

松辽盆地北部生物降解成因气及其成藏特征

帅燕华¹, 宋娜娜^{1,2}, 张水昌¹, 冯子辉³, 朱光有¹, 王雪³, 黄海平^{4*}

1. 中国石油 勘探开发研究院 油气地球化学重点实验室,北京 100083;
2. 长江大学,湖北 荆州 434023;
3. 中国石油 大庆油田研究院,黑龙江 大庆 166500;
4. 中国地质大学,北京 100083

Gas of biodegradation origin and their pooling characteristics in northern Songliao Basin

Shuai Yanhua¹, Song Na'na^{1,2}, Zhang Shuichang¹, Feng Zihui³, Zhu Guangyou¹, Wang Xue³, Huang Haiping^{4*}

1. PetroChina Research Institute of Petroleum Exploration and Development, Beijing 100083, China;
2. Yangtze University, Jingzhou, Hubei 434023, China;
3. Research Institute of Petroleum Exploration and Development, PetroChina Daqing Oilfield Company, Daqing, Heilongjiang 166500, China;
4. China University of Geosciences, Beijing 100083, China

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摘要 松辽盆地具有与北美盛产生物气的白垩纪诸盆地最为接近的地质条件,无论维度上还是源岩质量均可以进行类比。目前,松辽盆地已探明17个具生物气特征的气藏;干燥系数大($C_1/\Sigma C_{1+}$ 大于0.95);甲烷稳定碳同位素较轻($\delta^{13}C_1$ 分布在-60‰~-50‰)。因此,对这个地区的生物气潜力一直给与了极大的期望,这些气藏的赋存条件研究也成了找寻该区生物气聚集的主要立足点。然而综合分析认为,该区目前探明的“生物气藏”以次生型生物改造气藏为主,是热成因油气遭受生物降解产生的次生物气与残留热成因甲烷混合而成。主要证据如下:①生物降解导致异构烷烃含量增加、丙烷含量明显减少;②湿气组分的稳定碳同位素特征具有生物降解痕迹;③天然气中氮气含量越高,反映生物活动有关的特征越明显;④生物气藏伴生液态烃均发生过明显的生物降解作用。微生物降解程度、保存条件以及后期热成因天然气有否补充是造成生物降解气特征复杂的重要原因。而目前尚未探明原生型生物气的赋存,主要原因是松辽盆地自晚白垩纪-古近纪以来长期处于抬升降温状态,不利于原生生物气的持续形成,更加不利于构造部位原生生物气的保存;只有在稳定性相对较好的区块发育的岩性圈闭中,才可能有原生生物气藏的赋存。最后,总结了次生物气藏的判别方法和标志,以为同类地区浅层生物气勘探提供参考。

关键词: 稳定碳同位素 生物降解 生物气 天然气 松辽盆地

Abstract: Songliao Basin has similar favorable geological conditions for biogenic gas accumulation as the Cretaceous basins in North America, including the both dimension and high quality of source rocks. At present, 17 gas reservoirs in the Songliao Basin have been discovered to have the features biogenetic gas such as high dryness coefficient ($C_1/\Sigma C_{1+} > 0.95$) and light stable carbon isotope ($\delta^{13}C_1$ ranging from -60‰ to -50‰). Therefore, much attention has been paid to the biogenic gas potential in this area and study of their occurrence. However, comprehensive analysis demonstrates that the discovered biogenic gas reservoirs are dominated by secondary biogenic modification gas reservoirs with mixed secondary biogenic gas from biodegradation of thermal oil/gas and residual thermal gas. The following evidences were obtained from detailed geochemical character analysis: significant increase of isoparaffin content and significant decrease of propane due to biodegradation; biodegradation trace of stable carbon isotope ratios of heavy gaseous hydrocarbons; features reflecting biodegradation getting prominent along with the increasing N_2 content; significant biodegradation of liquid hydrocarbons associated with biogenetic gas reservoirs. Biodegradation degree, preservation conditions and the replenishment of thermal gas at later stage are the factors that complicate the characteristics of biodegradation gas. No primary biogenic gas reservoirs have been discovered so far. It is mainly caused by that the Songliao Basin has been in uplifting and cooling since the Late Cretaceous, unfavorable for the sustained generation and preservation of primary biogenic gas. Primary biogenic gas reservoirs possibly occur in lithologic traps in relatively stable blocks. Methods and marks for identification of secondary biogenic gas reservoirs are summarized to guide exploration of shallow biogenetic gases in other areas with similar background.

Keywords: stable carbon isotope biodegradation biogenic gas natural gas Songliao Basin

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About author: 帅燕华(1971-),女,高级工程师,油气地质和地球化学。

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