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CO_2 Storage Screening Criteria Based on Seal Capacity in Indonesia

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ABSTRACT - CO_2 storage screening ensuring the long-term containment of injected CO_2 and the integrity of carbon capture and storage. In Indonesia, robust seal evaluation is constrained by the limited availability of caprock core data. This study develops a dimensionless Caprock Quality Index (CQI) as a practical CO_2 storage screening tool based on displacement pressure (P_d) and caprock thickness (h). Displacement pressure is estimated using an empirical P_d equation derived from existing caprock core data. The CQI provides a quantitative classification of seal quality within the 0-1 range, where values closer to 1 indicate better caprock quality. Based on the data availability of this study, the results show that the Banggai and Salawati basins currently exhibit the highest CQI, indicating strong suitability for CO_2 storage. This study provides a framework for conducting preliminary CO_2 storage screening, particularly valuable in settings where caprock core data are sparse and contributes to the development of a more efficient, data-driven framework for future CCS planning and implementation.

Keywords: CO_2, caprock quality index (CQI), displacement pressure

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INTRODUCTION

As part of commitment to achieving the Net Zero Emission target by 2060, Indonesia has adopted the strategic implementation of carbon capture and storage (CCS) technology. CCS is designed to capture carbon dioxide emissions from fossil fuel power plants, industrial facilities, and other processes, and securely store them underground. Indonesia have a potential for the implementation of low-carbon technologies, supported by the presence of sedimentary basins with suitable geological formations such as depleted oil and gas reservoirs. Additionally, there is readily available captured CO_2 from gas processing facilities, with future expansion opportunities expanding with advancement in infrastructure for CO_2 transport and storage capacity increases over time (Iskandar et al., 2011).

The primary challenge in carbon capture and storage (CCS) projects is ensuring the long-term containment of injected CO_2, as the most significant risk lies in its potential leakage from underground storage sites. The containment security of a depleted field is influenced by various factors, particularly the integrity of old wells, the presence of faults and fractures, and the sealing capacity of the caprock (Syahrial et al., 2010). Any failure in these containment barriers could undermine the credibility and viability of CCS on a global scale. Therefore, the success parameter of CCS projects is ensuring the secure containment of injected CO_2 within the subsurface. Addressing potential leakage risks requires thorough seal assessments. This involves understanding the minimum capillary pressure (P_c) required to initiate fluid movement in caprock, commonly referred to as displacement pressure (P_d) that typically expressed in pound per square inc (psi). Capillary pressure (P_c) itself is defined as the pressure difference between the non-wetting and wetting phases across the pore interfaces in a rock. Currently, P_d is determined through laboratory testing of core samples using the mercury injection capillary pressure (MICP) method. However, the current status of core data from caprock remains very limited, posing a significant challenge to seal assessment analysis. This scarcity of data poses a major limitation for seal screening in candidate CCS basins.

The caprock seal index (CSI) is one of the methods used to evaluate the sealing capacity of a caprock, first introduced by (Pang et al., 1998). This model incorporates parameters such as gas permeability, gas viscosity, and a gas correction factor to provide a quantitative measure of sealing strength. Over time, the CSI concept also been adopted, refined, and modified by other researchers such as (Li et al., 2005; Espinoza & Santamarina 2017; Ma et al., 2020b) to suit different geological settings, evaluation parameters, and analytical scales. However, the evaluation of CSI requires a comprehensive and high-quality dataset, and therefore it cannot be reliably performed when data are limited, particularly in the absence of core measurements. To address the limitation, this study introduces a P_d empirical equation. The developed P_d utilizes available well logs, to estimate the seal's P_d in the absence of core or MICP data. Furthermore, the estimated P_d values are used to derive a caprock quality index, as a quantitative evaluation of sealing performance.

