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Sedimentology and Reservoir Potential of Lower Tanjung Sandstone in Martapura, Barito Basin, South Kalimantan

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Abstract

The Barito Basin in South Kalimantan, Indonesia, is a hydrocarbon-producing basin where the Eocene Tanjung Formation serves as both the primary source rock and reservoir. Despite historical discoveries, recent exploration has faced challenges in identifying high-quality reservoir rocks. This study evaluates the reservoir potential of the Lower Tanjung Formation in the Martapura area using fieldwork and laboratory analyses, focusing on porosity, permeability, and texture and depositional geometry. The formation comprises thick shale with minor sandstone and coal layers, interpreted to be deposited in an estuarine environment. Sandstone layers, 0.2–12 m thick, are limited in lateral extent, forming a narrow "shoestring" geometry. Porosity measurements range from 19.0% to 33.1% (good to very good), with an average of 24%, while permeability varies from 1.5 mD to 105 mD (tight to very good), averaging 29.7 mD. However, primary porosity of the sandstone (3.6–7.2%) is poor, with secondary porosity (3.6–14.8%) dominating, driven by near-surface weathering during uplift. Our study suggests that some sandstone layers exhibit good potential, but the overall reservoir quality is limited due to poor primary porosity and restricted depositional geometry.

Keywords: *Barito , Lower Tanjung Sandstone, Potential*

Abstrak

Cekungan Barito di Kalimantan Selatan, Indonesia, merupakan cekungan penghasil hidrokarbon di mana Formasi Tanjung berumur Eosen bertindak sebagai batuan induk dan reservoir utama. Meskipun terdapat beberapa penemuan migas, eksplorasi terkini menghadapi tantangan dalam mengidentifikasi batuan *reservoir* berkualitas tinggi. Penelitian ini mengevaluasi potensi *reservoir* Formasi *Lower Tanjung* di wilayah Martapura melalui kerja lapangan dan analisis laboratorium, dengan fokus pada porositas, permeabilitas, tekstur dan geometri pengendapan. Formasi ini terdiri dari serpih tebal dengan lapisan tipis batupasir dan batubara, yang diinterpretasikan diendapkan dalam lingkungan estuarin. Lapisan batupasir, setebal 0,2–12 m, terbatas secara lateral dan membentuk geometri *"shoestring"*. Porositas Batupasir *Lower Tanjung* berkisar antara 19,0% hingga 33,1% (baik hingga sangat baik), dengan rata-rata 24%, sedangkan permeabilitas bervariasi dari 1,5 mD hingga 105 mD (ketat hingga sangat baik), dengan rata-rata 29,7 mD. Namun, porositas primer (3,6–7,2%) tergolong buruk, dengan dominasi porositas sekunder (3,6–14,8%) akibat pelapukan di dekat permukaan selama fase pengangkatan. Hasil studi ini menunjukkan bahwa batupasir Lower Tanjung memiliki potensi reservoir yang baik, namun kualitas reservoir secara keseluruhan terbatas karena porositas primer yang rendah dan geometri pengendapan yang sempit/terbatas.

Kata kunci: Cekungan, Batupasir Lower Tanjung, Potensial

I. INTRODUCTIONS

The Barito Basin, located in southeastern Kalimantan in South Kalimantan Province, is one of the basins proven capable of producing hydrocarbon. This is proven by the discovery of oil field such as Tanjung and Kabitin Fields in the late 1930s, the Warukin Field in 1965, and the Tapian Timur Field in the late 1967, which are collectively known as the Tanjung Raya Field (Satyana, 1995). The discovery strongly suggests an active petroleum play with the presence of organic rich source rocks (e.g. Wibowo and Subroto, 2017) within the basin that have matured and generated hydrocarbons. Subsequently, through migration pathways, the hydrocarbons move toward traps and finally accumulated in the reservoir rocks.

In the Barito Basin, the Eocene Tanjung Formation is the primary source rock and simultaneously serves as the main reservoir target in oil and gas exploration activities. Several wells have been drilled following the discovery of the Tapian Timur Field in 1967, but to date, no additional oil and gas fields have been successfully identified in the area. One significant factor contributing to the failure to discover hydrocarbon reserves in the Barito Basin is the inability to penetrate high quality reservoir rocks during drilling operations.

Several studies have been conducted in the Tanjung Formation (e.g. Pranajaya, 2007; Sumotarto et al., 2017; Wibowo and Subroto, 2017; Sinabang et al. 2024;), but the potential of Lower Tanjung Sandstone as reservoir rocks have not been adequately examined. Thus, this study attempts to assess the reservoir quality of Lower Tanjung Sandstone based on the outcrop data.

The quality of rock as a hydrocarbon reservoir is primarily determined by its porosity, permeability, and geometry, which are controlled by its depositional facies (Magoon and Dow, 1994). The objective of this study is to identify the reservoir rock quality of the Tanjung Formation in the Martapura area and its surroundings within the Barito Basin (Figure 1 and Figure 2), based on porosity, permeability, and geometry.

