Untangling the Details of North Sea Crude Oil

Sundberg, Jonas Folke; Jensen, Annette Eva; Feilberg, Karen L.

Publication date: 2018

Document Version
Publisher's PDF, also known as Version of record

Citation (APA):

General rights
Copyright and moral rights for the publications made accessible in the public portal are retained by the authors and/or other copyright owners and it is a condition of accessing publications that users recognise and abide by the legal requirements associated with these rights.

- Users may download and print one copy of any publication from the public portal for the purpose of private study or research.
- You may not further distribute the material or use it for any profit-making activity or commercial gain
- You may freely distribute the URL identifying the publication in the public portal

If you believe that this document breaches copyright please contact us providing details, and we will remove access to the work immediately and investigate your claim.
Untangling the Details of North Sea Crude Oil

Jonas Sundberg, Annette Eva Jensen, Karen L. Feilberg

Reservoir Fluid Characterization
A detailed knowledge of the molecular composition of crude oil and reservoir fluids is fundamental to understanding its formation, physical properties and macroscopic behavior. Our objective is to study compositional changes that occur during recovery processes, and gain a better understanding of the underlying mechanisms on a molecular level. Additionally, parameters that correlate to maturity, biodegradation and oil genetics are employed to understand migration patterns. The results will provide input for computational models that links laboratory-scale enhanced oil recovery (EOR) experiments to theory, and ultimately field applications.

Sample Set
Geochemical parameters were determined for a sample set consisting of 5 oils and 2 condensates from different fields and wells in the Danish North Sea. The condensates are visually distinguishable based on colour, and are lighter than the crudes which also is evident in the data.

Group-type Analysis
The crude oil samples show typical distributions of saturates and aromatics, with OIS4 having slightly higher content of polar components than the others. The two condensates show a high concentration of light hydrocarbons and monomethers. However, the SARA distribution was not determined due to lack of method specificity for this type of samples. The oils have low asphaltene content, and due to the high uncertainty associated with asphaltene precipitation at these levels, values are reported as <0.5% without further specification. The percentage of resin is back-calculated.

Maturity and Biodegradation
Semi-quantitative parameters used for maturity, biodegradation and oil source correlation are based upon peak area ratios and should be used with care. Issues such as co-elution, and integration parameters affect the data and interpretation and the values must be used in relation with others and as indications, not absolute truths. Compounds were identified by a combination of deconvolution of high-resolution data and comparison of retention using a reference sample (NGS NGS-1) of known composition.

The alkene distribution is noticeable different between OIS1 and the other samples. Maturity parameters indicate that these oils are of similar thermal maturity, and the difference is likely due to slight biodegradation. Ratios of Prn/C17 and Phn/C18 add further evidence, as biodegradation affects linear hydrocarbons before branched. OIS2 and OIS3 are the most affected samples. For the condensates, the distribution is shifted towards lighter hydrocarbons as expected. Only very low levels of saturated biomarkers were detected in the condensates, which indicates that evaporative fractionation / gas-condensate migration in the source has taken place.

Geochemical Parameters

<table>
<thead>
<tr>
<th>Parameter</th>
<th>OilS1</th>
<th>OilS2</th>
<th>OilS3</th>
<th>CondS1</th>
<th>CondS2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pr/Ph</td>
<td>0.89</td>
<td>0.57</td>
<td>0.60</td>
<td>0.57</td>
<td>0.59</td>
</tr>
<tr>
<td>Ph/n</td>
<td>0.59</td>
<td>0.57</td>
<td>0.64</td>
<td>0.82</td>
<td>0.98</td>
</tr>
<tr>
<td>Omega 5</td>
<td>1.08</td>
<td>1.24</td>
<td>1.16</td>
<td>1.10</td>
<td>1.00</td>
</tr>
<tr>
<td>Omega 7</td>
<td>1.01</td>
<td>1.38</td>
<td>1.50</td>
<td>1.55</td>
<td>1.06</td>
</tr>
<tr>
<td>Omega 9</td>
<td>0.68</td>
<td>0.89</td>
<td>1.01</td>
<td>1.10</td>
<td>0.93</td>
</tr>
<tr>
<td>Omega 11</td>
<td>0.62</td>
<td>0.57</td>
<td>0.60</td>
<td>0.57</td>
<td>0.42</td>
</tr>
</tbody>
</table>

Experiment Details
Solid Phase Extraction
Crude oils and condensates were fractionated into saturated and aromatic hydrocarbons using Paramagnetic BNH solid-phase extraction columns. The SPE eluates were conditioned with CH2Cl2 and 0.1 % formic acid to remove contaminants. Subsequent elutions were dried under nitrogen, re-dissolved in n-hexane and injected into the GC/MS, QTOF and HRAM analyses.

Quality Control
Two oil sets of known composition (OIS5 CondS1 and CondS2) were used as internal quality control during fractionation and analysis.