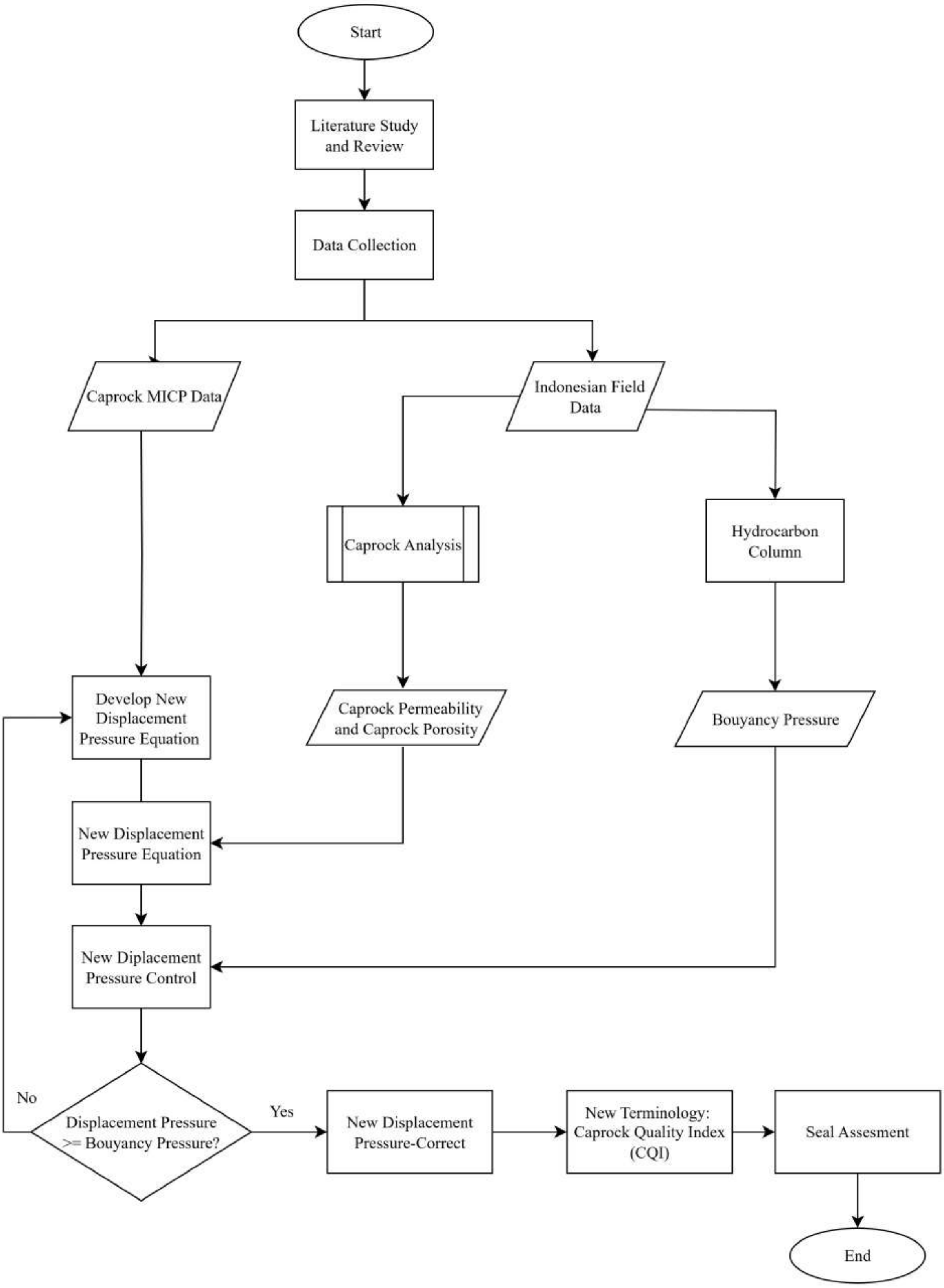
The candidate basins of this study cover 11 sedimentary basins in Indonesia, represented by 22 fields in total. Among these, all fields are equipped with triple-combo logs (gamma ray, neutron, and density, hydrocarbon column data, and about 55% field contain mud log information.

