COMPOSITIONAL CHARACTERISTICS OF LACUSTRINE OILS IN THE DUNGA FIELD, KAZAKHSTAN

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Introduction

The Dunga Field is located in the Mangyshlak Basin on the eastern coastline of the Caspian Sea, western Kazakhstan. The basin is known to contain oil and gas in Jurassic clastic reservoirs, but the Dunga Field has also proven hydrocarbons within Lower Cretaceous clastic and carbonate reservoirs. A regional oil family study (Maersk Oil in-house) has demonstrated that the oils in the Dunga Field and fields to the S-SE were sourced from lacustrine source rocks, likely of Triassic age. Regional to reservoir scale geological studies have inferred faulting and tilting to explain the complex charging history of the Dunga Field.

The present study focused on compositional similarities/dissimilarities of oil samples from the different reservoir units in the Dunga Field in order to: 1) better distinguish oil provenance of the samples and 2) better constrain timing/mechanism for migration based on the maturation and composition observations. The conducted analyses included stable carbon isotopes, GC (incl. light HCs) and GC-MS of biomarkers (incl. tricyclic terpanes and Quantitative Diamondoid Analysis [QDA]).

Results

The C7 oil correlation star diagram (Halpern, 1995) shows minor variation among the oil samples which together with similarity in isotopic and biomarker compositions suggest that the investigated oils were charged from the same organofacies. Cross-plots of tricyclic terpane ratios (low T22/T21, high T24/T23 and T26/T25) indicate a lacustrine source (Organofacies C). This is corroborated by correlation of normalized tricyclic terpanes that display the ‘typical’ pattern for lacustrine-sourced oils. The very low sulphur content (mean: 0.04 wt.%) is also in compliance with a lacustrine source.

The oils display alteration by different processes. All oil samples independent of reservoir age appear to have experienced water washing to varying degree. This is recognized in the gasoline range GCs by the decrease in the proportion of toluene (Tol/MCyC6) and benzene (Benz/CyC6). In contrast biodegradation seems to be absent, which may be related to reservoir temperature. Apart from one of the oils they do not show evidence for fractionation as recorded by the Aromaticity (Tol/nC7) and Paraffinicity (nC7/MCyC6) indices of Thompson (1987). This one oil has some affinity with a fractionation residue due to the increased toluene content (higher Aromaticity Index).

QDA was used to investigate for mixed oils or potential cracking (Moldowan et al., 2015). In a 1- +2-methyladamantane *vs* 3- +4-methyldiamantane diagram the oils form a very well-defined trendline which indicates charging from the same source, but significantly higher diamondoid concentrations in the Barremian reservoir oils suggest they have been cracked. Despite a relatively small data-set a ‘diamondoid baseline’ was tentatively defined close to 2 ppm 3- +4-methyldiamantanes (Figure 1). The oil from the Albian reservoir may be non-

cracked to light/moderate cracked, whereas the two oils from the Barremian reservoir appear to be strongly cracked, likely ~79–83%. Cracking requires high temperatures in the reservoir.

Maturity parameters are ambiguous but the oils in the Barremian reservoir appear to have been sourced from a less mature source rock than the Aptian/Albian oils.

This suggests a potential complex charging history, e.g. in order to reach the necessary temperatures for in-reservoir cracking the cracked oils might have experienced 'hotelling' at another reservoir before remigrating to the Dunga Field.

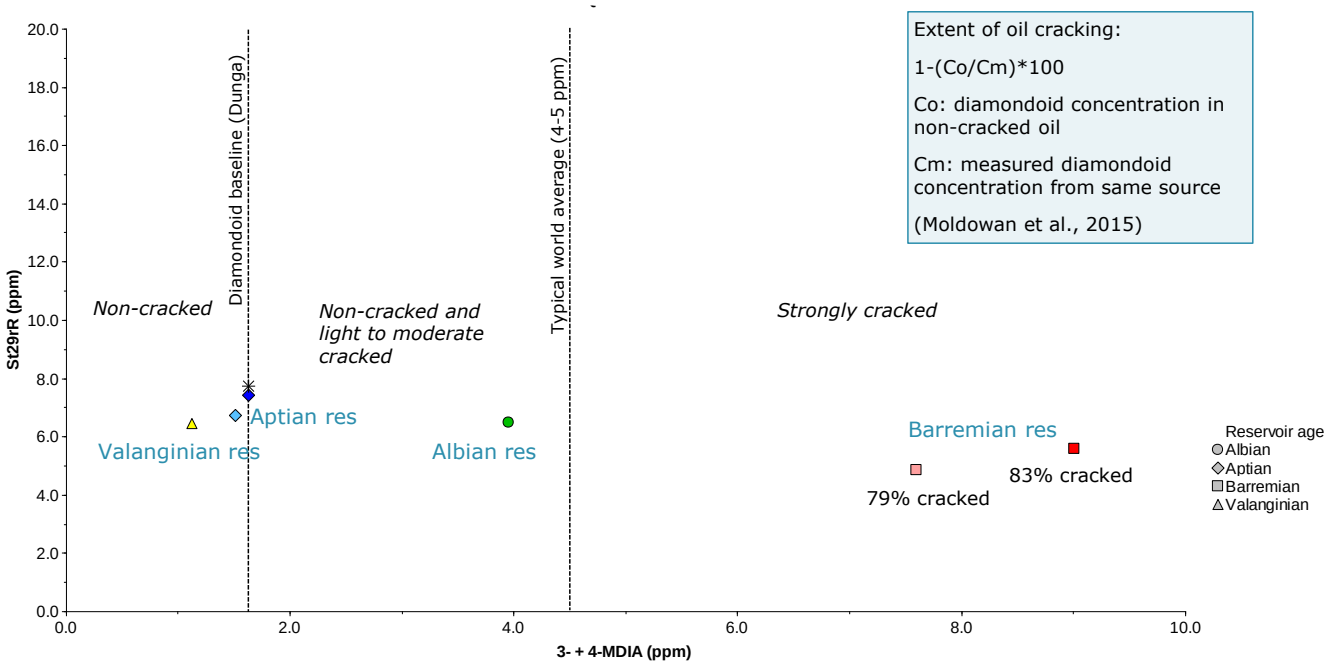

Figure 1 *St29R vs 3- +4methyldiamantane plot of the Dunga oils showing the defined baseline, the typical world average baseline and the calculated amount of cracking of the oils in the Barremian reservoir.*

Conclusions

The Dunga oils were charged from the same lacustrine source rock facies. The oils display varying degrees of water washing but show no signs of biodegradation. Diamondoids suggest that the oils in the Barremian reservoir have been strongly cracked and these oils seem to be less mature. This suggests a complex charging history.

References

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