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Bangko Shaly Sand is the Key for The Future To Be Main Reservoir and Increase Oil Production with The Fracturing Stimulation in Beruk Field Coastal Plan Pekanbaru Block Central

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Bangko Shaly Sand Is The Key For The Future To Be Main Reservoir And Increase Oil Production With The Fracturing Stimulation In Beruk Field, Coastal Plan Pekanbaru Block, Central Sumatra Basin.

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1. Badan Operasi Bersama PT. BSP-Pertamina Hulu

Abstract

Beruk field is located in the western part of Bengkalis Graben, Central Sumatra Basin, Coastal Plain Pekanbaru (CPP) Block. Started production since 1980, Beruk is mature field that has entered the waterflood phase in 1996 with recovery factor (RF) 45.5%. Production of Beruk Field continues to decline with an annual decline of 25%, average water cut 98% which is produced from clean sand reservoir from Bekasap and Bangko Formation, but shaly sand reservoir not yet optimized. This study explains shaly sand become main reservoir with the detail stratigraphy analysis and precise stimulation method, based on well dan production data.

In lithology, shaly sand reservoir included in Bangko Formation indicated not tight, thin thickness, low resistivity, high shale content, limited lateral distribution and low of liquid rate. This reservoir interpreted as sand flat and tidal mud flat in the estuarine to marine environment system, characterized with lenticular and flaser sediment structure. Based on ultraviolet light, isolated sand on the lenticular dan flaser sandstone show oil indication from core data.

Fracturing stimulation using carbolite combined with water shutoff stimulation made non connected oil sand become connected and stimulated flow to the well. This method can increase production index shaly sand reservoir while water shut off is used to restricted flow of water. Fracturing have been implemented at well BRK-25, increased production from 20 BOPD become 160 BOPD and stayed above the baseline production for almost two years, with incremental cumulative reaching 58.42 MSTB. Stimulation works have successfully raised oil production from shaly sand and has brought profit for company. Based on this condition, shaly sand reservoir needs to be considered for more advanced develop at others well in Beruk fields.

Keywords : Shaly Sand, Fracturing Stimulation, Beruk Field

1. Introduction

Beruk field located around Bengkalis sub-basin in the eastern part of Central Sumatra Basin included into the working area CPP (Coastal Plain Pekanbaru) block. This field is part of working area which is operated by BOB PT. Bumi Siak Pusako-Pertamina Hulu. Geographically included in the Siak District, Riau Province, which is approximately 69 kilometers from the city of Pekanbaru (Figure 1).

Beruk Field structure was found in July 1974 and started production since March 1980. Beruk is mature field that has entered the waterflood phase in 1996, until December 31, 2018, total of 47 wells oil had been drilled with the main reservoir is sandstone from Bekasap and Formation Bangko. Beruk field has a structural traps, structure is a NNW-SSE trending anticline and bounded on the west by a high angle reverse fault.

Production of Beruk Field continues to decline with an annual decline of 25%,

average water cut 98% which is produced from clean sand reservoir from Bekasap and Bangko Formation. Clean sand reservoir also has also been done waterflood, but shaly sand reservoir not yet optimized.

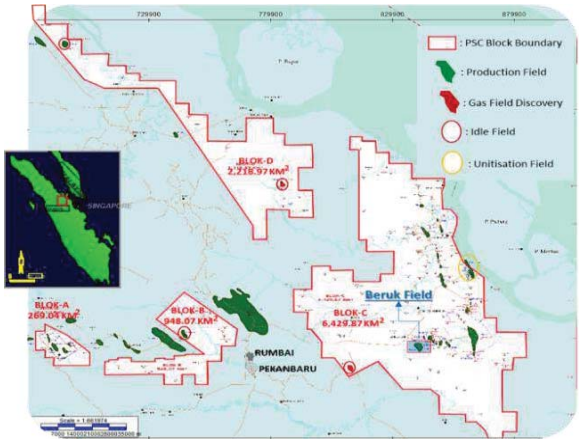


Figure 1: Beruk Field location inside the working area of the CPP Block .

2. Geological Review

Bengkalis sub-basin is a part of Central Sumatra Basin (CSB) and is one of the most prolific oil basins in Indonesia (Figure 2). It is related to the mechanism of Paleogene rifting. From the source, reservoir and seal perspective, rift-related sediment is the most important elements petroleum system and have been proven in this sub-basin, ex Beruk Field. Especially for shaly sand with poor reservoir quality also filled by hydrocarbons.