METHODOLOGY

The seal assessment conducted in this study is a data-based research. The scope in this study are as follows: 1). This study focuses only on caprock stability and does not consider rock geomechanics (fracture gradient or fault reactivation); 2). The available data is considered sufficient to represent a basin; 3). The petroleum system has reached a state of equilibrium, where all processes such as hydrocarbon generation, migration, and structural adjustments have ceased; 4). Seal assessment determination is based only on a static system, without accounting for the CO_2 inflow rate into the reservoir or its outflow rate through the caprock; 5). The hydrocarbon column function as a reference for the maximum CO_2 column height that the caprock can retain; 6). The porosity used in caprock analysis is effective porosity. The limitations of this study are: 1). No caprock laboratory measurement (MICP) data on Indonesia's field data; 2). Neglecting overpressure; 3). Formation differences are not considered in this study; 4). Due to a lack of caprock data, permeability is estimated using correlations; 5). CO_2 injection does not exceed than P_i.

Figure 1 shows the flowchart for the seal assessment in this research. Data is a critical component, as this study heavily relies on the availability and quality of existing data. The data collection is categorized into two main types: caprock MICP data (Table 1 & 2) and Indonesia field data (Table 3) This study uses the MICP data from paper, "Using Mercury Injection Pressure Analyses to Estimate Sealing Capacity of the

Figure 1
Seal Assessment Flowchart



Tuscaloosa Marine Shale in Mississippi, USA: Implications for Carbon Dioxide Sequestration." International Journal of Greenhouse Gas Control, (Lohr & Hackley 2018) and from the paper "Threshold Pressure Phenomena in Porous Media." Society of Petroleum Engineers Journal, (Thomas et al., 1968). As MICP measurements are typically obtained using an air–mercury system, the resulting pressure values correspond to mercury. Consequently, these values must be converted to reflect a brine–CO_2 system to accurately estimate seal capacity.

$$P_{c_{bc}} = \frac{\gamma_{bc}\cos\theta_{bc}}{\gamma_{am}\cos\theta_{am}} \times P_{c_{am}} \quad (1)$$

According to (Vavra 1992), typical values for the air–mercury system are 140° for the contact angle and 486 mN/m (dynes/cm) for the interfacial tension. For the brine–CO_2 system, an interfacial tension of 25 mN/m is selected and a contact angle of 0° is assumed, reflecting the assumption that supercritical CO_2 is immiscible with water (Lanin et al., 2024).

Table 1. Caprock MICP Data
(Lohr and Hackley 2018)

Sample	ϕ (%)	k(mD)	MICP(psi)	Measured pd(psi)
S1	5.37	0.00011	2199	572
S2	5.22	0.00009	3265	849
S3	7.68	0.00120	876	228
S4	5.75	0.00012	1608	418
S5	9.86	0.00299	709	184
S6	6.06	0.00014	5986	1557
S7	3.86	0.00006	4398	1144
S8	5.19	0.00005	3991	1038
S9	8.46	0.00163	798	208
S10	4.88	0.00014	1761	458
S11	4.94	0.00005	8288	2155
S12	4.79	0.00006	6019	1565
S13	8.45	0.00106	876	228
S14	6.72	0.00034	962	250
S15	7.58	0.00074	1197	311
S16	5.89	0.00014	4897	1273
S17	6.59	0.00021	7330	1906
S18	5.12	0.00010	2960	770
S19	5.63	0.00011	4452	1158
S20	6.59	0.00017	3226	839
S21	5.19	0.00011	3226	839
S22	4.78	0.00006	4380	1139
S23	5.78	0.00013	2660	692
S24	3.12	0.00006	3265	849
S25	7.04	0.00016	3652	950
S26	1.34	0.00000	5986	1557
S27	4.45	0.00006	4398	1144
S28	2.97	0.00003	8162	2122
S29	7.96	0.00244	723	188
S30	2.13	0.00001	4380	1139
S31	3.57	0.00003	5986	1557

Measured Pd refers to the displacement pressure that calculated from core data using Equation 1.