Geological Background

The Barito Basin is situated in the southeastern region of Sundaland and is separated from the Asem-asem and Pasir Basins by the Meratus Mountains on its northwestern boundary. To the north, the basin is bordered by the Paternoster Fault System. The structural history of the basin began in the Late Cretaceous after the collision microcontinent between Paternoster and SW Borneo Microcontinent (Satyana and Idris, 2006). The basin formation began during the Paleogene, followed by compressional tectonics in the Neogene. The rifting phase in Paleogene created a fault system-oriented southeast to northwest, resulting in the formation of grabens and horsts. In contrast, the compressional tectonic which happened in the Neogene led to the uplift of the Meratus Mountains, Kasale-Sihung High, and Tanjung High. This uplift process also influenced the development of reverse faults trending north-northeast to south-southwest, as well as wrench faults (Pranajaya et al., 2007).

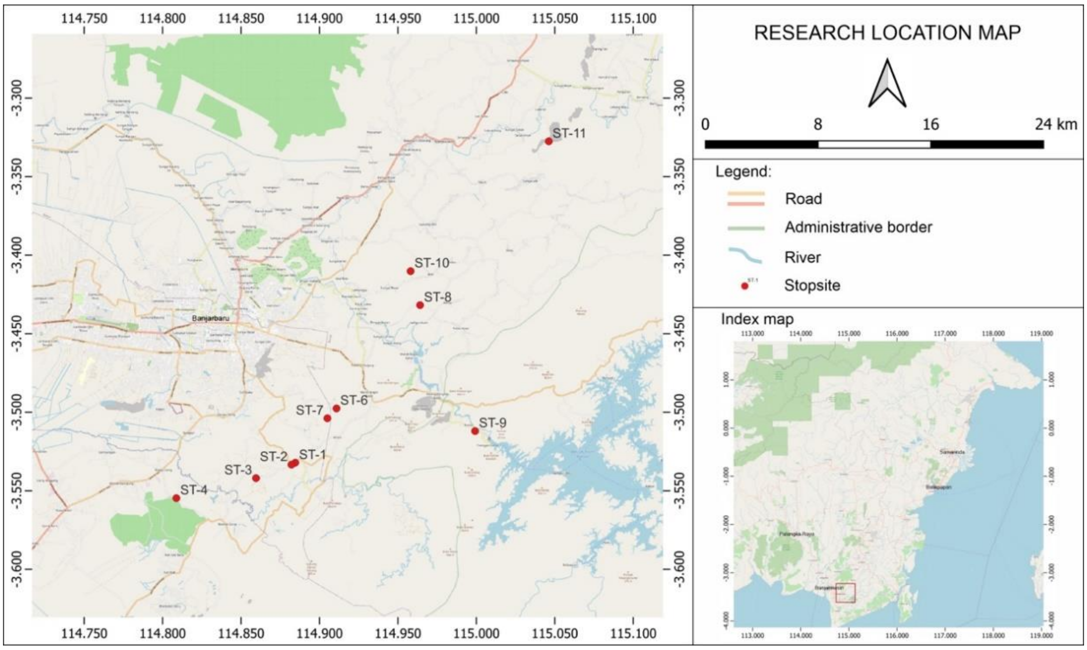

Figure 1. Research location.

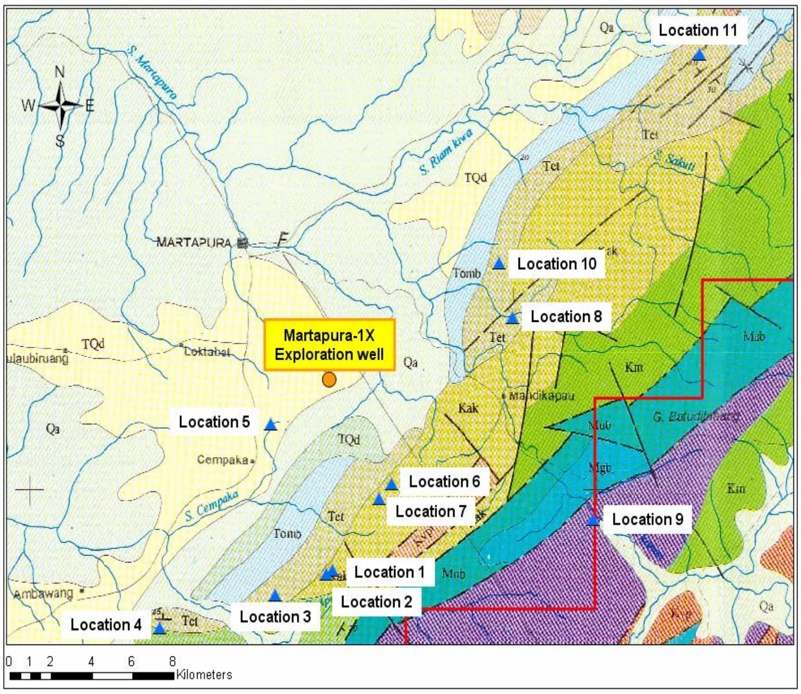

Figure 2. Geologic map of the studied area. Tanjung outcrop is labelled as "Tet" and coloured light brown (Supriatna et al., 1994).

Stratigraphy of Barito Basin

The stratigraphy of the Barito Basin records a history of deposition from the Late Cretaceous to the present. It is characterized by a thick sequence of clastic and carbonate sediments, reflecting the transition from marine to non-marine environments over time. The basement rocks of the Barito Basin consist of pre-

Tertiary granitic and metamorphic rocks of the Schwaner and Meratus Mountains. These rocks represent the crystalline foundation upon which the sedimentary succession was deposited.

