PROCEEDINGS
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A LESSON LEARNED OF FORMATION PRESSURE MEASUREMENT AT S-X1 and S-X2 WELLS, SUNGAI GELAM AREA, JAMBI

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Abstract

Sungai Gelam Structure is one of the backbone structures in Jambi Field. Air Benakat Formation has been proven as the main productive formation. The challenges of reservoir in Sungai Gelam are reservoir characterization, unknown potential layer's hydrocarbon bearing, and formation pressure issue.

The formation pressure measurement in this field was run in two wells, with operational problems occurred in each wells. The formation pressure data is very important for better understanding of reservoir's pressure regime due to highly related fault system and to identify other potential layers. The initial operational problem occurred in S-X2 well, related to the probe on instrument string which not set properly that resulted in lost seal, even when tested in casing. Fishing job was also been done due to cable stuck in run #2, and the further study shown that the differential pressure between formation and wellbore is too high, another highly probable reason was the trajectory of the well was skewed from the drilling program.

Air Benakat Formation (ABF) is commonly known for its poor rock properties (tight). In both S-X1 and S-X2 wells, formation pressure measurement was defined within 15-20 stations, and a total of 61 attempts were conducted due to tight, supercharged and loss seal problems. The data gained shows that the main target has higher formation pressure than the prognosed; based on reservoir simulation, interpreted located in different block faulted and the unprognosed hydrocarbon bearing sand is shown from fluid analysis with virgin formation pressure.

This formation pressure has proven to measure formation pressure in tight sand, even failed in some sands, but the operational problem occurred lead us to consider another option of measurement method, ie measurement while drilling method to give a clearer reservoir characterization.

Introduction

Sungai Gelam C Field located about ten kilometers to the southeast area of Jambi City (Figure 1). The geological setting of Jambi Field belongs to Jambi Sub-Basin and South Sumatra Basin. Jambi structural framework has been driven by the basin asymmetric trapping mechanism. The syn-rift megasequence episode during the Eocene to Early Oligocene period produced multi division traps which further differentiate the northwest-southeast oriented South and Central Palembang Sub Basins with the Northeast-Southwest oriented South and Central Palembang sub basins with the northeast-southwest oriented Jambi sub basin. The earlier extensional episode which formed the north-south graben series had been overtaken by the Miocene rotation which later produced present day north northeast-south southwest orientation (Ginger, D. and Fielding, K., 2005) (Figure 2).

There were two wells drilled in 2018: S-X1 and S-X2. Dealing with blanket sand reservoir with complex fault system, knowing the formation pressure is important in order to know the vertical permeability, detect fluid contact movement, indentify depleted sand zone, interpret the fluid content of the sand body by making pressure gradient, and decide completion method to produce the hydrocarbon (Rahadian et al., 2015).

Formation pressure measurement can be done through wireline or by while drilling job, with inserting the probe into the reservoir and with drawing a small amount of fluid. Since the pressure gauge is exposed to many temperature and pressure changes, these measurements require accurate gauges with high resolution that can dependably react to the dynamic conditions (MDT Modular Formation Dynamic Tester, 2002).

Data and Method

S-X2 well is a vertical well 8.5" hydrocarbon section with actual survey records maximum inclination of 1.21 degree. Previously, formation pressure measurement is rarely run in Sungai Gelam Area because the old wisdom demonstrates an extensive sand distribution will have similar reservoir pressure value, making the pressure measurement less important.

The workflow of the pressure measurement through wireline and by while drilling is quite similar, as both of them have a pad/probe (Rahadian et al., 2015). When the tool is approaching the target reservoir, the probe is set to the reservoir and measuring the formation pressure. In order to identify reservoir fluid, fluid analysis is also been done by measuring optical properties if the fluid in the flowline. The fluid analysis module employs an absorption spectrometer that utilizes visible and near infrared light to quantify the amount of reservoir and drilling fluids in the flowline. Light is transmitted through fluid as it flows past the fluid analysis spectrometer. The amount of light absorbed by the fluid depends on the composition of the fluid (MDT Modular Formation Dynamic Tester, 2002).