Table 2 Caprock MICP Data (Thomas et al., 1968)

Sample	ϕ (%)	k (mD)	MICP (psi)	Measured pd (psi)
Sample G	10	0.131	37	10
Sample I	9.48	0.0209	112	29
Sample K	3.26	0.00124	240	62

GR refers to the gamma ray log, NPHI refers to the neutron porosity log, and RHOB refers to the density log. As the data above is confidential, the field name has been anonymized.

From the MICP data, a new displacement pressure is developed using the following equation.

$$Pd = \frac{2\gamma\cos\theta}{R} \quad (2)$$

The Kozeny–Carman permeability equation for a circular cross-section is:

$$k = \frac{\phi^3}{2S^2\tau^2} \quad (3)$$

where:

$$\tau = \frac{l}{L} \quad (4)$$

$$S = \frac{2\pi RL}{AL} = \frac{2\pi R\tau}{A} = \frac{\pi R^2\tau 2}{AR} = \frac{2\phi}{R} \quad (5)$$

Substituted equation(4) and (5) to equation (3):

$$k = \frac{\phi^3}{2S^2\tau^2} = \frac{\phi}{8\tau^2}R^2 \quad (6)$$

So, R can be calculated:

$$R = \sqrt{\frac{8k\tau}{\phi}} \quad (7)$$

Thus, by combining Equations 2 and 7, it becomes:

$$P_d = \frac{2\,\gamma\cos\theta\,\sqrt{\phi}}{\sqrt{8k\tau}} \quad (8)$$

Based on equation 8, it can be concluded that displacement pressure is proportional to porosity to

Table 2. Caprock MICP Data
(Thomas et al., 1968)

Basin	Field	GR, NPHI, RHOB log	Mudlog	Hydrocarbon column (m)
North Sumatra	NS-1	✓	✓	✓
	NS-2	✓	✓	✓
South Sumatra	SS-1	✓	×	✓
	SS-2	✓	×	✓
Central Sumatra	CS-1	✓	×	✓
Sunda Asri Basin	SA-1	✓	×	✓
	SA-2	✓	×	✓
	SA-3	✓	×	✓
	SA-4	✓	×	✓
	SA-5	✓	×	✓
West Natuna	WN-1	✓	×	✓
North East Java	NEJ-1	✓	✓	✓
	NEJ-2	✓	✓	✓
	NEJ-3	✓	×	✓
West Java	WJ-1	✓	✓	✓
	WJ-2	✓	✓	✓
Banggai	B-1	✓	✓	✓
Tarakan	T-1	✓	×	✓
	T-2	✓	✓	✓
Kutai	K-1	✓	×	✓
	K-2	✓	✓	✓
Salawati	S-1	✓	×	✓

the power of n and inversely proportional to permeability to the power of n. In the development of empirical displacement pressure equation, buoyancy pressure is utilized as a controlling parameter due to its higher confidence level compared to displacement pressure. This is based on fact that buoyancy pressure effectively contains hydrocarbon accumulations beneath the caprock under natural conditions, thereby reflecting a proven sealing capacity. Consequently, buoyancy pressure is adopted as a primary reference in constructing empirical equation of displacement pressure to enhance the accuracy and reliability of seal capacity evaluations. The displacement pressure equation developed is considered valid when the calculated displacement pressure exceeds or at least same as the buoyancy pressure. Buoyancy pressure (P_b) is calculated using the following equation,

$$P_b = (\rho_w - \rho_{CO_2})\ g\ (h_{oil}+h_{gas}) \quad (9)$$

ρ_w assumed to be 1 g/cm^3, ρ_{CO_2} assumes as 0.6 g/cm^3, g is assumes to be 980.665 cm/s^2. The density of water is assumed to be 1 g/cm^3 because its value is not highly sensitive to changes in pressure and temperature. Even with variations in temperature and pressure, the density water remains close to 1 g/cm^3. Meanwhile, the density of CO_2 is assumed to be 0.6 g/cm^3, based on the assumption that the reservoir has a temperature of 60 °C and a pressure of 2390 psi (supercritical CO_2). Since the MICP data does not include hydrocarbon column thickness (which would later be interpreted as the CO_2 column), the displacement pressure is verified using data from an Indonesian field where hydrocarbon column data is available.