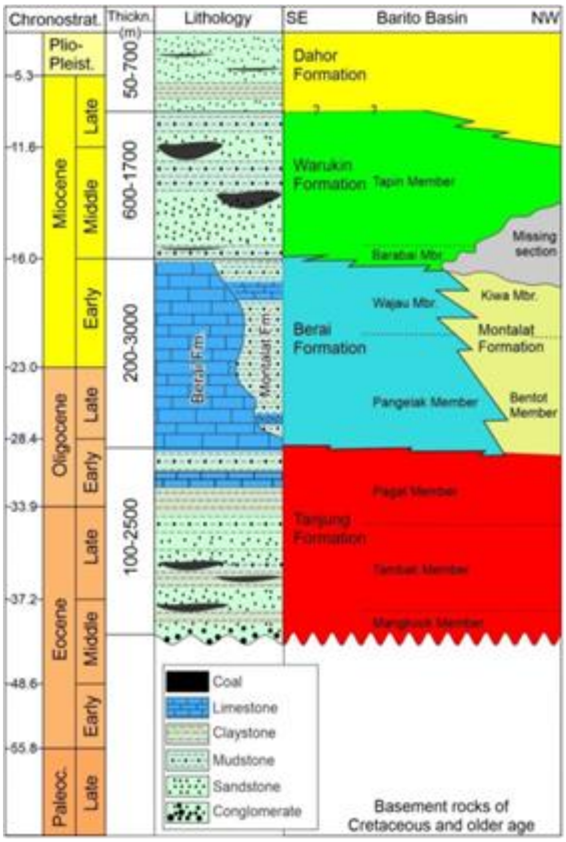

Figure 3. Stratigraphic column of Barito Basin (Witts et al., 2014; Fikri et al., 2022)

During the Eocene, the basin was characterized by fluvio-tidal to marginal marine (Witts et al., 2011). The deposition of the Tanjung Formation, a key unit in the Barito Basin, marks this period. The Tanjung Formation consists of interbedded sandstones, shales, and coal seams, and conglomerate. Witts (2012) divided Tanjung Formation into 4 Facies Association, namely TFA1-4 and interpreted Tanjung Formation to have been deposited alluvial to marginal marine. Overall stratigraphy of Tanjung Formation suggests a transgressive sequence.

In the Late Oligocene to Early Miocene, the deposition of Berai Formation took place. The Berai Formation primarily consists of carbonate rocks, including limestone, dolomitic limestone, and marl. The Berai Formation overlies the Tanjung Formation and is overlain by the Warukin Formation. The Warukin Formation, deposited after Berai Formation, reflects a shift to more terrestrial and fluvial-dominated environments, reflecting a period of basin inversion and regression until the Plio-Plistocene (Satyana et al., 1999). This unit is characterized by sandstones, siltstones, and coals, with evidence of swampy and deltaic conditions.

The Dahor Formation, representing the youngest stratigraphic unit, was deposited in Late Miocene to Quartenary. It consists of fluvial and deltaic sediments, reflecting continued subsidence and sediment supply from the surrounding uplands. The uplift of the Meratus Mountains during this period influenced sedimentation patterns, causing progradation of deltaic systems (van de Weerd and Armin, 1992).

II. METHODOLOGY

The methods employed in this research include fieldwork and laboratory analysis. Fieldwork was conducted to observe outcrops to identify the lithology of the Tajung Formation, followed by the collection of representative samples for laboratory analysis. The laboratory analysis involved determining porosity and permeability.

Porosity Analysis

Two types of porosity in the Tanjung Formation were analyzed in this study, namely observed porosity and measured porosity, determined using two methods:

1. Petrography
   In this method, the porosity of the rock is determined based on the size of pores observed in thin sections. The porosity value for each sample is calculated as the average of five measurements from petrographic observations. Parameters observed in this method include the type of porosity, grain size, grain sorting, grain shape, packing, and pore cavity morphology.
2. Weight based method
   In this method, rock sample are cut into cubic shapes, and the measurements include the dry weight of the rock in air, the saturated weight in kerosene, and the saturated weight in air. The porosity value is derived from the rasio of the difference between the saturated weight in air and the dry weight in air to the difference between the saturated weight in air and the saturated weight in kerosene. This analysis provides the effective porosity, as it only measures interconnected pore spaces.

Permeability Analysis

The permeability of the rock was determined using a gas permeameter in this study. The gas used was free air with a viscosity of 0,0183 cp a tan average room temperature of 28 C. The samples were cut into cubes measuring 2 cm x 2 cm x 2 cm, and permeability was calculated using the following equation:

$$K_g = \mu_g * Q_g * L / A * \Delta P$$

K_g = Absolute Gas Permeability (Darcy)
μ_g = Gas Viscosity (cp)
Q_g = average discharge (cc/s)
L = the length of the sample (cm)
A = the area of the sample (cm^2)
ΔP = pressure gradient (atm)

This approach ensures an accurate determination of permeability, which is a critical parameter for evaluating reservoir rock quality.

III. RESULTS AND DISCUSSIONS

Field Observation

In the study area, the Tanjung Formation is well exposed on the northwestern flank of the meratus Uplift, in coal mining areas that are either still active or abondoned, as well as in newly constructed road cuts. Outcrop observations and rock sampling were conducted at 10 observation locations (Figure 1).