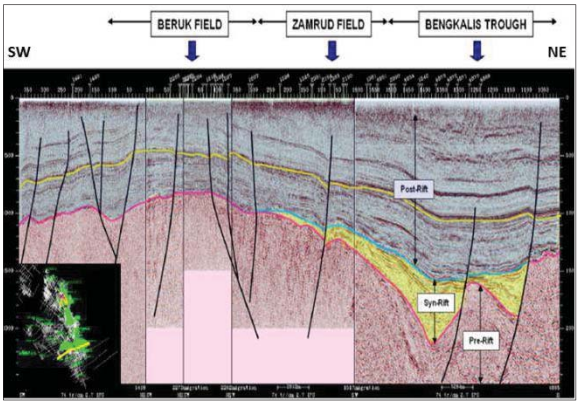


Figure 2: Seismic section Bengkalis Sub-Basin CPP Block.

Generally, the stratigraphy of Beruk Field contains Tertiary sediments, ranging from Paleogene to Pleistocene in age, resting on heterogeneous Pre-Tertiary basement of commonly sedimentary, igneous and metamorphic rocks. The overlying tertiary sediments can generally be divided into five sequences, which reflect distinct tectonic phases in the development of the basin. From the oldest to the youngest, these sequences are known as paleogene Pematang Formation, Lower Miocene Sihapas, Group (Menggala, Bangko, Bekasap, and Duri formation), Lower to Middle Miocene Telisa Formation, Upper Miocene to Pliocene Petani Formation, and Pleistocene Minas Fomation (Heidrick and Aulia, 1993) (Figure 3).

Beruk field has 4 main reservoirs, including 1440'sand & 1460'sand (Formation Bekasap) and 1500'sand and 1570'sand (Bangko Formation) (Figure 3). For this study, we will focus on 1500’sand that is as shaly sand reservoir. 1500’sand indicated not tight, thin thickness, low resistivity, high shale content, limited lateral distribution and low of liquid rate.

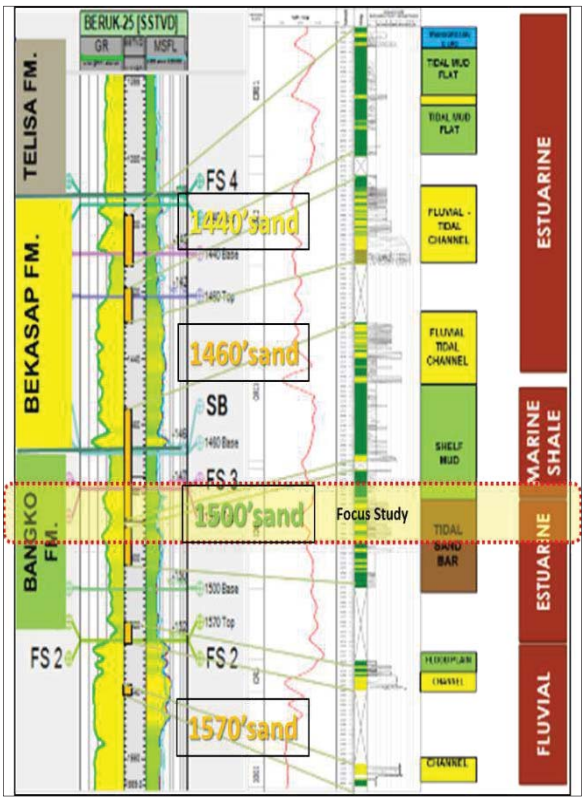


Figure 3: Statigraphy Central Sumatera Basin (Heidrick and Aulia, 1993).

3. Methodology

The main data used in this study are well log, petrography, core, reservoir pressure and also production data. Petrography and core data are needed to analyze the reservoir shaly sand character and determine indication of hydrocarbon. Depositional facies are determined based on core data combined with Gamma Ray log character. Reservoir pressure data is used to determine the sand to reservoir connectivity and determine lateral facies distribution.

Based on reservoir characteristic, stimulation stimulation using carbolite combined with water shutoff stimulation is the method to optimize production from shaly sand reservoir.

4. Result and Discussion

Based on core BRK25, shaly sand 1500'sand in the field Beruk deposited on estuarine tidal environment system. 1500'sand reservoir showed that lenticular and flaser structures are quite dominant as the effect of tidal currents in the estuary environment. The lenticular and flaser structures are in some places unconnected and isolated from one another. However, based on the ultraviolet light the structure shows an indication filled by hydrocarbons that will not flow through the wellbore with the usual perforation method (Figure 4).