Caprock analysis in this study was performed using commercial software. Identification of the caprock zone is based on available log data and formation markers (Figure 2). If the gamma ray (GR) log has a high GR value—indicating a shale-dominated interval—and the marker data confirm that the zone is not part of the reservoir, the interval can be classified as caprock. High RHOB values and low NPHI values typically indicate low-permeability rocks such as shale, which are commonly found as caprock. Porosity and permeability calculations in IP software are performed using the following equation,

$$V_{sh} = \frac{GR - GRClean}{GRClay - GRClean} \quad (10)$$

$$\rho_b = (1 - \emptyset_e - Vsh) \times \rho_{ma} + \phi_e \times \rho_{fl} + V_{sh} \times \rho_{cl} \quad (11)$$

$$\phi_e = \frac{\rho_{ma} - \rho_b + (\rho_{cl} - \rho_{ma})Vsh}{\rho_{ma} - \rho_{fl}} \quad (12)$$

$$k = 8581\ \frac{{\emptyset_e}^{4.4}}{Swi^2} \quad (13)$$

Swi is assumed to be approximately 1 g/cm^3, based on the assumption that caprock formations are fully saturated with water and contain no space for hydrocarbons or gas.

Additionally, mud log data are reviewed to further validate the selected caprock zone. The integration of petrophysical evaluation, as part of a comprehensive reservoir characterization approach in this study, is fundamentally adopted to identify the most representative petrophysical properties and their corresponding outputs, which will serve as input for the displacement pressure calculation in the caprock. This method aims to maximize the contribution of all available data and information to ensure that all aspects of interpretation are appropriately considered. Furthermore, it is intended to reduce misleading results that may arise from standalone interpretive approaches.

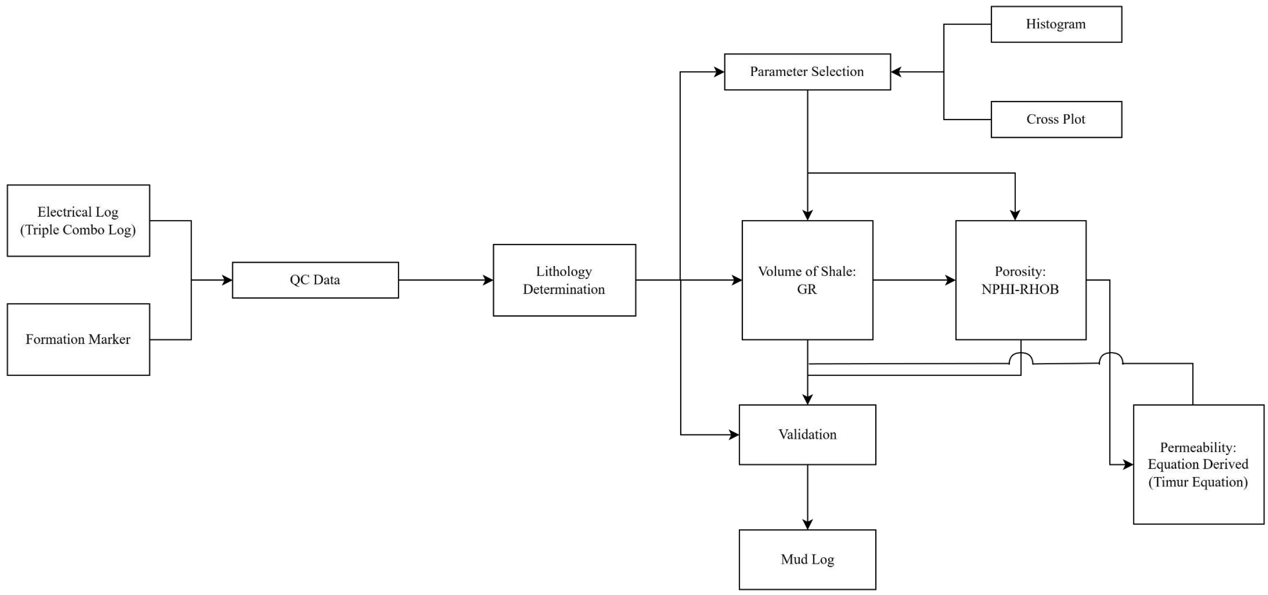
RESULT AND DISCUSSION

New equation for calculating displacement pressure

The formulation of the equation was based on the relationship in Equation (8), followed by multiple trial iterations to obtain the smallest possible error with a high R^2 value. Based on this procedure, an R^2 value of 0.57 were obtained, resulting in the following equation:

$$Pd = 169\ \left(\frac{k}{\phi}\right)^{-0.45} \quad (14)$$

Figure 2. Caprock Analysis Flowchart



The empirical equation was developed using a log–log regression approach, which is appropriate for capturing power-law relationships. This model is specifically calibrated for shale lithologies and should not be applied to other rock types. Based on the calibration dataset, the correlation is valid only within the permeability values below 1 mD and porosity values lower than 0.1. Application beyond these ranges is not recommended. Although the calculated and measured P_d values from the paper data reveal a significant difference, the equation will still be tested for application in an Indonesian field, with the condition that Pd must be equal to or greater than the buoyancy pressure.

Caprock analysis

A total of 22 fields from 11 basins were analysed in this study. Due to the confidentiality of data, only the K-2 field is presented in this section as an example of the petrophysical analysis conducted to calculate permeability and porosity values. In the K-2 field, the caprock interval is located at a depth of 5058.8 ft MD to 5071 ft MD or 4030.8 ft TVDSS to 4043 ft TVDSS. This determination is based on GR log data, NPHI log, RHOB log, and further confirmed by mud log data. A crossplot between NPHI and RHOB was then generated to calculate porosity values. Permeability was also calculated using the IP software, resulting in an average permeability value of 0.0454 mD. A comprehensive plot of the petrophysical analysis for the K-2 caprock is presented below: Comprehensive Plot of Caprock Analysis for K-2 Field. To validate that the selected zone corresponds to a shale interval, mud log from the K -2 field is presented in figure 10.

It can be observed that within the selected depth interval of 5058.8 ft MD to 5071 ft MD, the rock formation is predominantly composed of shale. This lithology is considered suitable to serve as caprock due to its low permeability, fine grain size, which are essential for preventing hydrocarbon migration. The same procedure was applied to 21 other fields, resulting in the following values of permeability, porosity, and thickness of the caprock.

Validation of new displacement pressure equation

After obtaining the permeability and porosity values, the displacement pressure can be calculated using equation 13. The resulting values are then compared to the buoyancy pressure.

Figure 11 illustrates the comparison between displacement pressure (Pd) calculated and

Table 4. Comparison of Calculated Pd (as New Equation) and Measured Pd

Sample	ϕ (%)	k(mD)	Measured pd (psi)	Calcuated displacement pressure (psi)
S1	5.37	0.00011	572	2707
S2	5.22	0.00009	849	2975
S3	7.68	0.00120	228	1098
S4	5.75	0.00012	418	2717
S5	9.86	0.00299	184	815
S6	6.06	0.00014	1557	2621
S7	3.86	0.00006	1144	3034
S8	5.19	0.00005	1038	3813
S9	8.46	0.00163	208	999
S10	4.88	0.00014	458	2339
S11	4.94	0.00005	2155	3906
S12	4.79	0.00006	1565	3444
S13	8.45	0.00106	228	1212
S14	6.72	0.00034	250	1819
S15	7.58	0.00074	311	1359
S16	5.89	0.00014	1273	2562
S17	6.59	0.00021	1906	2231
S18	5.12	0.00010	770	2750
S19	5.63	0.00011	1158	2787
S20	6.59	0.00017	839	2483
S21	5.19	0.00011	839	2698
S22	4.78	0.00006	1139	3441
S23	5.78	0.00013	692	2600
S24	3.12	0.00006	849	2738
S25	7.04	0.00016	950	2614
S26	1.34	0.00000	1557	6518
S27	4.45	0.00006	1144	3358
S28	2.97	0.00003	2122	3885
S29	7.96	0.00244	188	811
S30	2.13	0.00001	1139	5093
S31	3.57	0.00003	1557	3919
Sample G	10	0.131	10	150
Sample I	9.48	0.0209	29	334
Sample K	3.26	0.00124	62	736

