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Microbial alteration of organic matter accumulation and preservation and influence on hydrocarbon production potential - evidence from geochemistry

HONG JI[1], WENJIE XIAO[2] AND GUANGHUI HUANG[2]

[1]Guangdong University of Petrochemical Technology
[2]Yangtz University

Presenting Author: jihong@gdupt.edu.cn

Hydrocarbons are the product of biogeological processes, and microorganisms modify organic matter, affecting its accumulation and preservations. The hydrocarbon composition of source rock extracts from the Chagan Depression, Inner Mongolia, China, was found to be sophisticated, with a carbon isotope fractionation effect of about 7‰ between crude oil and kerogen $\delta^{13}C$ values, well above normal. Geochemical approaches of organic petrology and chromatography-mass spectrometry are used to analyse the organic matter of source rocks. The results show that of all the maceral compositions, the morphological component is low and the content of amorphous organic matter is high, which can reach 60% to 80%. The morphological maceral composition is dominated by the exinite and vitrinite of higher plant origin, and contains a certain number of angels; the amorphous maceral composition is dominated by humic amorphous with mycospores.

The composition of soluble organic matter reveals a large number of biomarker compounds for bacterial biogenesis or bacterial modification of higher plants. The widespread distribution of monomethyl alkane compounds indicates bacterial and waxy biogenic contributions; saturated hydrocarbons are quite rich in hopanes; the large number of long side-chain alkylated naphthalene series compounds in the aromatic fractions are bacterial biogenic compounds and are associated with microbial biogenic contributions. Aromatized de A-triterpenes, 8,14-seco-triterpenes formed when higher plants undergo more intense biotransformation, with oleanane, ulsane and lupane often losing their A rings.

Both a source of primary organic matter and a contribution of regenerated organic matter are indicated by the compositional characteristics of the maceral components of the hydrocarbon source rocks of the Chagan Sag. Microbial action is suggested to have had an important influence on the organic matter in the hydrocarbon rocks through humic amorphous organic matter and a large number of specific biomarker compounds of bacterial origin or associated with bacterial activity. Microorganisms use primary organic matter as a source of carbon and energy, consume and decompose organic matter, and accelerate the development of a reductive milieu which facilitates the preservation of organic matter. These hydrocarbon-producing organics include not only the original hydrogen-rich input, but also protein- and lipid-dominated organics.