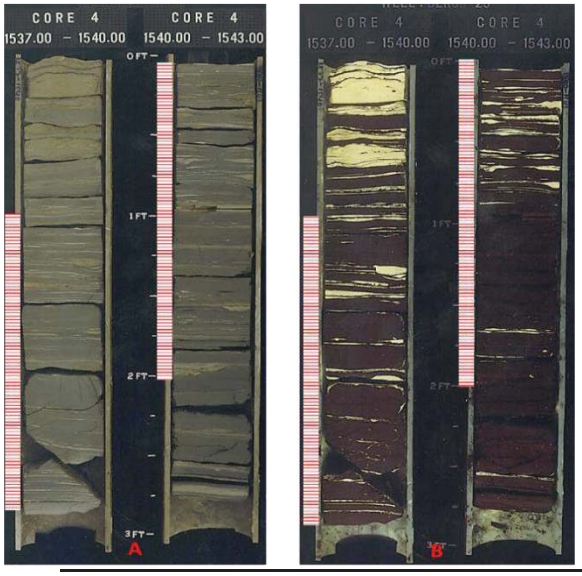


Figure 4: Core Photo 1500'sand reservoir Beruk 25 (A. Photo) (B. UV Photo)

Grain sizes range from very fine to fine, thin clay drapes and silty laminae are common. Mineralogy consist of quartz, feldspar, gloucony, pyrite, siderite, clay mineral and calcite cemented. Sedimentary structures include even and uneven laminae, common current ripples, wave ripples, lentikuler, carbonaceous laminae and localized roots. These sands interpreted to represent tidal sand flats and bars of estuarine tidal environments deposit.

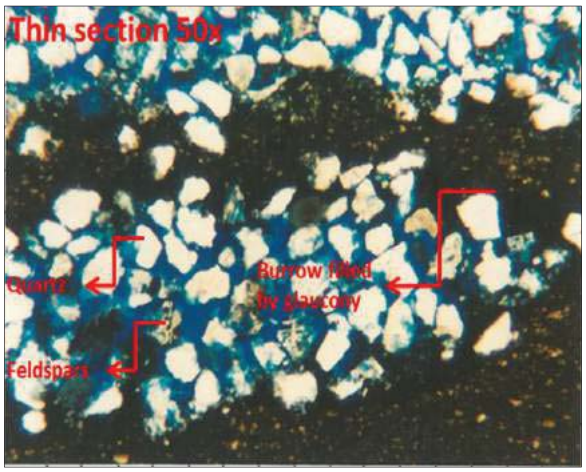
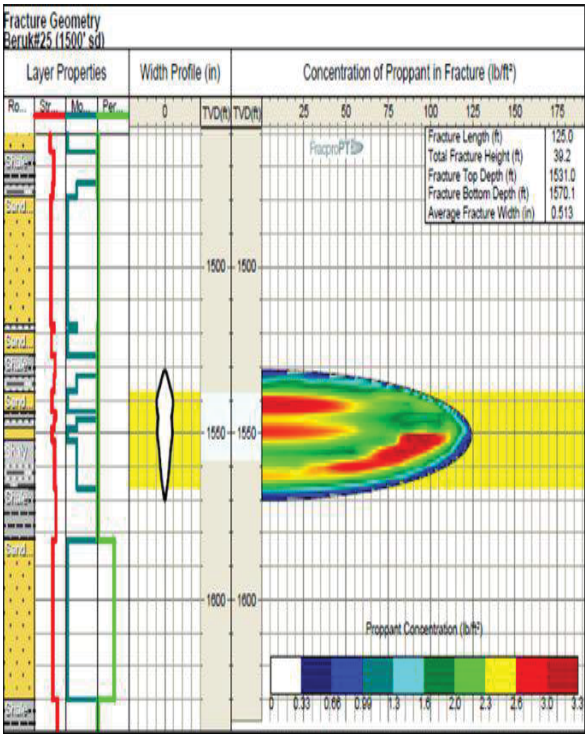


Figure 5: Thin Section 1500'sd Beruk 25 (50X).

The burrow presence, which is then filled with gloucony and clays minerals, causes reservoir pores in lentiukuler and flaser structures not one and the other (Figure 5). Measurement Effective porosity and permeability of core data at reservoir 1500'sand Bangko Fomation, showed good properties value. The mean porosity value is 25% and permeability 80 mD. Based on the laboratory results show the reservoir is not problematic in properties, but the problem is isolated flaser and lenticular structure sediments.

