PROFESSIONAL TECHNICAL PAPER
ONLINE PRESENTATION
24 - 25 OCTOBER 2020

A Tight – Low Resistivity Coastal Deposit Reservoir as Potential Prospect in Sungai Gelam Area, Jambi

Reza Rahadian[1], Rachma Winurani[1], Chandra Mustofa[1], Fannopo Rikardo[1], Reza Alfajri[1], Erwin Dicky Dusyanto[1]

[1]Asset 1 Exploitation Pertamina EP
Email: reza.rahadian@pertamina.com

Abstract. Sungai Gelam Structure is one of the backbone structure in Jambi Field. Air Benakat Formation (ABF) have been known as the main productive sand beside Talang Akar Formation, which oil and gas bearing, supporting most of South Sumatra Basin's hydrocarbon production. The ABF is Miocene sediment deposited in coastal depositional environment. Typical clean and porous sand showed from lithology and porosity log are representation of main reservoirs. Since the main reservoirs found lower than estimated at S-X1 well, another potential reservoir was needed, on the other hand, the potential sand is typically shaly sand, tight, and low resistivity value. Integration method of sequence stratigraphy, pressure test/fluid analysis, ratio gas analysis, and petrophysical analysis has conducted to capture the other potential reservoirs. New uncovered A1 and A2 reservoirs are the potential sands which proven containing oil, despite resistivity value of 4 ohm.m, with oil rate ranging from 30-60 bopd.
In conclusion, the integration evaluation method is successfully in identifying potential bypassed zone reservoirs within coastal deposit sediments.

Keyword: Tight Reservoir, Low Resistivity, Shoreface Deposit, Prospect, Air Benakat Formation.

1 Introduction

Sungai Gelam field is located within Jambi sub-basin, onshore South Sumatra. The field physical location is at Muaro Jambi district, Jambi province about ten kilometers to the southeast area of Jambi city (Figure 1). The working area once operated by PN PERTAMIN in 1960-1992 and has been consolidated back to PT Pertamina EP since 2005 to operate under PSC term for thirty years.

The field anticlinal structure was established in 1958 through the discovery of S-01 and S-03 wells. The ensuing 2D interpretation in 1974 had divided the field structure into three development blocks; A, C and D which are still pertinent at this time. Each block has then been developed by production wells. The focus of this development plan activity is at the block C, or known as Sungai Gelam-C (SGC).

The SGC field currently has twenty nine (29) wells, divided further into four compartments; Block-1A, Block-1B, Block-2 and Block-3, based generally upon the fluid production dominance. Block 1A consists of mainly oil producing wells group, whereas active gas wells located mostly at the other three blocks.

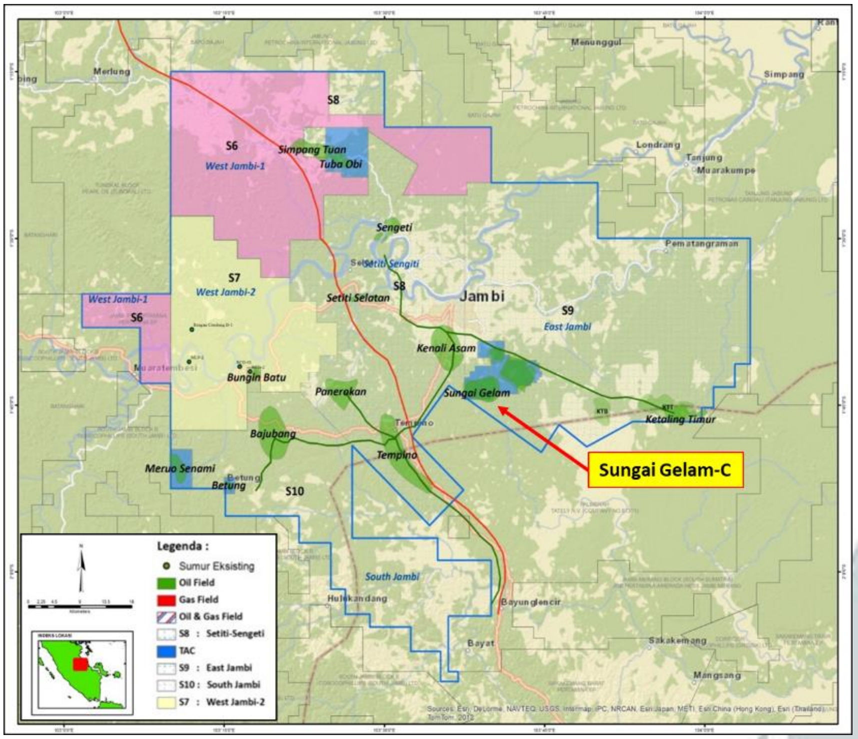

Figure 1. Sungai Gelam C is located about 10 km to the southeast of Jambi City, a capital of Jambi Province.