Based on field outcrop profiles, this formation primarily consists of thick shale interbedded with thin coal layers and minor sandstone, especially in the lower part of the formation. The sandstone is characterized by yellow to pink coloration, composed of very fine to coarse sand-sized particles, poorly to moderately sorted, with sub-angular to sub-rounded grains. The grains exhibit grain-supported textures, and in some cases, matrix-supported textures. The sandstone is primarily composed of quartz fragments (83-97%), with minor amounts of K-Feldspar fragments (1-5%) and lithic fragments (1-11%), cemented by silica.

The lithic fragments are mostly chert and metaquartzite, with minor components of granite and heavy minerals. Some sandstone layers are carbonaceous, containing dark organic material forming thin wavy laminations. The sedimentary structures observed in the sandstone layers include parallel bedding, cross-bedding, massive bedding, bioturbation, and wavy laminations (Figure 2)

Based on the surface geological map published by the Geological research and Development Center (1994), the width of the Tanjung Formation outcrops in the study area varies from 500 meters to 1500 meters. The mapped outcrop, predominantly trending southward, show a width approaching 1000 meters, with a dip of 45°. This suggests that the true vertical thickness of the Tanjung Formation at this location is approximately 700 meters. Outcrop data indicate that the sandstone to formation thickness rasio ranges from 10-30%, with individual sandstone layers varying in thickness from 0.2 meters to 12 meters.

Figure 2. Outcrop observation of Lower Tanjung Sandstone showing **A.** Amalgamated channel sandstones exposed at Location 2. **B.** Detailed photographs of cross-bedded pink sandstones (black arrow) directly underlying main coal seam in Location 4. Petrographically this sandstone has less clay materials than other sandstones sampled in the nearby area, with less lithic components and the sample 404 falls in the quartz arenite field on the QFL ternary plot. **C.** Massive sandstones of the Tanjung Formation exposed in abandoned coal mine at Location 6. Overall section is 12 meters high. **D.** Five-meter-thick massive sandstones of the Tanjung Formation at Location 6. Samples were taken from the sandstone and underlying mudstones (samples 601 and 603). **E.** Wavy-laminated, fine-grained sandstone exposed by the roadside at Location 3 (Sample 303). **F.** White claystone and sandstones at Location 8-B.

Petrography, Porosity and Permeability Analysis

A total of 12 sandstone samples from the Tanjung Formation (103, 201, 204, 303, 402, 404, 601, 806, 807, 1001, 1104, and 1105) were analyzed under polarized light microscopy to determine their texture, grain type. and visible porosity. Laboratory analysis were conducted to measure the porosity and permeability Based on the petrography data, Lower Tanjung Sandstone comprised of two type of sandstone, which are: Sublitharenite and Quartzarenite (Figure 3).

Sample 103 was collected from the base of a cross-bedded sandstone layer, 4-meters-thick, observed at Location 1. Petrographically, it is classified as sublitharenite, consisting of fine to medium grained sand, sub-angular to sub-rounded grains, with moderate sorting. It is composed of 86% quartz grains and minor lithic fragments, along with a small amount of detrital clay matrix (Figure 4). The measured porosity is 21.2%, with visible intergranular porosity of 6.4%, secondary porosity of 9.6%, and permeability of 2.5 mD (Table 1).

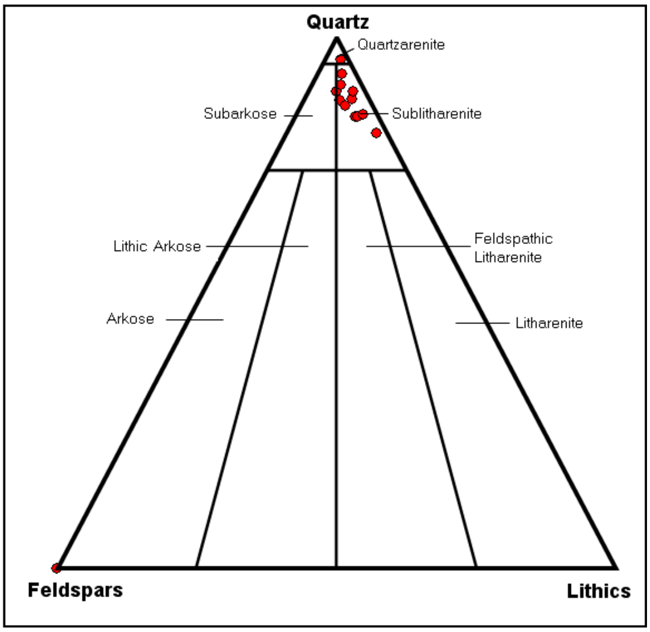

Figure 3. QFL diagram showing that Lower Tanjung Sandstones predominantly are Sublitharenite with minor quartzarenite.

Samples 201 and 204 were taken from sandstone layer sat Location 2. The sandstone at this location is fine-grained, moderately sorted, with sub-angular to sub-rounded grain shapes. It is primarily composed of quartz fragments, with minor lithic fragments and a small amount of clay matrix, petrographically classified as sublitharenite. Laboratory measurements and observations revealed measured porosity ranging from 20.7% to 22.9%, visible intergranular porosity between 3.6% and 5.2 %, secondary porosity between 5.6% and 6%, and permeability ranging from 1.5 mD to 8 mD (Table 1).

Sample 303 was collected from a 70-cm-thick fine-grained light-gray sandstone layer with wavy laminations at location 3 (Figure 2E) . The sandstone at this location is fine-grained, moderately sorted, with sub-angular to subrounded grains shapes. It primarily consists of quartz fragments, minor lithic fragments, carbonaceous material, and small amounts of detrital clay and kaolinite (Figure 4). Petrographically, it is classified as sublitharenite. Laboratory measurements and observations revealed a measured porosity of 23.7%, visible intergranular porosity of 7.2%, secondary porosity of 8.8%, and permeability of 5 mD (Table 1).