The fracturing stimulation 1500'sand at Beruk 25 well is done in 2012, technically using 12/18 carbolite 16,486 lbs with water web 1000 gallon as buffer water shut off is

pumped before main fract. Water shut off is used to anticipate water flow in water zones above and below the 1500'sand layer. Maximum pressure Breakdown test 1806 Psi



with 1109 Psi closure pressure and fract gradient 0.977 Psi / ft. Mini fract result using Crosslink Hybor fluid obtained maximum pumping pressure 1721 Psi with fract gradient 1,041 Psi / ft and closure gradient 0.846 Psi / ft. racture geometry from main fract result obtained Fracture Length 125 ft, Height 39 ft and average Width 0.513 inch (Figure 6). Fracturing stimulation made isolated flaser and lenticular that filled by oil become connected.

Figure 6: Fracture Geometry Model Beruk 25

Fracturing stimulation have been implemented at well BRK-25, increased production from 20 BOPD become 160 BOPD. This production stayed above the baseline production for almost two years, with incremental cumulative reaching 58.42 MSTB (Figure 7).

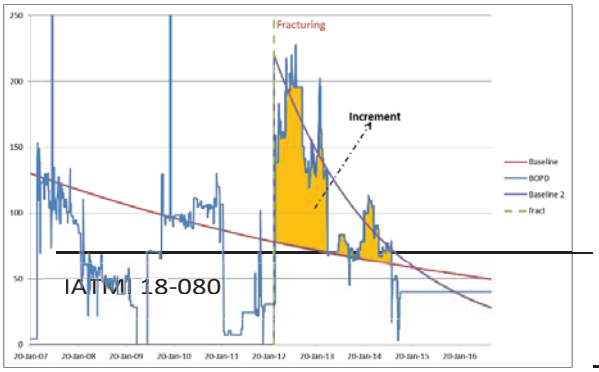
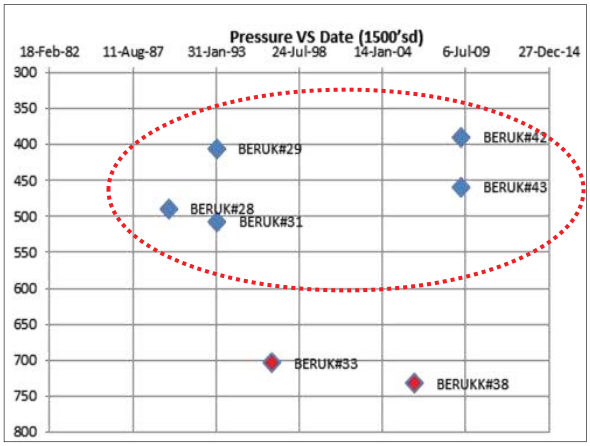


Figure 7: Oil Production Perfomance reservoir 1500'sand Beruk 25.

The successful fracturing of the 1500'sand reservoir at the Beruk 25 well, becomes success case that can applied on another well with the same reservoir character. Determination of other potential potential wells in the 1500'sand reservoir for fracturing stimulation, using a detailed and comprehensive sequence analysis.

The stratigraphic correlation was performed by flattening the flooding surface as the Top Bangko Formation boundary, as the field of time equality. Correlation indicates that the spread of the 1500'sand reservoir not develop in all wells, its distribution is limited to only a few wells. Well log type shows the same reservoir character as the BRK25 well, ie the