Sungai Gelam reservoirs produce both oil and gas. There are three productive layers within the Air Benakat Formation; Layer-B, C, and D sands. Layer-N sands mostly produce oil, whereas A sands are gas bearing layers within the field crestal area. Other potential reservoir intervals with scattered oil indications are the A1, A2, E, F, G and H sands, albeit not currently being the focus of the field development. The reservoirs initial condition has been measured from few wells and indicate separate relationship between the two fluid properties. The oil reservoir pressure variation with depth uses relation P=0.3125*Depth-187.5. Oil reservoir temperature variation with depth (T=0.0304*Depth+75). Gas reservoir pressure variation with depth (P=0.08797 *Depth–2146.2). Gas reservoir temperature variation with depth (T=0.0305*Depth+75). The measurement pressure in psia, depth in feet, and temperature in degF (Rahadian et al., 2019).

Depositional Environment

The Pre Tertiary complex comprises dominantly of Paleozoic-Mesozoic metamorphic rocks and carbonates which further deformed by intensive folding and faulting mechanism during Mid Mesozoic igneous rock intrusion. Sediment deposition in the basin commenced during Eocene to early Oligocene, known as Lemat Formation and Lahat Formation, consist of brackish and lacustrine environment. Lake environment may have been formed and may have intermittent connection with marine through the outlets on the west and south western area. Deposits consist of tuffaceous, coarse clastic sequence or granite wash conformably overlain by shale, siltstone, sandstone and coal deposits or called the Benakat member according to De Coster, G.L. (1974) and Ginger, D. and Fielding, K. (2005). The oldest dating of this formation from the Gumai Mountain outcrop, located at southwest of Lahat, indicates Mesozoic-Paleozoic age. The sediment

has been identified as Tuffaceous Kikim Formation. Further fluvial deltaic sedimentation occurred during the Late Oligocene to early Miocene, known as Talang Akar Formation. The typical pattern of suchsediments at around proximal area is braided while at around distal is meandering belt. The fluvial sediment during the transgressive episode in the early Miocene had been shifted to the deltaic and marginal to deep marine deposits. Talang Akar lithology has been identified as delta plain sandstone, shale, silt, and tuffaceous sandstone with carbonate, conglomerate, or coal interbeds. The planktonic Foraminifera analysis
indicates Banner and Blow N.3 (P.22), N.7 and N.5 zones closely related to the delta plain and shelf sediments. The transgressive process had been continued during early Miocene, known as Baturaja Formation, with marine shale sediments and shallow marine deposit at the intra basin. Carbonate rocks had growth at the basin slope and as reef carbonate at the peak of the intra basin structure. The better reservoir quality has been identified at around the southern part of basin because of the increasing sediment supply toward the area. The transgressive process continue to further accommodate sedimentation of the marine shale, silt and sandstone known as Gumai Formation, occurred during early to middle Miocene period. Glauconitic shale mainly dominates the peak of the transgression in the open marine system to form a regional seal for the area. The episode had shifted to the deltaic sediment progradation to overtake the open marine shale. The prograding process had been widespread during middle Miocene period and formed good quality shallow marine sandstone known as the actively producing Air Benakat Formation. Volcanic activity and deposits had increased during late Miocene period marked by the creation of Barisan Mountain at the western part location as sediment supplier to form fluvial deltaic and coastal swamp deposits known as Muara Enim Formation. The volcanic activity had been continued during Plio-Pleistocene period to form volcaniclastic sediment with tuffaceous, clay, sand matrix, and thin coal layers known as Kasai Formation (Rahadian et al, 2019) (Figure 2).

