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New Idea in Original Oil Water Contact (OOWC) Reconstruction for Mature Oil Field - Example from Terbang Field

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SUMMARY

'Terbang' field is located in Central Sumatra Basin and discovered in 1971 with 49 wells in 14 oil reservoirs where 141,407 MMSTB oil has been booked for the OOIP (2007). The RF in still reach 34.36 % (Nov, 2013) & WC from all the wells is 97.6%: an indication of overestimated OOIP where Boi, porosity (Φ) and Sw are not seems to produce the overestimation. The overestimation comes from the net pay volume where the OOWC as the boundary is never addressed carefully. For that, this paper integrates a new methodology to produce a better OOWC assessment by consider the depletion history (1971-recent). A new idea that be purposed here is to utilize data that rarely be used in OOWC interpretation: rock sample oil stain from 2159 side well core samples that integrated with log & swab test and completion data. This integration produce reservoir depletion history that used to reconstruct the original condition and OOWC position before first well drilled. Result: almost all the reservoirs multiple and complex OOWC controlled by compartmentalization and spill point. These never been seen before due to limited of seismic resolution, means this methodology shows a better result than the previous study result.

Introduction

'Terbang' field is located in the northern part of Central Sumatra Basin, Indonesia and discovered in 1971. Until this paper published, 49 wells have been penetrated in 14 oil reservoirs from 3 different geological Formations (Bekasap, Bangko and Menggala) and produce 'Sumatra Light Oil' by using primary recovery. 141,407 MMSTB oil has been booked for the OOIP (Original Oil in Place) value by a service company work in 2007. Refers to the accumulative production in November 2013, the recovery factor in 'Terbang' field still reach 34.36 % but the value of water cut average from all the wells has reach 97.6%.

This incompatibility indicate the uncertainty in the last reserve estimation which causes the over estimation of OOIP. Refers to some reservoir parameters that included in OOIP calculation: Boi, porosity (Φ) and Sw are not seems to produce an overestimation. The overestimation actually comes from the net pay volume (reservoir area x oil zone thickness) where the OOWC as the boundary of net pay volume in OOIP calculation is never addressed carefully (OOWC level become deeper). Beside there was no clear Pay-No-Pay definition and compartmentalization issue never be assessed before. For that reason, this paper integrate a new methodology to reduce these uncertainty above and produce a better OOWC assessment (reduce the over estimation) in 14 oil reservoirs. But, since the field has been produced for almost 40 years makes the methodology need to consider the oil depletion history.

The New Methodology

The methodology consists of data collection, RNR and PNP definition, residual oil zone and depleted oil interpretation, depletion history assessment and the last is original oil reconstruction. Data collection step include complete wireline log, swab test rate data and completion data from 49 wells where the most important thing is oil stain data from 2159 side well core. Then all the data turned into RNR definition and PNP definition by using new syntax and different DRES (deep resistivity) cut off is applied as the function of salinity. This PNP process then produce new object named: "Oil", "Water", "no-Reservoir" and "Probable Oil". For the residual oil zone interpretation step, the last object named "Depleted Oil" is produced where this object is recognized by the flat DRES response but good oil stain (2-3 dots oil show). Then in depletion history step, all the wells is sorted from first well until to the last well (based on their well number) to show the reservoir depletion history. This depletion history then can be used to reconstruct the original condition of OOWC in "Terbang" field.

Conclusions

Surprising result shows after this method applied. There are a lot of miss-interpretations from the previous study where almost all the reservoirs have different depletion history scenario which is also indicate that there are some multiple and complex OOWC that controlled by compartmentalization issues and spill point position (factor that cause the reserve over estimation). This compartmentalization never been seen before due to the limited of seismic resolution, where it means that this methodology shows a better result than the previous study result in assess the OOWC position. Some reservoirs candidate for water flooding target (based on their OOWC characteristic that produced from this methodology) from each reservoir also purposed here. A simple methodology but show a lot of utilities for reservoir management in any mature field like 'Terbang' field.

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Most of the references come from Chevron Pacific Indonesia (CPI) internal publication and it could not be described here.

Reservoir-no-Reservoir (RNR) Criteria	Sand Unit	DRES Cut-Off (ohm. m)
VSH ≤ 0.5 & PHIE ≥ 0.125 → Reservoir	Bekasap-01	10 Ω .m
VSH < 0.5 & PHIE < 0.125 → Tight Sand (no-Reservoir)	Bekasap-02	10 Ω .m
VSH > 0.5 → Shale (no-Reservoir)	Bekasap-03	10 Ω .m
Pay-No-Pay (PNP) Criteria (Integrated with Saturation Data form Swab Test)		
Water Criteria <ul style="list-style-type: none"> Meets "Reservoir" criteria DRES $<$ classification WC from Swab Test 95%-100% 	Bekasap-04	13 Ω .m
	Bekasap-05	13 Ω .m
	Bekasap-06	13 Ω .m
	Bekasap-07	15 Ω .m
Probable Oil Criteria <ul style="list-style-type: none"> Meets "Reservoir" criteria DRES $>$ classification No Swab Test Data 	Bekasap-08	18 Ω .m
	Bekasap-09	18 Ω .m
	Bekasap-10	18 Ω .m
Oil Criteria <ul style="list-style-type: none"> Meets "Reservoir" criteria DRES $>$ classification WC from Swab Test $< 95\%$ 	Bekasap-11	20 Ω .m
	Bekasap-12	20 Ω .m
	Bangko-01	20 Ω .m
	Menggala-01	20 Ω .m

Table 1 The new syntax that been generated to define RNR to PNP definition and the different DRES cut-off for better PNP definition.

Figure 1 The comparison between previous study (right) with this paper interpretation (left). The previous study show some miss assumption that all closure are assumed to be charged by oil in a flat OOWC without interpret any compartmentalization potential.