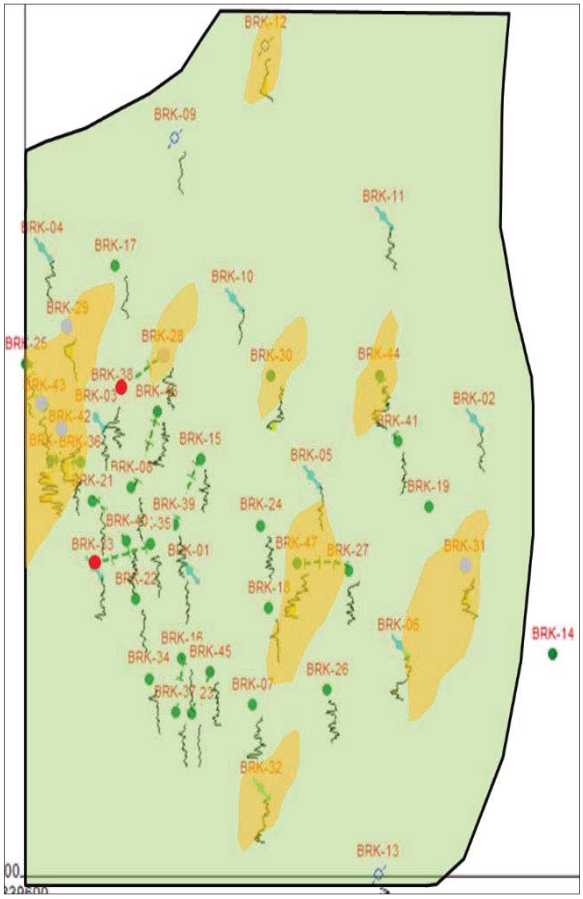


log type fannel as the facies bar

Figure 8: Pressure vs Depth 1500'sand, Beruk Field

Pressure analysis are used to confirm the facies that has been define from conventional core analysis and electrofacies analysis. The pressure data from some wells were used to analyze the facies distribution of shaly sand

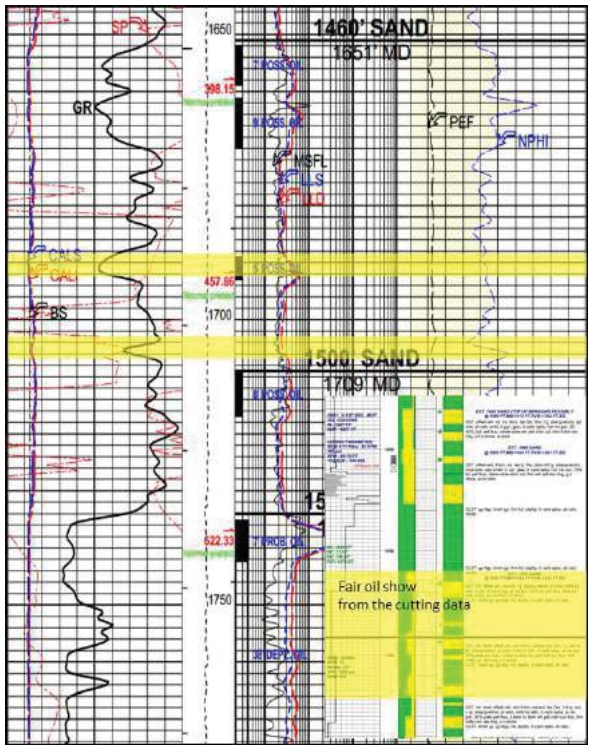
1500’sand. All of the pressure data are initial pressure of the wells which was measured during the drilling activities. It was done by comparing the pressure data of the formation of wells drilled in the same period. Furthermore, the data from wells drilled



from different period still can be used, in condition that pressure anomaly exist between wells. Similar pressure shows connectivity between sand bar, but pressure anomaly show not connectivity sand bar. Based on the data pressure is made the model of distribution reservoir 1500'sand (Figure 9).

Figure 9: Model of Distribution reservoir 1500’sd, Beruk Field.

In the field there are still some wells that have the potential for fracturing stimulation in the 1500'sand reservoir. One of the potential wells for fracturing stimulation is



Beruk 43 well (Figure 10). The well log type shows the same character as the Beruk 25 well, ie the log type fannel as the facies bar. Beruk 43 well is structurally more updip than Beruk 25. Potentially for 1500'sand reservoir in Beruk Field is still very interesting to do on some wells as a step to restrain the rate of decline in production and bring profits to company.

Figure 10: This caption is placed inside the frame

5. Conclusion

Shaly sand 1500'sand in the field Beruk deposited on estuarine tidal environment system. Characterized with lenticular and flaser sediment structure, however isolated sand on the lenticular dan flaser sandstone show oil indication. Fracturing stimulation using carbolite combined with water shutoff stimulation made non connected oil sand become connected and stimulated flow to the well. This method have been implemented at well BRK-25, increased production from 20 BOPD become 160 BOPD and stayed above

the baseline production for almost two years, with incremental cumulative reaching 58.42 MSTB. Stimulation works have successfully raised oil production from shaly sand and has brought profit for company.

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7. References

Heidrick, T.L., and Aulia, K., 1993, Proceedings of the Indonesian Petroleum Association.