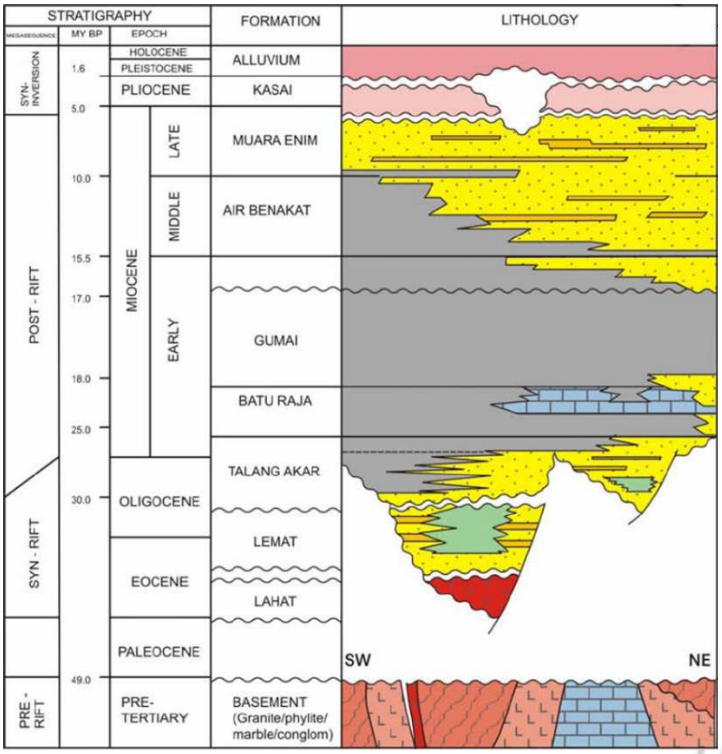

Figure 2. Chronostratigraphic of South Sumatra Basin (after Ginger, 2005).

Reservoirs in Sungai Gelam C Structures are coastal deposits which highly influenced by sea level changes. Source of depositional was come from eastern of the area and western of it is the basin deep. Sequence stratigraphy correlation showing transgression system during Air Benakat Formation depositional and geological concept of the area is predicted to be shallow marine with retrogradational sequence (Rahadian et al, 2019) (Figure 3).

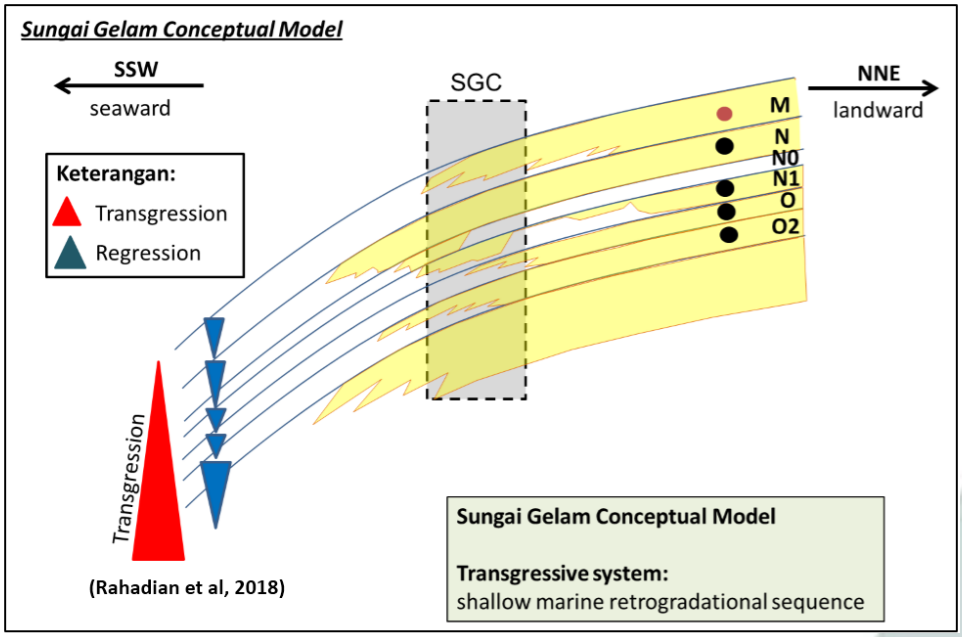

Figure 3. Geological concept of Sungai Gelam C area.

No stratigraphy trap evidence is found within this area, meaning Sungai Gelam structures is a structural trap related. In 2018, Pertamina EP drilled 2 (two) wells which both of those wells are unfortunately located on flank of the main target's structure (Figure 4). A1 sand is interpreted to be oil-contained reservoir.