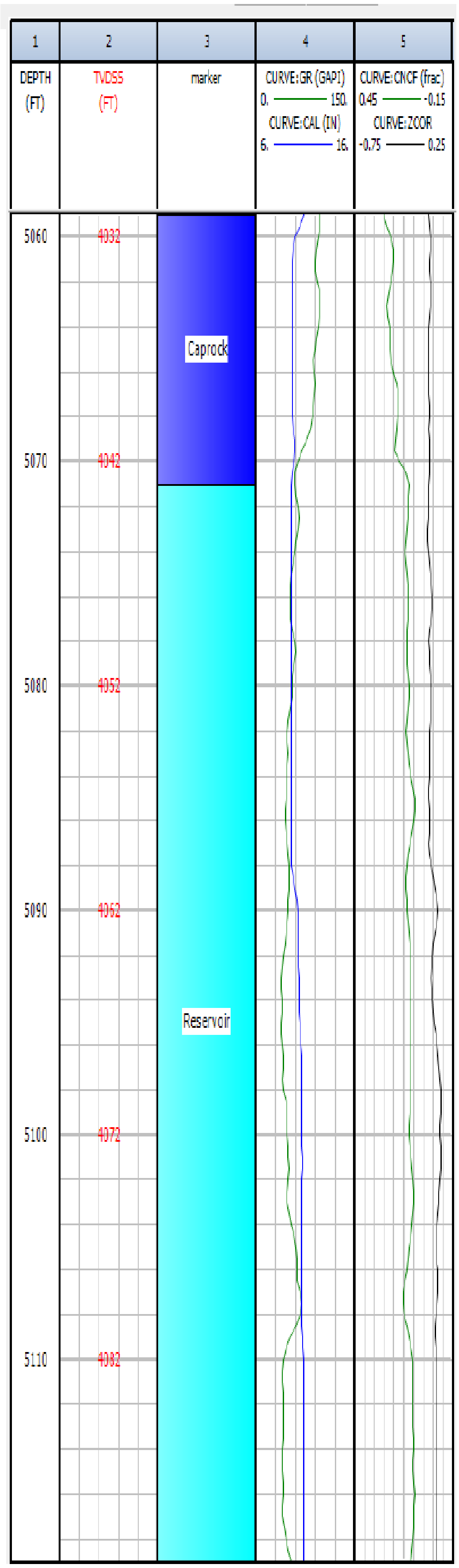


Figure 3. Triple Combo Log of K-2 Field

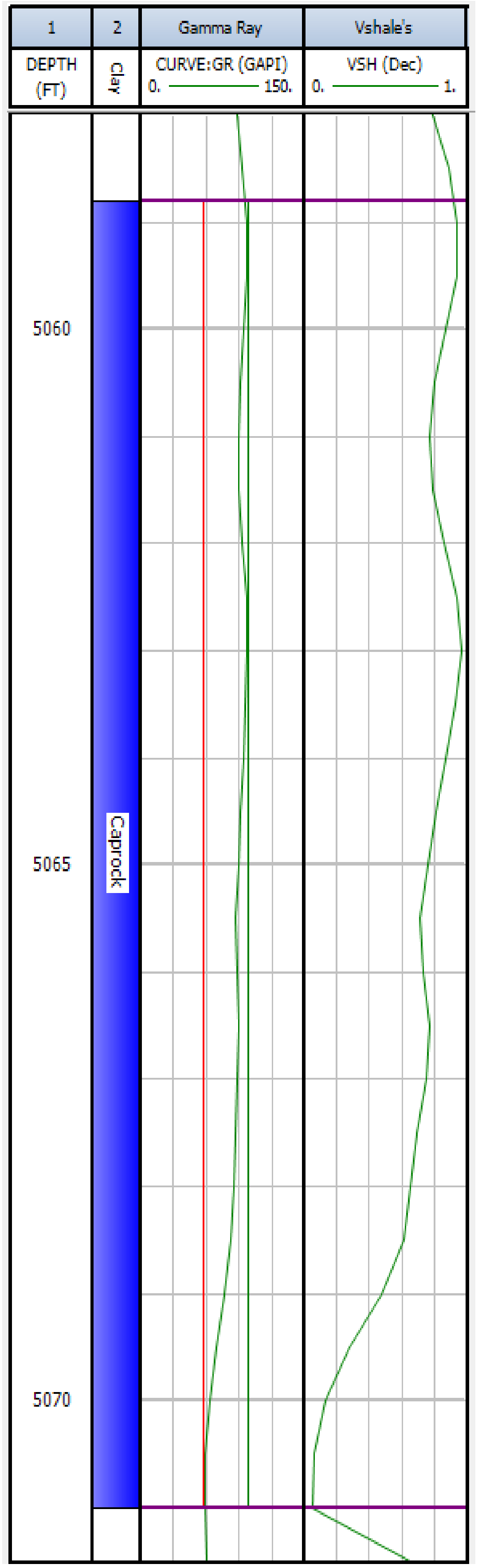