Samples 402 and 404 were collected from a 6-meter-thick pink sandstone layer with tabular cross bedding at Location 4 (Figure 2B). The sandstone in this location is fine- to corase-grained, moderately to well sorted, with subangular to subrounded grain shapes. It is primarily composed of quartz fragments, minor lithic fragments, and small amounts of clay matrix (Figure 4). Petrographically, these sandstones are classified as sublitharenite to quartzarenite. Laboratory measurements and observations indicated a measuered porosity ranging from 31.9-33.1%, visible intergranular porosity between 5.2 to 7.2%, secondary porosity ranging from 6.8 to 12.4%, and permeability ranging from 99 mD to 105 mD (Table 1).

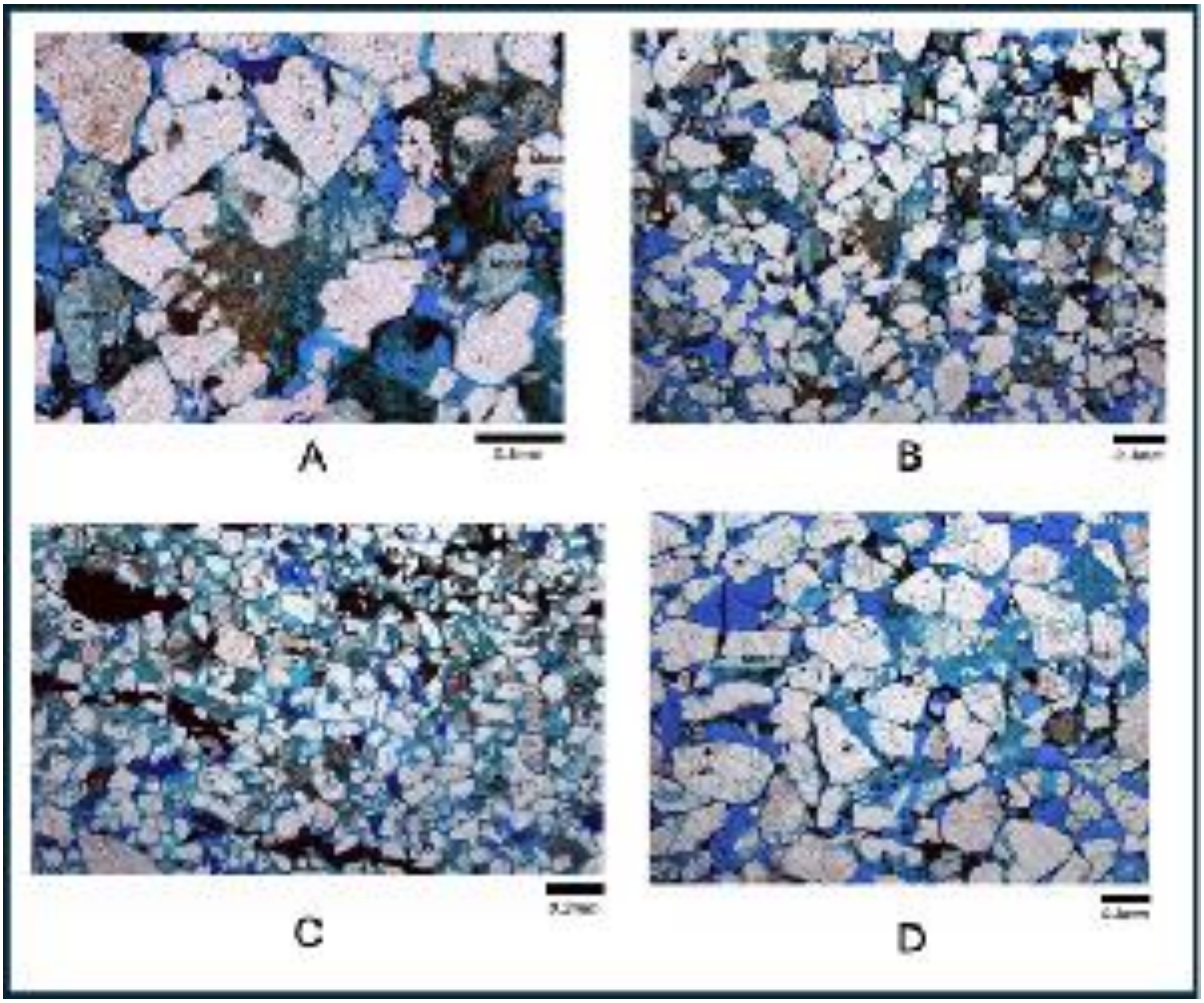

Figure 4. Photomicrograph of thin section of Lower Tanjung Sandstone **A.** Sample 103 showing a fine to medium grained sublitharenite. **B.** Photomicrographs of sandstone sample 103 from base of massive four-meter sandstone at Location 1. Note presence of intergranular porosity (IP) estimated at 6.4%, secondary porosity (SP) estimated at 9.6%, predominantly sub-angular to sub-rounded quartz grains (Q), with lesser lithic fragments, metaquartzite (Mqtz), chert (Ch), and granitic rock. There is around 5% detrital clay. Authigenic kaolinite (K) occurs as a secondary mineral in intergranular pores and as replacement of grains (possible surface weathering phenomenon) **C.** Photomicrograph of sandstone sample 303. Black material is organic matter. Note that it has good porosity and small amount of lithics. **D.** Photomicrograph of Sample 402 coarse grained sandstone.

