging from -56.3‰ to -61.7‰, and from -215‰ to -244‰, respectively, and carbon isotopic composition of C₂H₆ from -20.5‰ to -22.4‰, this coalbed gas was considered to be a mixed gas of thermogenic and secondary microbial gases, and the majority of methane to be secondary microbial origin (Tao et al., 2005).

Biomarker compounds of saturated hydrocarbons extracted from the coal samples of the No.2 coalbed in Liyazhuang coal mine were analyzed and abundant acyclic isoprenoid alkanes, especially C₂₅ isomers 2,6,10,14,18-pentamethylcosane, 2,6,10,14,19-pentamethylcosane as well as 2,6,10,15,19-pentamethylcosane (PME), C₃₀ isoprenoid squalane and head-to-head linked irregular long chain (C₃₁ to C₄₀) acyclic isoprenoid alkanes (Fig. 1) have been identified according to their GC-MS retention time and mass spectra compared with the published documents (Tornabene et al., 1979; Wang, 1998; Stefanova, 2000).

Conclusions

As 2,6,10,15,19-pentamethylcosane(PME), C₃₀ isoprenoid squalane and head-to-head linked irregular long chain (C₃₈ to C₄₀) acyclic isoprenoid alkanes are well known special biomarkers for methanogens (Tornabene et al., 1979; Wang, 1998; Stefanova, 2000), it could be presumed that methanogenic bacteria developed in the No.2 coalbed in the Liyazhuang coal mine after coalification and uplift of coal rocks. Combined with the relatively high

maturity of the coal, it seems certain that coalbed gas with methane $\delta^{13}\text{C}$ ranging from -56.3‰ to -61.7‰ in the Liyazhuang coal mine be mainly secondary microbial origin.

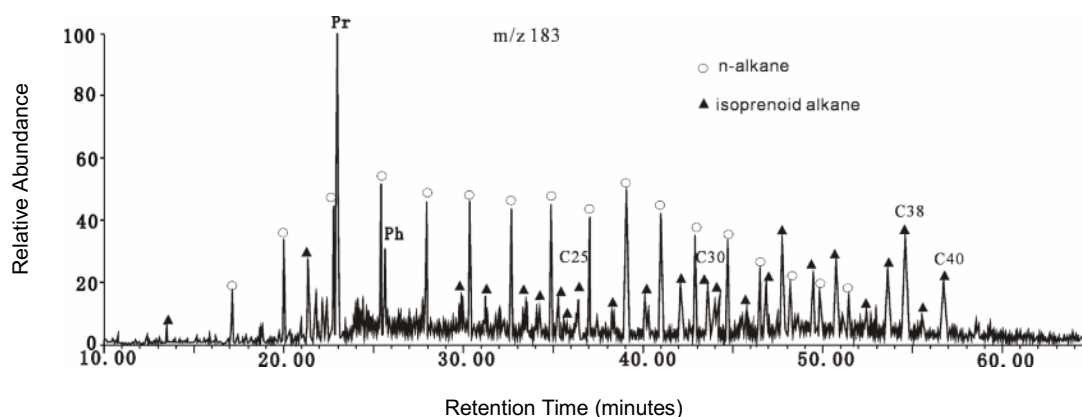


Figure 1 *M/z 183 mass chromatogram of hydrocarbons extracted from coal samples of Liyazhuang coal mine*

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