

IDENTIFICATION OF POTENTIAL SOURCE ROCKS OF BIOGENIC GAS BY BIOMARKERS OF BACTERIA ACTIVITY IN THE QUATERNARY OF THE Q Aidam BASIN, NORTHWESTERN CHINA

Wanchun WANG¹ and Daowei ZHANG²

1. Key Laboratory of Gas Geochemistry, Institute of Geology and Geophysics, Chinese Academy of Sciences, Lanzhou, 730000, P.R.China; 2. Research Institute of Exploration and Development, Qinghai Oil Field Branch, CNPC, Gansu, Donghuang 736202, P.R.China

The Qaidam Basin is located in the Qinghai Province of northwestern China. The Quaternary gas resource of the Qaidam Basin is enriched in the central and eastern part of the basin in the three lakes area. The proved and controlled Quaternary biogenic gas reserves of the basin have reached 290 billion cubic meters (BCM) (Dang et al, 2004). Up to now, the identification of the biogenic gas source beds in the Qaidam Basin is still a matter needing to be settled.

Of the 44 core rock samples of Quaternary in the depth of 540m to 1536m from the Sebei No.1 gas field of the Qaidam Basin, the contents of TOC range from 0.10% to 19.88%, with the majority of them range from 0.20% to 0.30%; the contents of chloroform asphalt "A" range from 0.0017% to 0.2294%, mostly lower than 0.01%, and the contents of total hydrocarbons range from 0.0003% to 0.1218%, mostly lower than 0.005%. The abundance of the acyclic isoprenoid alkanes, especially pristane and phytane are high in the 17 analyzed samples, and the Pr/Ph ratios range from 0.10 to 0.68, with very high predominance of phytane; the nC₂₁-/nC₂₂₊ ratios are lower than 1 for most of the samples, indicating that the depositional environment of the Quaternary in the Sebei No.1 gas field tend to be brackish to saline water environment, and the input of organic materials from higher plants are larger than that from algae.

C₂₅ and C₃₀ acyclic isoprenoid alkanes were detected in most of the 17 saturated hydrocarbon samples of the Quaternary from the Sebei No.1 gas field, and the relative contents of C₂₅ and C₃₀ acyclic isoprenoid alkanes in saturated hydrocarbons change greatly in different beds and depth, from non detectable to as high as 1.40%, indicating that methanogens are widespread in the Quaternary rocks.

The Quaternary of the Sebei area are immature, with the vitrinite reflectance from 0.22% to 0.47% (Zhou et al, 1990), and hence underwent very slight thermal process, but some biomarker parameters generally used as thermal maturity indicators of organic matter, such as

C30 $\beta\alpha$ -moretane/C30 $\alpha\beta$ -hopane ratios, ratios of $\alpha\beta\beta/(\alpha\beta\beta+\alpha\alpha\alpha)$ for C29-sterane and ratios of 20S/(20S+20R) for $\alpha\alpha\alpha$ C29-sterane, approximate their low mature value in some rock beds. The distribution of these rock beds on the section is not correlated with the burial depth, so the changes of the biomarker parameters proposed to reflect the development of bacteria in the Quaternary rocks.

For samples in the depth of 796 to 802m and 1290~1292m, the relative contents of C25 and C30 acyclic isoprenoid alkanes in saturated hydrocarbons are comparatively high (0.56% and 1.40%), the relative contents of C30 $\alpha\beta$ -hopane among C30 $\beta\beta$ -hopane, C30 $\beta\alpha$ -moretane and C30 $\alpha\beta$ -hopane are higher than 80%, the ratios of $\beta\beta/(\beta\beta+\beta\alpha+\alpha\beta)$ for C30-hopane are lower than 3, the ratio of C30 $\beta\alpha$ -moretane/C30 $\alpha\beta$ -hopane is 0.17, the ratios of $\alpha\beta\beta/(\alpha\beta\beta+\alpha\alpha\alpha)$ for C29-sterane are 0.42 and 0.39, respectively, the ratios of 20S/(20S+20R) for $\alpha\alpha\alpha$ C29-sterane are 0.39 and 0.37, respectively. These two samples are proposed to be well developed in bacteria and methanogens and are excellent source rocks for biogenic gas.

In the carbonaceous mudstone samples at the depth of 1241 to 1249m and 1292-1301m, C25 and C30 isoprenoid alkanes were nearly not detectable, the relative contents of C30 $\alpha\beta$ -hopane among C30 $\beta\beta$ -hopane, C30 $\beta\alpha$ -moretane and C30 $\alpha\beta$ -hopane are lower than 25%, the ratios of $\beta\beta/(\beta\beta+\beta\alpha+\alpha\beta)$ for C30-hopane are higher than 30, the ratios of C30 $\beta\alpha$ -moretane/C30 $\alpha\beta$ -hopane range from 1.56 to 2.67, the ratios of 20S/(20S+20R) for $\alpha\alpha\alpha$ C29-sterane are as low as 0.02. The carbonaceous mudstones are proposed to be not proper for the activity of bacteria and are non-source rocks for biogenic gas.

Based on the relative contents of C30 $\beta\beta$ -hopane, C30 $\beta\alpha$ -moretane and C30 $\alpha\beta$ -hopane calculated from peak areas on the m/z 191 mass fragmentogram, and the ratios of $\alpha\beta\beta/(\alpha\beta\beta+\alpha\alpha\alpha)$ for C29-sterane and 20S/(20S+20R) for $\alpha\alpha\alpha$ C29-sterane, the analyzed samples can be divided into: samples of high intense bacterial activity, samples of intense bacterial activity, samples of weak bacterial activity and samples of very weak bacterial activity.

REFERENCES

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