There are 61 (fifty nine) pressure measurement were performed from 20 points which planned in 8.5" section. The results are 12 points valid tests, 2 points unstabilized tests, 6 points supercharged tests, 28 points tight tests, and 11 points lost seals. Fluid analysis are performed on 6 points, where 1 point was identified as gas, 1 point was identified as oil, 2 points were identified as formation water, and 2 points were identified as formation water and gas traces. The low rate of valid test number is considered because of the tight reservoir, tool condition, and hole condition (Figure 3).

Moreover, operational problems were occurred in both S-X1 and S-X2 Well. In S-X1 well, the probe of the MDT tool was fail to set during measurement, indicated by lost seal result in several stations and also have been tested in 9.625in casing, reflecting the same result (Figure 4). In S-X2 well, a more severe problem faced, an unpredictable cable sticking was found even though in vertical well. An analysis of those problems was conducted to identify any factors may affect.

Result and Discussion

In S-X1 well, a change of probe was highly needed for accuracy. The first run was using extra-large diameter, as we deal with low permeability reservoir, resulting in the need of fracturing job in producing state. As mentioned previously, several lost seal pressure measurement results indicated malfunction with probe replaced with the back up tools, unfortunately the only available back up tools at the moment was with large diameter probe.

In S-X2 well, cable sticking was occurred when approaching points #9, quoted 15 attempts in depth 1442 mMD. The cable stuck and fishing job accumulated 48 hours of non-productive time (NPT). The cable stuck was indicated by increasing cable tension (overpull) while the head tension was still in normal range. Analysis was held with focus on well condition. Initial hypothesis was there is skewed well trajectory at 1000-1080 mMD with an abrupt change in azimuth from 230 to 9 degree and inclination of 1 degree. The skewed trajectory condition could affect the cable movement during the pressure measurement (Figure 5).

This formation pressure has proven to measure formation pressure in tight sand even failed in some sands, but the operational problem occurred lead us to consider another option measurement method, i.e. formation pressure while drilling method to give a clearer reservoir characterization.

On contrary, the main reservoir had higher formation pressure than surrounding wells. The previous geological model then being updated with possibly fault exist among S-X1 and S-X2 wells to existing wells as there is no different facies (Figure 6).

Conclusions

The formation pressure measurement is very important to be implemented in the next wells, even dealing with blanket reservoir system. As the importance of the pressure data, the operational job need to be concerned, in example making sure the tools condition (either main tools and back up tools), and also the mud applied is should be maintained to avoid wash out and formation damage.

In conlusion, it can be considered to use formation pressure while drilling to reduce sticking risk potential at Sungai Gelam Area.

References

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Acknowledgements

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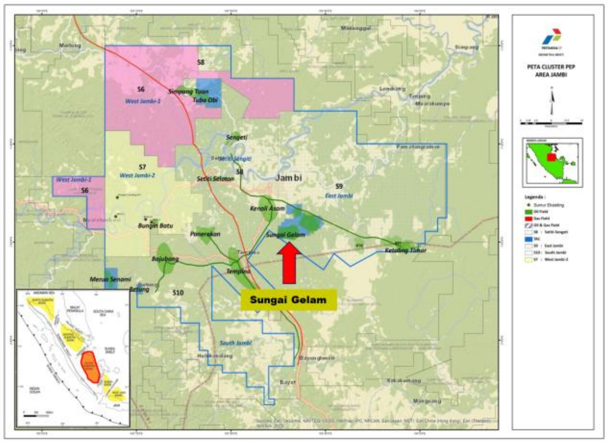

Figure 1. Sungai Gelam-C Field located about ten kilometers to the southeast area of Jambi City.

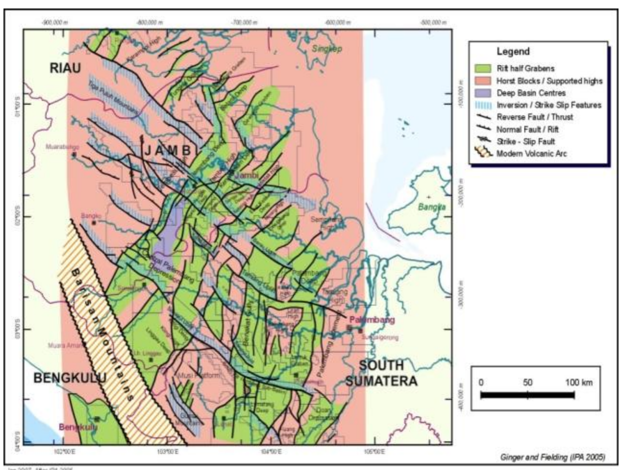

Figure 2. Key structure elements, showing Eocene-Oligocene age rifts (NE-SW oriented) cross cut by Pliocene – Pleistocene inversion (Ginger, D. and Fielding, K., 2005).