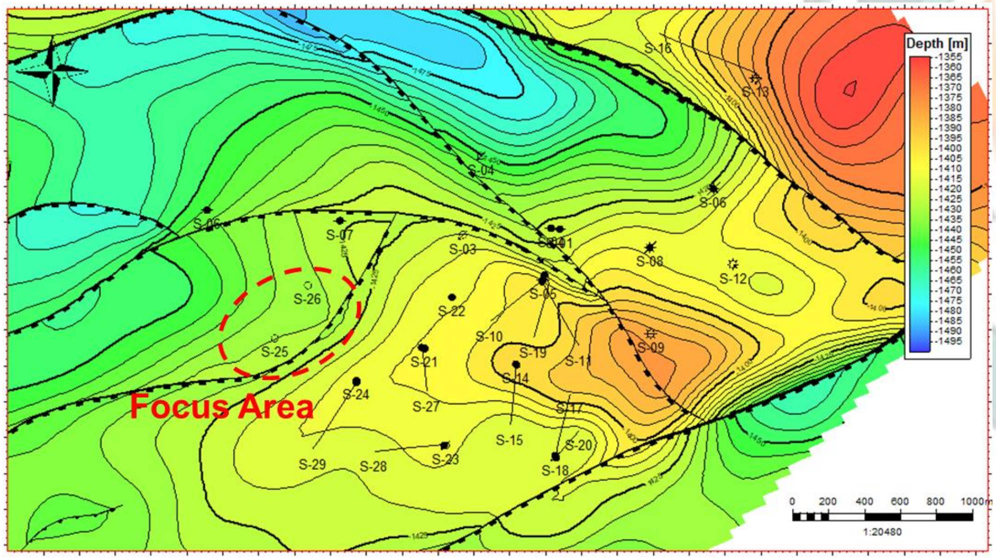

Figure 4. Location of wells drilled in 2018: S-25 and S-26 which exist on structure's flank (red circle).

2 Methodology

Further analysis by well to well correlation, ratio gas analysis, petrophysical analysis, and data acquisition led to yield A1 sand to be prominent candidate to produce (Figure 5). Typically, A1 sand is a tight sand, pressure test acquisition by wireline logging indicating mobility value of 2.41 md/cp and permeability calculation is about 1.6 mD. On the other hand, A1 sand is separated only 2.5 meters away from A sand, which is a gas sand reservoir (Figure 6). A1 sand is previously perceived as non-potential sand but pressure test and fluid identification technology had helped to capture its potential (Figure 7). The low quality reservoirs are required stimulation job to be implemented in improving oil production rate.

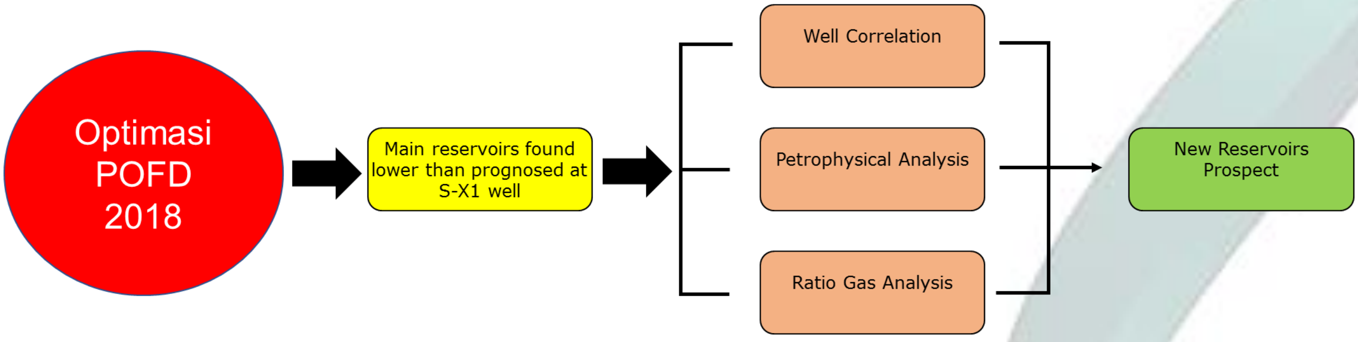

Figure 5. Simplified workflow of the method used in evaluation.

