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QUANTIFICATION OF BIODEGRADATION AND DETERMINATION OF ALTERATION PATTERNS IN CRUDE OILS

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Biodegradation of crude oil causes volumetrically important compositional changes which lead to a significant quality deterioration in particular during the early stages of alteration. Considering the molecular alterations, various classification systems describing different degradation stages were proposed, whereby the most commonly applied schemes were suggested by Peters & Moldowan (1993) and Wenger et al. (2001). These widely employed biodegradation models focus on qualitative alterations mainly occurring at advanced biodegradation levels, although it is likely that the strongest deterioration of petroleum quality goes along with the depletion of volumetrically relevant compounds during the rather early stages of biodegradation.

A rationale approach for a quantitative assessment of biodegradation needs to consider the volumetrically important oil constituents as starting point. In this context Behar et al. (2006) determined degradation extents for hydrocarbon subgroups. However, so far it was not shown in detail how ongoing biodegradation influences the specific molecular composition in a petroleum reservoir. It is also not known to which extent compositional alterations, even within the rather early stages of biodegradation affect the deterioration of the crude oil quality. Therefore, this study concentrates on the effects of initial to moderate biodegradation on the molecular petroleum composition and the related deterioration of crude oil quality.

We have investigated a suite of 55 crude oils from 5 different petroleum systems to decipher compositional alterations occurring in biodegraded reservoirs. Based on a comprehensive geochemical characterisation individual sequences were defined, where compositional variability is mainly due to microbial activity. We illustrate that conventional molecular biodegradation parameters, such as the Pr/*n*-C_{17} and Ph/*n*-C_{18} ratios are not suitable to define the extent of biodegradation in a petroleum reservoir.

Here, we suggest a new molecular biodegradation parameter, the DEGRADATIVE LOSS [%] that can be used to quantify depletions of individual crude oil constituents (Fig. 1). The approach discussed in this study also enables an improved assessment of biodegradation extent in a single crude oil sample by the MEAN DEGRADATIVE LOSS [%]. It is demonstrated that the crude oil quality, as assessed by the API gravity can be predicted directly from the

molecular composition of crude oils. Our data clearly indicate that patterns of compositional alteration due to biodegradation differ in different petroleum systems (Fig. 1). This suggests that microbial communities are different and therefore generate varying molecular degradation patterns in distinct petroleum systems.

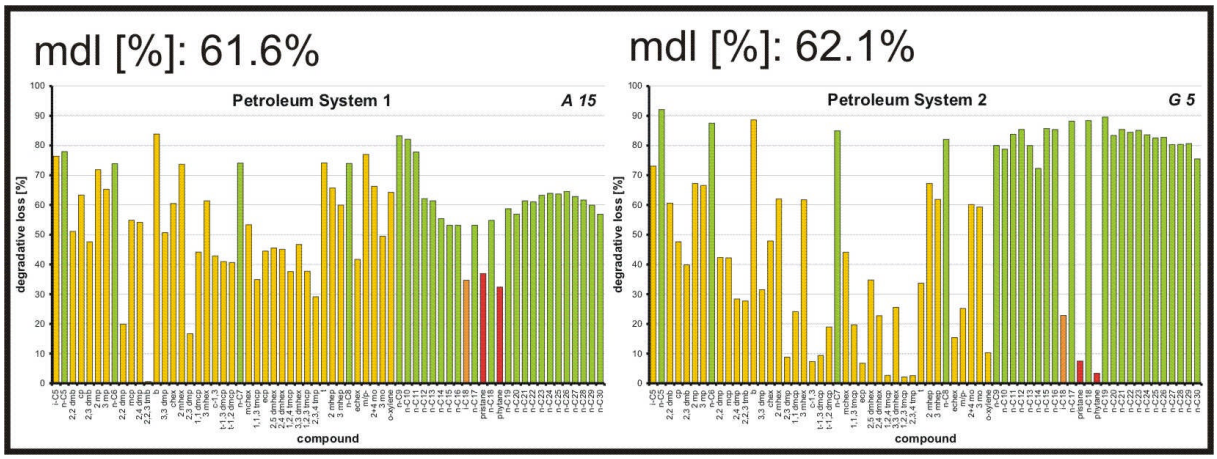

Figure 1. The bar charts show DEGRADATIVE LOSSES for 66 individual crude oil constituents in two crude oils from reservoirs in Angola (1) and Norway (2). The selected samples represent crude oils with comparable extent of biodegradation as assessed by our new biodegradation parameter, the MEAN DEGRADATIVE LOSS (mdl).

REFERENCES

Behar, F., de Barros Penteado, H.L., Lorant, F., Budzinski, H., 2006. Study of biodegradation processes along the Carnaubais trend, Potiguar Basin (Brasil) – Part 1. Organic Geochemistry 37, 1042-1051.

Peters, K.E., Moldowan, J.M., 1993. The Biomarker Guide: interpreting molecular fossils in petroleum and ancient sediments. Prentice Hall, New Jersey.

Wenger, L.M., Davis, C.L., Isaksen, G.H., 2001. Multiple controls on petroleum biodegradation and impact on oil quality. Society of Petroleum Engineers Paper 71450.