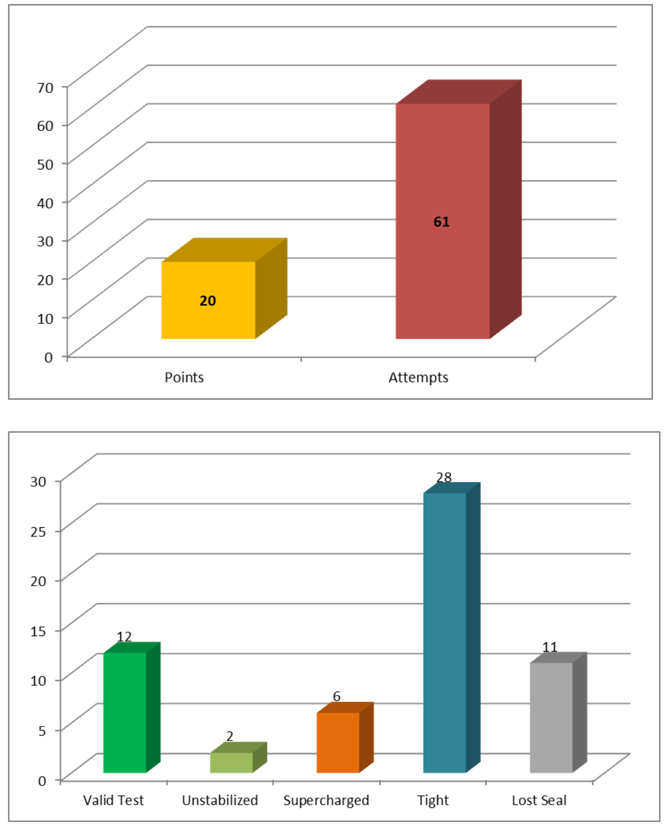

Figure 3. Summary of MDT Logging in S-X1 Well.

Figure 4. The Extra Large Probe Diameter which found error in reading (left) then replaced by the back up tools (middle and right).

