Biomarker and n-alkanes isotope profile study in oil samples from Recôncavo basin, Miranga field, Brazil.

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Introduction

The Recôncavo basin, has 11,500 km2, is located at the northeastern part of Bahia state and is considered one of the most petroliferous basins in Brazil. Miranga is among the seven biggest fields in this basin, and understanding how biodegradation works in Miranga oil field is of economic interest. The investigation required a previous geochemical characterization of the oil samples focusing the isotopic composition. The oil samples will be evaluated using the isotopic profile (δ13C) of the n-alkanes before and after biodegradation assays (future work). Knowing this, two oil samples from Miranga field in the Recôncavo basin, were evaluated in order to recognize their maturation level, depositional environment and biodegradation levels.

Experimental

The oil samples were selected based on their biodegradation levels and collected from reservoirs of different depths. Sample fractioning was performed using a standard procedure with dry silica gel column, eluted with 15-20 mL of n-hexane to obtain the saturated fraction which was analyzed by GC-MS using SCAN and SIM mode.

n-alkane purification was achieved by crystallization of the aliphatic fraction with a saturated solution of urea in methanol and analyzed with a GC-C-IRMS. The isotopic values were measured in a Trace GC Ultra with a Delta V Advantage mass spectrometer from Thermo using splitless mode for analysis. The temperature program was starting at 80°C (holding for 2 min.), increasing to 270°C at 40°C/min., and then to 300°C (holding for 25 min.) at 10°C/min. using a DB-5 column (30 m x 0.25 mm x 0.25μm). The δ13C values were compared to the PDB standard and calibrated by CO2 pulses. The injector was kept at 300°C, the interface at 350°C and the combustion oven at 850°C.

Results and Discussion

Two Miranga oil samples, 7MG and 9MG, pooled in sandstone reservoirs, both of lacustrine origin and different biodegradation levels were selected for our study. Case study to explain 7MG oil resistance to biodegradation process, notwithstanding its favorable conditions to microorganisms development. The analysis of the bulk data of the saturated fractions of the samples revealed high wax content, n-alkane distributions with abundant high molecular weight components and odd predominance, pristane dominant over phytane (values 1.3-1.6). The C26tricyclic terpanes over C25tricyclic terpanes were relatively similar for both samples (C26TT/C25TT) (Table 1), confirming the Lacustrine depositional environment.

Table 1. Geochemical parameters obtained by GC-MS in SIM and SCAN mode.

<table>
<thead>
<tr>
<th>Oils</th>
<th>P/F</th>
<th>CPI</th>
<th>C26 TT/C25 TT</th>
<th>NOR25/H30</th>
<th>Tsi/Ts+Tm</th>
</tr>
</thead>
<tbody>
<tr>
<td>7MG</td>
<td>1.60</td>
<td>1.08</td>
<td>1.77</td>
<td>0.39</td>
<td>0.65</td>
</tr>
<tr>
<td>9MG</td>
<td>1.38</td>
<td>1.19</td>
<td>1.67</td>
<td>0.49</td>
<td>0.45</td>
</tr>
</tbody>
</table>

The oils samples showed different P/F ratios suggesting in few changes in the depositional environment. Both samples were thermally mature (Ts/(Ts+Tm)) however 7MG was more, confirmed by its CPI level.

Their biodegradation levels were also evaluated using the ratio between C29 25-nor-17α(H) hopano/C3017α,21β(H)hopano together with analyzing the presence of n-alkanes, confirming the oil sample 9MG as the most biodegraded.

The isotopic distribution of the n-alkanes was obtained by GC-C-IRMS showing the presence of the n-alkanes ranging from C10 to C34. The aquatic origin n-alkanes (nC15, nC17, nC19) showed values between -29.85‰ and -32.07‰ for sample 7MG and -30.58‰ and -36.97‰ for sample 9MG showing 13C content for the 9MG oil. Then, alkanes representing superior vascularized plants (nC27, nC29, nC31) showed values ranging from -37.58‰ to -40.52‰ for oil 7MG and from -30.47‰ to -35.04‰ for sample 9MG, showing different ratios of wax lipids from leaves of higher plants. Most of the n-alkanes from C14 to C33 in both oils showed higher 13C ratios in n-alkanes of odd carbon numbers, although the difference in δ13C values was greater in sample 9MG.
Conclusions
Using saturated biomarkers parameters obtained by GC-MS combined with the isotopic distribution profile of the n-alkanes in a GC-C-IRMS, we could characterize two oil samples from Miranga oil field. These results are preliminary however depict different biodegradation levels which will be used in future biodegradation assays using polar fractions.

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References