COMPLEX RESERVOIR 2G&R SYNTHESIS USING PCA ANALYSIS ON GEOCHEMICAL DATA SET

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Introduction

To image the potential of this technique; one of the key particularities of the chosen deep offshore field is the variability of the hydrocarbons property with depth and location.
Each drilled and sampled well encountered hydrocarbons with significantly different fluid properties.
It is well admitted and proven that the biodegradation (and compartmentalization) plays an important role in this variability but biodegradation near oil-water contacts alone do no permit to understand the observed variations.
In order to unlock the understanding of the system, a Principal Component Analysis was carried out on available geochemical data and the actual 3G understanding of the field was used to help interpreting the results.
PCA was particularly adapted to the available data-set due to large number of variables, observations, possible correlations between all the variables and no obvious clustering of the data.

Results

A significant amount of data is available regarding fluid sample properties of this field; composition, macro fluid properties, C7-C11 peak ratio and gas isotope ratio).
In order to make the most of the available dataset, a Principal Component Analysis (PCA) was performed. The methodology is particularly well suited for such large data-set.
A total of 64 properties were gathered for 22 fluid samples. A particular attention was taken to ensure that those 22 samples have a complete data-set.
Due to the fact that the number of variables exceeds the number of samples, 12 out of 64 variables were selected for the final interpretation. The choice of the variables was performed using a trial and error approach that is to say that several combinations of variables were tested and only the most interpretable were kept.
The first step was to define how many principal components should be used to interpret the results. In order to minimize the loss of information during the interpretation – maximize the data dispersion explained by the interpretation
The second step consists in trying to interpret the principal components (PC). Only 2 principal components, accounting for around 75% of the data dispersion, satisfy this requirement.
The first axe (PC1) is strongly correlated to reservoir temperature, initial GOR, reservoir and saturation pressure and oil density. It can be interpreted as an indicator of alteration intensity.
For the second axe (PC2), the interpretation is quite less obvious but this axis is strongly correlated to hydrocarbon and isotope composition of gas. It can be interpreted as an indicator of the gas flux origin.
This work permitted to prove that an additional phenomenon is responsible for the variability of fluid properties observed on this low buried deep offshore field.

Three distinct phenomena take place on the field. Oil biodegradation occurs near WOCs, this biodegradation induce gas fluxes that strip (alter) the oil in-place. In addition to those 2 phenomena, external gas fluxes seem to strip the oil only in the Eastern part of the structure. As there are only data in the central part of deeper reservoir R3, one cannot conclude with certainty that all these phenomena exist in this reservoir. Nevertheless, there is no tangible geological reason why they could not take place as in the lowest reservoir R1 and R2

Conclusions

This PCA treatment give a better vision of the fluid distribution in the field and so have a strong impact on perspective of drilling new development wells or exploring near-by areas. Zones showing only biodegradation gas fluxes should be favored compared to zones exhibiting both biodegradation and external gas fluxes, especially if the risked in-place and petrophysical properties of both zone are considered similar. Thus, the chance of finding better oil quality will be drastically increased and hence greater recovery efficiency possible.