Sample 601 was collected from a 7.5 meter-thick massive pink sandstone layer at location 6 (Figure 2D). The sandstone here is coarse-grained, moderately to well sorted, with sub-angular to sub-rounded grain shapes. It is primarily composed of quartz fragments, minor lithic fragments, and small amounts of clay matrix. Petrographically, it is classified as sublitharenite. Laboratory measurements and observations revealed a measured porosity of 28.5%, visible porosity of 7.2%, secondary porosity of 14.4%, and permeability of 75 mD (Table 1).

Samples 806 and 807 were collected from a 12-meter-thick massive yellowish-pink sandstone layer at Location 8 (Figure 2F). This sandstone is coarse-grained, moderately to well-sorted, with sub-angular to-rounded grain shapes. It is primarily consists of quartz fragments, minor lithic fragments, and small amounts of clay matrix. Petrographically, it is classified as sublitharenite to quartzarenite. Laboratory analysis indicated measured porosities ranging from 22.8-23.8%, with visible intergranular porosity of 5.6-6%, secondary porosity of 8.8-14.8%, and permeabilities ranging from 22 mD to 23.5 mD (Table 1).

Tabel 1. Porosity and Permeability of Lower Tanjung Sandstones

Location	Samples	Measured Porosity (%)	Measured Permeability (mD)	Visible Intergranular Porosity %	Visible Secondary Porosity (%)	Secondary Porosity as a Percentage of Total Visible Porosity
Location 1	103	21.2	2.5	6.4	9.6	60%
Location 2	201	20.7	1.5	3.6	5.6	61%
Location 2	204	22.9	8.0	5.2	6.0	54%
Location 3	303	23.7	5.0	7.2	8.8	55%
Location 4	402	33.1	105.0	7.2	12.4	63%
Location 4	404	31.9	99.0	5.2	6.8	57%
Location 6	601	28.6	75.0	7.2	14.4	67%
Location 8	806	23.8	23.5	5.6	14.8	73%
Location 8	807	22.8	22.0	6.0	8.8	59%
Location 10	1001	19.0	2.5	6.0	12.4	67%
Location 11	1104	20.4	5.1	6.4	3.6	36%
Location 11	1105	20.0	7.5	7.2	8.0	53%

Sample 1001 was collected from a 0.5-meter-thick massive pink sandstone layer at location 10. The sandstone here is fine-to coarse grained, moderately to well sorted, with sub-angular to sub-rounded grain shapes. It is primarily composed of quartz fragments, minor lithic fragments, and small amounts of clay matrix. Petrographically, it is classified as sublitharenite. Laboratory measurements revealed a measured porosity of 19%, visible intergranular porosity of 5.2%, secondary porosity of 12.4%, and permeability of 2.5 mD (Table 1).

Sample 1104 and 1105 were collected from a 6-meter-thick sandstone layer with parallel bedding at location 11. This sandstone is fine- to coarse grained, moderately to well soreted, with sub-angular to sub-rounded grain shapes. It is primarily composed of quartz fragments, minor lithic fragments, and small amounts of clay matrix. Petrographically, it is classified as sublitharenite to quartzarenite. Laboratory analysis showed measured porosities ranging from 20 to 20.5%, visible intergranular porosities of 6.4 to 7.2%, secondary porosities of 3.6 to 8%, and permeabilities ranging from 5.1 to 7.5 mD (Table 1).

Reservoir Potential

In this study, the reservoir potential of the Tanjung Sandstone is assessed based on three main parameters: geometry (lateral distribution and thickness), porosity, and permeability. These parameters are significantly influenced by the depositional environment of the rocks. Field data reveal that the lower part of the Tanjung Formation in the study area is composed of interbedded shale and sandstone, while the upper part is dominated by thick shale with thin coal seams. Overall, this formation can be interpreted as a transgressive depositional sequence characterized by fining-upward patterns. Based on the lithological composition and depositional patterns, the Tanjung Formation in the study area is inferred to have been deposited in a transitional environment, likely a coastal plain with estuarine channels. This interpretation is supported by paleontological analysis of the shale samples, which show an absence of foraminifera, and the presence of mangrove pollen fossils typically found in coastal swamps.

Depositional Environment

Our study suggests that the Lower Tanjung Formation (Tambak Member) deposited in estuarine settings. Although some authors interpreted this sandstone to have been deposited in deltaic setting (e.g. Satyana et al., 1999,2001), no evidence of regressive succession observed in the outcrop.

In an estuarine environment, sandstone deposits are found in estuarine channels, as sand bars at the estuary mouth, or in sandflat areas. Exposures of estuarine channel sandstones are observed in Locations 1, 2, 3, 4, 6, 7, 8, 9, 10, and 11. The characteristic feature of these deposits is the erosional contact between the sandstone and the underlying shale or coal. The thickness of the sandstone in the study area ranges from 0.2 to 12 meters, with the maximum thickness (12 meters) observed at Location 8, interpreted as amalgamated estuarine channel deposits.

