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USING ASPHALTENES TO RECONSTRUCT THE ORIGINAL CHARGE COMPOSITIONS AND VOLUMETRICS OF PETROLEUM IN RESERVOIR COMPARTMENTS

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In many reservoirs the original composition of petroleum is subjected to post-filling alteration processes such as cap rock leakage, evaporative fractionation, deasphalting, water washing or biodegradation. These processes have strong economic consequences since they lead to a decrease in oil quality and producibility. The aim of “PARC”, our Industry-Partnership-Program project started in October 2006, is the investigation of reservoir asphaltenes in order to reconstruct the original composition of trapped oil in the different reservoir levels and to estimate how much and what type of petroleum is lost due to the post-filling alteration processes. The basic principle of using petroleum asphaltenes is the fact that they seem to be resistant to physical, chemical and biological alteration. Work performed in a related project by Lehne and Dieckmann (2007) has shown that these large highly functionalized complex molecules are not affected by low temperature alteration processes such as biodegradation or water washing. Even phase separation does not influence the characteristics of asphaltenes, although it may lead to asphaltene precipitation from the bulk oil in the reservoir. Asphaltenes remain in different compartments and can constitute fingerprints of alteration and migration processes.

Reservoir core extracts are known to contain higher proportions of asphaltenes as compared to produced oils, indicating the preferential retention of these polar constituents by the mineral matrix. As asphaltenes bear close structural similarities to their parent kerogen (Béhar & Pelet, 1985; di Primio *et al.*, 2000) analysis of asphaltenes from reservoir core extracts should allow the reconstruction of reservoir filling history. As an example of this type of approach Bhullar *et al.* (1999) illustrated that the enrichment and distribution of asphaltenes in reservoir rocks can be a helpful marker of the oil water and especially the paleo-oil water contact in reservoir structures. On the other hand the less stable constituents of produced oil contain asphaltene fingerprints of the bulk parent oil with which the asphaltenes was generated.

Our main study areas are the Norwegian continental shelf, offshore Brazil and the Gulf of Mexico. We aim to investigate and compare asphaltenes from reservoir cores which range from below the present oil-water contact up to the top of the oil column as well as asphaltenes from the produced oil equivalents. By using reservoir core samples it will be possible to identify small scale variations within the reservoir while produced oils represent an average product of thick reservoir intervals.

As heterogeneities in reservoirs can be subtle, a reproducible asphaltene separation method is needed. Therefore we are establishing a method which can be applied to several types of oils and asphaltenes whereas the focus lies on linearity and reproducibility. It is well known that asphaltenes precipitate by adding an excess of short chain alkanes. The basis of our asphaltene precipitation method is the dissolution of the oil in a minimum amount of dichloromethane and the subsequent addition of an excess of short chain alkanes. After a settle down time of 48 hours the asphaltenes are separated by vacuum filtration and afterwards washed from the filter. The purity is validated measuring S1 and S2 using Rock-Eval pyrolysis. Currently we are testing different precipitants (n-C_5, n-C_6 and n-C_7) and further components, which influence the asphaltene amount and properties, like precipitant/oil ratio, solvent type and solvent/oil ratio, settle down time as well as separation and wash technique, to obtain an applicable method.

It is further planned to investigate the asphaltenes using open and closed pyrolysis coupled to GC-FID and GC-IRMS analysis in order to reconstruct the original molecular and isotopic characteristic of the first oil in place and the filling history. Additionally we try to reconstruct important primary compositional features of parent oils like aromaticity, paraffinicity and density. The results will be used to delineate vertical and horizontal reservoir scale heterogeneities concerning asphaltene composition as well as maturity differences or gradients for the studied fields. Based on the obtained data, asphaltene kinetic models will be defined to reconstruct petroleum formation and evolution of the petroleum phase charging the reservoir structures. The results of this project should aid in deepening our understanding of reservoir charging processes.

REFERENCES

Lehne, E. and Dieckmann, V. (2007) The significance of kinetic parameters and structural markers in source rock asphaltenes, reservoir asphaltenes and related source rock kerogens, the Duvernay Formation (WCSB). *Fuel*, **86**, 887-901.

Bhullar, A.G., Karlsen, D.A., Lacharpagne, J.C. and Holm K. (1999) Reservoir screening using Iatroscan TLC-FID and identification of palaeo-oil zones, oil–water contacts, tar-mats and residual oil saturations in the Frøy and Rind petroleum accumulations. *Journal of Petroleum Science and Engineering*, **23**, 41-63.

Béhar, F. and Pelet, R. (1985) Structural similarities between kerogens and asphaltenes from related rock extracts and oils. *Journal of Analytical and Applied Pyrolysis*, **8**, 173-187.

di Primio, R., Horsfield, B. and Guzman-Vega, M.A. (2000) Determining the temperature of petroleum formation from the kinetic properties of petroleum asphaltenes. *Nature*, **406**, 173-176.