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ORIGIN, MATURITY AND BIODEGRADATION OF NATURAL GASES FROM UPPER ASSAM BASIN, INDIA

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Abstract

The Upper Assam Basin is a Tertiary sub-basin of the Assam-Arakan Geological Province in north-east India. Hydrocarbons occur in the Upper Palaeocene, Lower Eocene, Oligocene and Miocene reservoirs in the basin. The isotopic ($\delta^{13}C$) and molecular composition of natural gases from reservoirs of the Upper Assam Basin indicates the presence of two types of gases. Pristine thermogenic gases ("Group I"), generated from humic organic matter, with possible contribution from algal organic matter and occurring in deeper reservoirs. Although they are not biodegraded, low $\delta^{13}C$ values for methane suggest that microbial methane has been added to these gases, probably due to anaerobic biodegradation of oil (methane being a major end-product). By contrast, gases from shallow reservoirs are biodegraded ("Group II"). In these gases, methane is isotopically light, suggesting that significant amount of ^{13}C-depleted methane has been mixed with the thermogenic (and biodegraded) gases. The microbial methane generation is again likely associated with biodegradation of oil in the reservoirs.

The pristine thermogenic gases ("Group I") were generated from a mid-to late oil window maturity source (vitrinite reflectance ~0.8% to 1.2% Ro). The altered composition of the shallow reservoirs gases ("Group II") does not allow for an unambiguous assessment of their maturity, which should however not exceed ~ 1.2%Ro, similar to that of the un altered thermogenic gases.

The following multi-step charging history is proposed for the Upper Assam reservoirs, based on geochemical data discussed in this work and supported by petroleum system models for the region: a) charging of the first oil in the reservoir when the reservoir temperature is low enough to permit bacterial activity, b) biodegradation of oil and generation of secondary microbial methane via methanogenesis, c) input of fresh charge of oil and thermogenic gas in the reservoir and d) biodegradation of oil and gas, if the reservoir temperature still permitted bacterial activity.

Keywords: Upper Assam Basin; natural gas; stable carbon isotopic composition; secondary microbial methane; methanogenesis; charging history