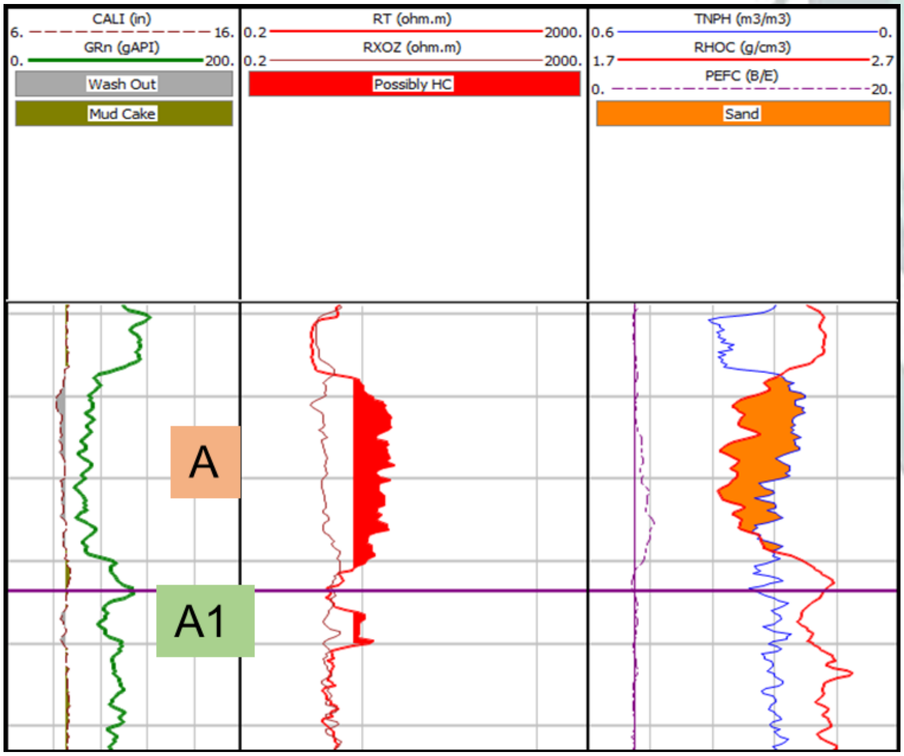

Figure 6. Fluid identification of A1 sand resulting oil contained.

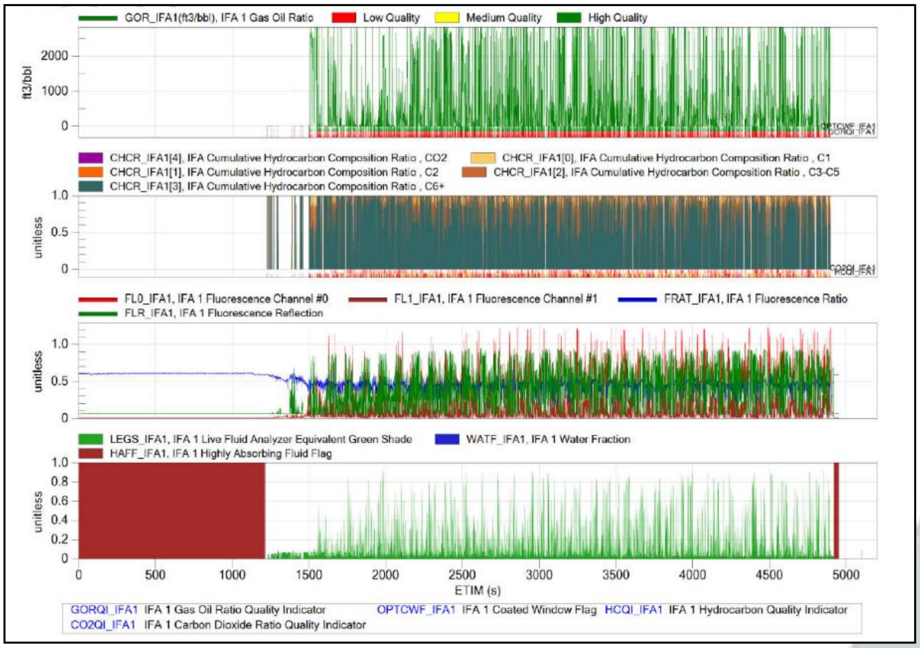

Figure 7. Fluid identification of A1 sand resulting oil contained.

2.1 Result and Discussion

Sequence stratigraphy correlation indicating quite stable accommodation space during reservoir's depositional and more detail could be divided into 3 stratigraphic unit, which are: A, A1, and A2 sand. All of them were easily found in all wells so that they are deposited widespread with NNW-SSE orientation with sediment source from eastern of the area.

Gas analysis ratio analysis is indicating the A sand contain gas whilst the A1 and A2 sand are demonstrated as oil sand bearing (Figure 8). Petrophysical analysis of this parasequence is represent significant properties between A sand and the A1, A2 sand.