Our findings indicate that the sandstone layers within the Tanjung Formation possess reservoir potential to some extends. However, the geometric aspects of the reservoir reveal certain limitations, both vertically and laterally:

1. Vertically, the sandstone layers are confined to the lower part of the Tanjung Formation, while the upper part is dominated by interbedded siltstone, shale, and coal. Sandstone accounts for only about 30% of the total thickness of the Tanjung Formation.
2. Laterally, the distribution of the Tanjung Sandstone is limited due to its deposition within estuarine channel environments. The geometry of the sandstone resembles a narrow and elongated "shoestring" shape.

Reservoir Quality Based on Porosity and Permeability Analysis

A total of 12 sandstone samples were analyzed to determine porosity and permeability values. The results show:

1. Measured porosity ranges from 19.0% to 33.1% (categorized as good to very good), with an average of 24% (very good).
2. Permeability varies from 1.5 mD to 105 mD (tight to very good), with an average of 29.7 mD (good).

However, petrographic analysis indicates that most of the porosity (~60%) is secondary porosity, with only 40% being primary (intergranular) porosity:

1. Intergranular porosity is observed to be in the poor category, ranging from 3.6% to 7.2% (average 6%).
2. Secondary porosity is more dominant, ranging from 3.6% to 14.8% (average 9%).

Secondary porosity is interpreted to have formed due to weathering processes near the surface during the inversion phase, which caused the formation to fold, uplift, and become exposed at the surface. These weathering processes produced secondary minerals such as kaolinite, pyrite, quartz overgrowths, sericite/illite, and limonite.

A recent study conducted by Nugraheni et al., (2021) showed that the Tanjung Sandstone porosity ranging from 4.8 to 30% with a depth of 800 to 1000 meters of Tanjung Well. They suggested that quartz cementation has been the major factor contributing to the pore volume reduction in a shallow depth, while the late stage of clay transformation of smectite to chlorite impeded the quartz overgrowth. The porosity and permeability of Tanjung Sandstone varied with depth which suggests diagenesis has a great contribution to the porosity and permeability of Tanjung Sandstone (Nugraheni et al., 2021). Although diagenesis may have been considered to have more profound affect to limestone (e.g. Morad et al., 2012; Morad, 2016; Prahastomi et al., 2022), our study suggests that Lower Tanjung Sandstone may have been susceptible to diagenesis to some extent.

The sandstone layers within the Tanjung Formation have good reservoir potential (Table 1). However, these results may not provide a realistic representation of the reservoir quality of the Tanjung Sandstone in the subsurface, due to several reasons:

1. Most of the porosity observed is secondary and may have formed due to near-surface weathering processes.
2. Previous study of subsurface Tanjung Formation conducted by Nugraheni et al., (2021) showed that the porosity and permeability vary with depth and lack of discernible pattern, which may suggest diagenesis strongly alter the porosity and permeability. It implies the same facies may have different porosity and permeability.
3. Mechanical compaction may reduce greatly the porosity and permeability value of Lower Tanjung in the subsurface.

IV. CONCLUSIONS

The Tanjung Formation exposed in the study area is primarily composed of thick shale interbedded with thin coal seams and minor sandstone, mainly concentrated in the lower part of the formation. These deposits are interpreted to have formed in an estuarine environment. The thickness of the Tanjung Sandstone ranges from 0.2 to 12 meters, constituting approximately 10% to 30% of the total thickness of the formation. Measured porosity ranges from 19.0% to 33.1% (good to very good), with an average of 24% (very good) whereas

Primary porosity (observed via petrographic analysis) ranges from 3.6% to 7.2% (poor), with an average of 6% (poor). Secondary porosity ranges from 3.6% to 14.8% (poor to good), with an average of 9% (poor). Permeability ranges from 1.5 mD to 105 mD (tight to very good), with an average of 29.7 mD (good). Most of the porosity observed in the Tanjung Sandstone is secondary, formed as a result of weathering processes near the surface during the inversion phase. Based on geometric and quality aspects, the reservoir potential of the Tanjung Sandstone is categorized as limited but reasonably good.

REFERENCES

Bon. J, Fraser. T, Amris, Stewart. D, Sosromihardjo. S. (1996). A Review of The Exploration Potential of the Paleocene Lower Tanjung Formation in The South Barito Basin., Proceeding Indonesia Petroleum Association, Twenty Fifth Annual Convention, October 1996.

Heriyanto. N, Nawawi. A, Mason. A, Ingram. F, Pedersen. D, Davis. R. (1996). Exploratory Update in The North Tanjung Block, South Kalimantan., Proceeding Indonesia Petroleum Association, Twenty Fifth Annual Convention, October 1996.

James, Noel P., and Dalrymple, R.W. (2010). Facies Models 4, Geological Association of Canada, Canada, Hal. 201– 233.

Klinkenberg, L.J. (1941). The Permeability of Porous Media to Liquids and Gases, Drilling and Production Practice. American Petroleum Institute. p. 200 –213.

Kusuma. I, Darin. T., (1989). The Hydrocarbon Potential of the Lower Tanjung Formation, Barito Basin, S.E. Kalimantan., Proceeding Indonesia Petroleum Association, Eighteenth Annual Convention, October 1989.

Magoon, L.B. and Dow, W.G. (1994) The Petroleum System. In: Magoon, L.B. and Dow, W.G., Eds., The Petroleum System—From Source to Trap, AAPG Memoire 60, 3-24.