Survey

Measured Depth (m)	Inclination (°)	Azimuth (°)	Vertical Depth (m)	+N/-S (m)	+E/-W (m)
305.20	0.23	299.55	305.19	-0.49	1.57
324.40	0.55	251.41	324.39	-0.50	1.45
343.60	0.50	261.57	343.59	-0.54	1.28
362.40	0.64	258.07	362.39	-0.58	1.09
381.70	0.55	267.74	381.69	-0.60	0.89
400.90	0.79	264.17	400.89	-0.62	0.67
420.20	0.76	272.26	420.19	-0.63	0.41
438.50	0.76	272.26	438.48	-0.62	0.17
458.70	0.80	271.98	458.68	-0.61	-0.11
478.50	1.06	260.66	478.48	-0.63	-0.43
497.00	0.87	267.91	496.98	-0.67	-0.74
516.20	0.37	290.00	516.18	-0.65	-0.94
535.10	0.19	320.03	535.08	-0.61	-1.02
554.20	0.12	350.28	554.18	-0.56	-1.04
573.00	0.05	61.84	572.98	-0.54	-1.04
592.00	0.20	83.06	591.98	-0.53	-1.00
610.80	0.25	33.09	610.78	-0.49	-0.94
629.80	0.26	55.01	629.78	-0.43	-0.88
649.10	0.29	36.91	649.08	-0.37	-0.82
668.10	0.32	45.85	668.08	-0.29	-0.75
687.10	0.36	37.29	687.07	-0.21	-0.68
706.40	0.33	39.29	706.37	-0.12	-0.61
725.30	0.46	47.98	725.27	-0.03	-0.51
744.50	0.28	69.84	744.47	0.04	-0.41
763.70	0.50	69.50	763.67	0.09	-0.29
782.60	0.68	60.40	782.57	0.17	-0.12
818.60	0.50	55.63	818.57	0.37	0.20
837.60	0.37	56.28	837.57	0.45	0.32
856.80	0.43	41.85	856.77	0.54	0.42
875.80	0.46	57.80	875.77	0.63	0.53
894.70	0.42	65.69	894.67	0.70	0.66
913.70	0.55	202.32	913.67	0.64	0.69
932.70	0.94	188.74	932.67	0.40	0.63
951.40	0.94	187.07	951.36	0.10	0.59
970.40	0.79	186.11	970.36	-0.19	0.55
989.70	1.00	185.75	989.66	-0.48	0.52
1,008.70	1.09	239.70	1,008.66	-0.74	0.35
1,027.80	1.12	248.57	1,027.75	-0.90	0.02
1,047.00	0.27	336.03	1,046.95	-0.93	-0.17
1,065.90	0.74	20.25	1,065.85	-0.77	-0.15
1,085.10	0.65	22.40	1,085.05	-0.56	-0.07
1,104.40	0.46	5.27	1,104.35	-0.38	-0.02
1,123.30	0.34	9.55	1,123.25	-0.25	0.00
1,141.90	0.44	21.08	1,141.85	-0.13	0.03
1,161.20	0.19	51.73	1,161.15	-0.04	0.09
1,180.40	0.26	68.57	1,180.35	0.00	0.15
1,199.60	0.27	95.22	1,199.55	0.01	0.24
1,218.90	0.62	109.37	1,218.85	-0.03	0.38
1,237.90	0.56	118.69	1,237.85	-0.11	0.56
1,256.90	0.48	117.40	1,256.84	-0.19	0.71
1,275.90	0.66	107.38	1,275.84	-0.26	0.89
1,295.20	1.21	121.15	1,295.14	-0.40	1.17
1,314.40	0.35	149.85	1,314.34	-0.55	1.37
1,333.30	0.14	303.56	1,333.24	-0.59	1.38
1,352.30	0.32	287.45	1,352.24	-0.56	1.31

Figure 5. The skewed trajectory condition could affect the cable movement during the pressure measurement at S-X2 well.

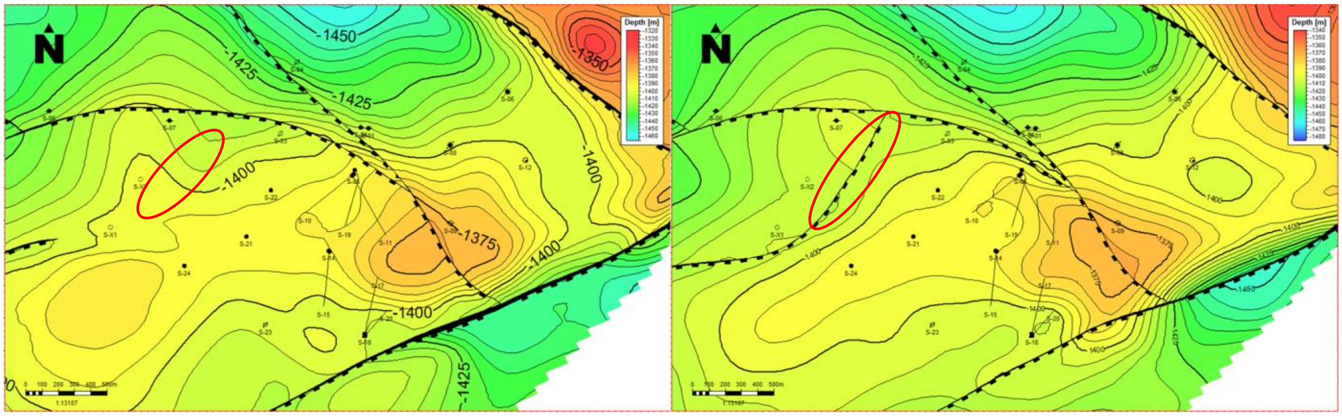

Figure 6. The previous geological model (left) is updated with possibly fault exist among S-X1 and S-X2 wells to existing wells.