GEOCHEMICAL ANALYSES CAN CONTRIBUTE TO SEARCH HYDROCARBON DEGRADING MICROBES FOR NEW CONCEPTUAL ENHANCED OIL RECOVERY

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Introduction

In the recent oil price downturn, enhanced oil recovery (EOR) environment has been being changed to focus on lean start-up applications without large initial investment. One of the low operational cost applications is Microbial EOR that can be an appropriate candidate for a numerous number of small matured oil fields facing abandonment due to economical limits and/or less oil productivity. MEOR is using many types of microbial functions: selective plugging of high permeability streak by microbial growth, producing of gas, surfactant and polymer in which those bio-products can consequently enhance oil production by swelling oil, reducing interfacial tension between oil/water, and improving mobility. Another important function, here we focus on, is biodegradation of hydrocarbons. This can result in reducing oil viscosity, and then make oil flow easier. A combination of oil degrading process and methanogenesis can convert liquid fluid (remaining immovable oil) to gas (movable methane) according to many reports of methanogenic oil degradation. Gas can flow easier than liquid oil in *in situ* reservoir, therefore, the methanogenic oil degradation can be effective from hydrocarbon recovery factor point of view. This new conceptual MEOR aiming the methanogenic oil degradation, instead of simply recovering additional oil, means to revive a new gas field by microbial conversion from marginal oil field.

According to the previous studies (Kano et al. 2009; Maeda et al. 2009 & 2010; Mayumi et al. 2015), two families of microbes are involved in the mechanism of methanogenic oil degradation, in which immovable hydrocarbon in *in situ* reservoir is degraded to low carbon chained intermediate product and then finally converted into methane. Details of methane-producing microbes in the subsequent process converting from the intermediate product to methane was discussed by Mayumi et al (2013). Namely, metabolic pathway in this new conceptual MEOR was revealed as C_nH_{2n+2} → (degradation) → intermediate product → (methanogenesis) → CH_4. The key for success in this new conceptual MEOR is how efficiently we can discover hydrocarbon degrading microbes (HDM) involved in the first oil degrading process under *in situ* reservoir conditions (i.e. high pressure/temperature and anaerobic), in particular. Random haphazard sampling of HDM should be avoided to save labour-intensive screening as much as possible, and this study demonstrates some guidelines based on geochemical analyses would be useful for a narrowed-down search of HDM.

Method

Geochemical analysis to evaluate intermediate product in reservoir brine and evidence of oil degradation is considered a useful approach for searching the HDM. In two domestic onshore depleted oil fields, reservoir brine and crude oil were sampled not only for molecular analysis but also for gathering hydrocarbon degrading microbes. Amount of intermediate product in brine and oil composition were analysed and enrichment cultures were performed for both

field's samples to catch HDM. Then, those geochemical information was compared with existence of indigenous HDM between those two fields.

Results

As a result of enrichment culture, HDM was discovered from the field B, while not from the field A. The geochemical analyses revealed more abundant intermediate product (acetate) in reservoir brine from the field A, in addition to relative depletion of n-alkanes in oil from the field B. More rapid consumption of the intermediate product and characteristic distribution of hydrocarbons were considered to be consistent with the existence of HDM.

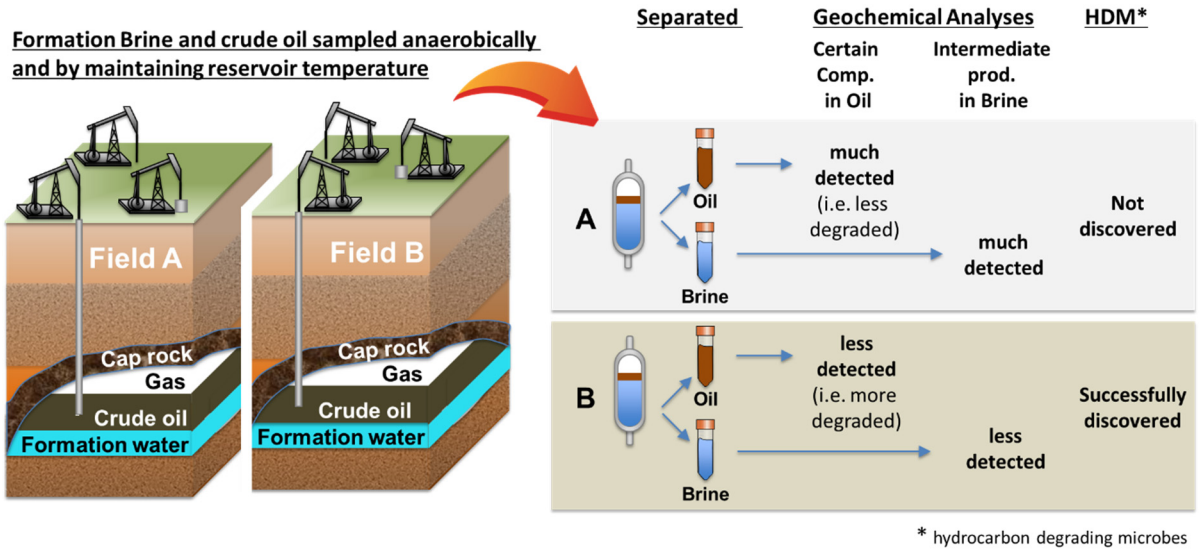

Figure 1 *Geochemical analyses results can provide useful guideline for pre-screening of hydrocarbon degrading microbes search.*

Conclusions

The study showed possibility of geochemical information to improve searching efficiency of HDM for the methanogenic oil degrading EOR. Based on amount of intermediate product involved in the metabolic pathway, occurrence of oil degradation could be predicted.

Reference

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