Formasi	Lapisan	Litologi	Kedalaman (mMD)	Oil Show	TG (U)	Gas Chromatograph (ppm)							Analisa Gas Chromatograph			
						C1	C2	C3	iC4	nC4	iC5	nC5	WH	BH	CH	HC Indication
ABF	A	Sandstone	1365	nos	2704	473411	33320	14347	1959	2023	1221	601	10.1	25.1	0.40	Gas
			1368		2737	328785	26150	12692	1749	1970	1306	668	11.9	19.3	0.45	Gas
			1371		3271	522005	42633	22619	3517	4294	1668	754	12.6	17.2	0.45	Gas
			1375		3530	579917	47676	25237	3869	4701	1761	759	12.7	17.3	0.44	Gas
			1377		3570	569296	47789	26087	4156	5025	1961	1066	13.1	16.1	0.47	Gas
			1380		3313	552419	43680	23396	3668	4510	1488	631	12.3	17.7	0.44	Gas
			1381		2762	441955	42179	20085	2855	3377	1290	591	13.7	17.2	0.40	Gas
	A1	Sandstone	1384	nos	2014.0	322244	23901	16871	3016	3931	1964	1164	13.6	12.8	0.60	Light Oil/ Condensate
			1385		2014.3	189102	26160	17875	3053	4064	2008	1164	22.3	7.6	0.58	Oil

Figure 8. Gas Ratio Analysis of the A sand group which capturing gas (A) and oil (A1).

The A sand has total porosity of 30% and effective porosity about 26.6%, a typical clean sand. On the other hand, the A1 and A2 sand have similar property with 20% total porosity and 11% effective porosity. The A1 and A2 sand representing low resistivity characteristic with resistivity around 4 ohm.m, but produce oil (Figure 9). The initial rate of the A1 sand is around 60 bopd and A2 is more likely around 50 bopd. The characteristic of the low influx sand is could be determine to have fracturing job afterward to optimize the production rate.

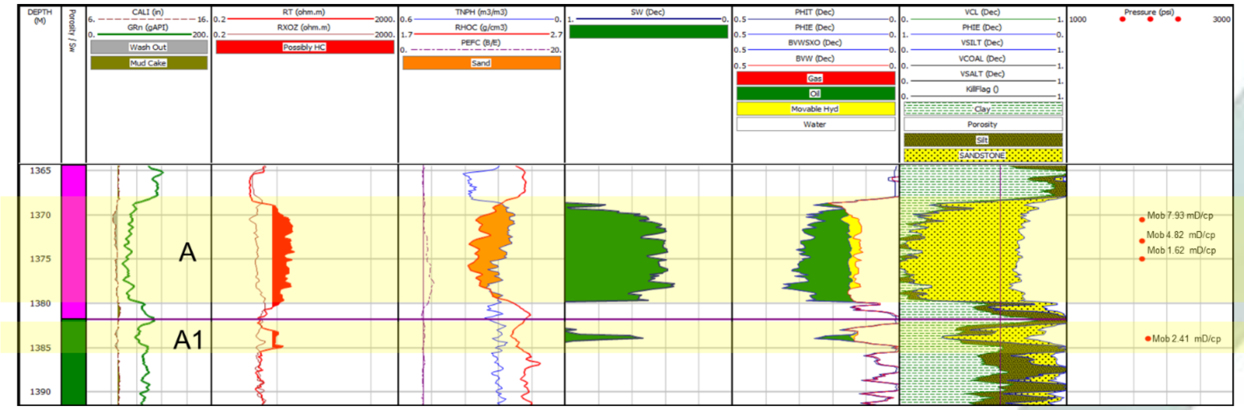

Figure 9. Petrophysical analysis of A and A1 sand in SGC-X1 Well.

3 Conclusion

In conclusion, lower part of foreshore facies which tend to shaly, tight, and thin could be an alternative potential to produce hydrocarbon. Low quality reservoir of lower part leads engineering job (ie. Stimulation) to be implemented to optimize hydrocarbon production rate. Integration of formation evaluation from regional geology concept, sequence stratigraphy correlation, ratio gas analysis, pressure test/fluid identification, and petrophysical analysis are needed to identify the bypassed zones.

References

[1] De Coster, G.L., 1974, The Geology of The Central and South Sumatra Basins: Proceedings of Indonesian Petroleum Association, 3rd Annual Convention.

[2] Rahadian, R., Dusyanto, E., Widyantoro, A., Musakti, O., and Baskara, H. 2019. Renewed Field Development Plan From Recently Found Uncertainty in Sungai Gelam Field, South Sumatra Basin, Jambi: Proceedings of Indonesian Petroleum Association, 43rd Annual Convention.