Mason. A, Haebig. J, McAdoo. R. (1993), A Fresh Look at North Barito Basin, Kalimantan., Proceeding Indonesia Petroleum Association, Twenty Second Annual Convention, October 1993.

Morad, D., Nader, F.H., Gasparrini, M., Morad, S., Rossi, C., Marchionda, E., Al-Darmaki, F., Martines, M., Hellevang, H.,. (2018). Comparison of the diagenetic and reservoir quality evolution between the anticline crest and flank of an Upper Jurassic carbonate gas reservoir, Abu Dhabi, United Arab Emirates. *Sedimentary Geology 367*, 96-113.

Morad, S., Al-Aasm, I.S., Nader, F.H., Ceriani, A., Gasparrini, M., Mansurbeg, H.,. (2012). Impact of diagenesis on the spatial and temporal distribution of reservoir quality in the Jurassic Arab D and C members, offshore Abu Dhabi oilfield, United Arab Emirates. *GeoArabia*, 17-56.

Nugraheni, R.D., Widianto, E. (2021). Reservoir Quality Assessment Based on the Occurrence of Burial Diagenesis: Sandstone Case Study from Tanjung Formation, Barito Basin, South Kalimantan. Journal of Earth Energy Science, Engineering, and Technology, Vol. 4, No. 3, 2021

Pettijohn, F.J. (1975). Sedimentary Rocks. Third Edition. New York: Harper & Row, Publishers. Hal. 1 – 13.

Prahastomi, M., Fahruddin, A., Santy, L.D., Adlan, R. (2022). Depositional Facies Model and Reservoir Quality of Paleogene Limestone in Labengki Island, Southeast Sulawesi. Jurnal Geologi dan Sumberdaya Mineral Vol. 23 No. 3 p. 189-196.

Pranajaya, G., Idris, R., Arifin, M., Imron, M. (2007). Petroleum Systems and Sub Basin Distribution in Tanjung Block, Barito Basin, South Kalimantan. Proceedings Joint Convention The 36th IAGI, 2007.

Satyana. A. (1995). Paleogene Uncoformities in The Barito Basin, Southeast Kalimantan: A Concept for The Solution pf The “Barito Dilemma” and Key to The Search for Paleogene Structures. Proceeding Indonesia Petroleum Association, Twenty Fourth Annual Convention, October 1995.

Satyana, A.H., Eka, M.M.P., Imron, M., (2001). Eocene coals of the Barito Basin, Southeast Kalimantan: sequence stratigraphic framework and potential for sources of oil. Berita Sedimentologi 17, 1–15.

Satyana, A.H., Idris, R., 2006. Chronology and Intensity of Barito Uplifts, Southeast Kalimantan: A Geochemical Constraint and Windows of Opportunity: Abstract 2006.

Satyana, A.H., Nugroho, D., Surantoko, I., (1999). Tectonic controls on the hydrocarbon habits of the Barito, Kutei and Tarakan Basins, Eastern Kalimantan, Indonesia: major dissimilarities in adjoining basins. Journal of Asian Earth Sciences 17, 99–122.

Selley, R.C. (1985). Elements of Petroleum Geology. New York: W. H. Freeman and Company. p. 219 – 231.

Sinabang, P.V.P., Anggara. F., Amijaya, D.H., Rahmat, S.B. (2024). Microfacies and Paleomire Reconstruction of Coal in the Tanjung Formation, Barito Basin, Kandangan Area, South Kalimantan. IOP Conf. Series: Earth and Environmental Science 1373 (2024)

Sumotarto, T.A., Haris, A., Bachtiar, A., Usman, A. (2017).Karakterisasi Batuan Serpih pada lapangan “RK” Formasi Tanjung, Cekungan barito, Kalimantan Selatan sebagai Potensi Shale Hydrocarbon.Spektra: Jurnal Fisika dan Aplikasinya Vol. 2 No.1. p. 37-44.

Supriatna. S, Djamal. B, Heryanto. R, Sanyoto. P. (1994). Geological Map of Indonesia, Banjarmasin Sheet. Scale : 1.000.000, Pusat Penelitian dan Pengembangan Geologi.

van de Weerd, A., Armin, R.A., 1992. Origin and evolution of the Tertiary hydrocarbon bearing basins in Kalimantan (Borneo), Indonesia. American Association of Petroleum Geologists Bulletin 76 (11), 1778–1803.

Williams, H., Turner, F.J., Gilbert, C.M. (1982). Petrography. An Introduction to the Study of Rocks in Thin Sections. Second Edition. W.H. San Fransisco: Freeman and Company. 626 hal.

Witts, D., Davies, L., Morley, R., 2014. Uplift of the Meratus complex: sedimentology, biostratigraphy, provenance and structure. In: Proceedings Indonesian Petroleum Association 38th Annual Convention & Exhibition. https://doi.org/10.29118/ ipa.0.14.g.082. IPA14-G-082.

Witts, D., Hall, R., Morley, R.J., Boudagher-Fadel, M.K., 2011. Stratigraphy and sediment provenance, Barito Basin, Southeast Kalimantan. In: Proceedings Indonesian Petroleum Association 35th Annual Convention. IPA11-G-054, pp. 1–18.

Witts, D., Hall, R., Nichols, G., Morley, R., 2012. A new depositional and provenance model for the Tanjung Formation, Barito Basin, SE Kalimantan, Indonesia. Asian J. Earth Sci. 56, 77–104. https://doi.org/10.1016/j.jseaes.2012.04.022.