Figure 4. GR & Vshale plot of K-2 Field

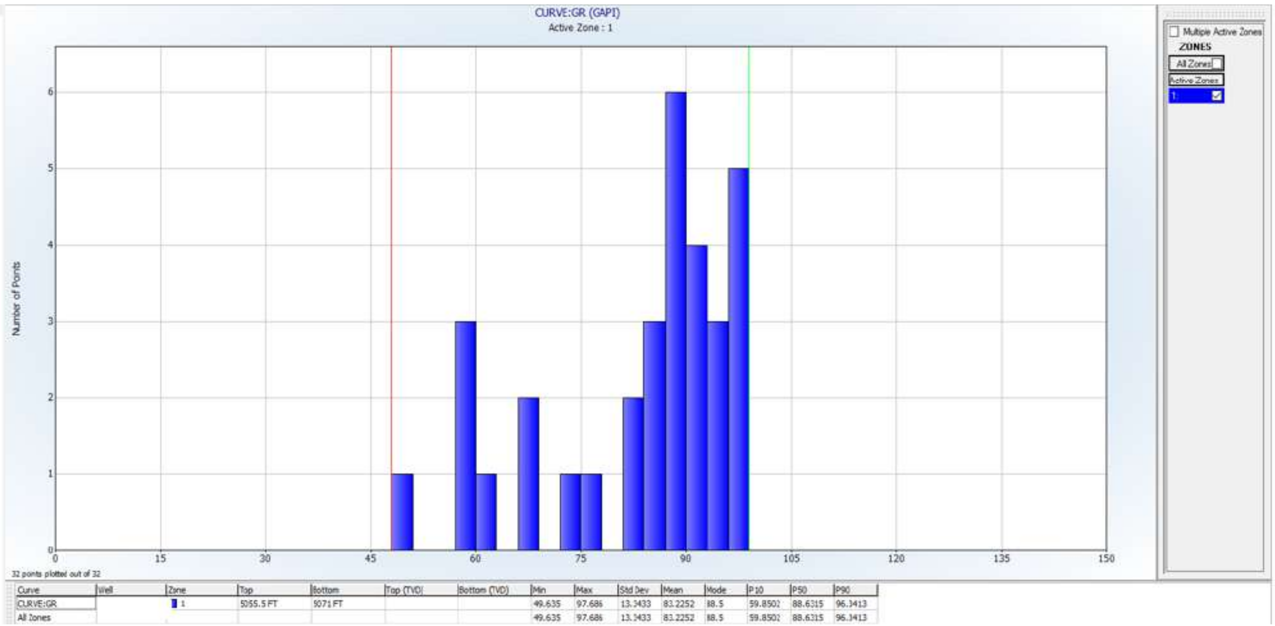


Figure 5. GR Histogram of K-2 Field

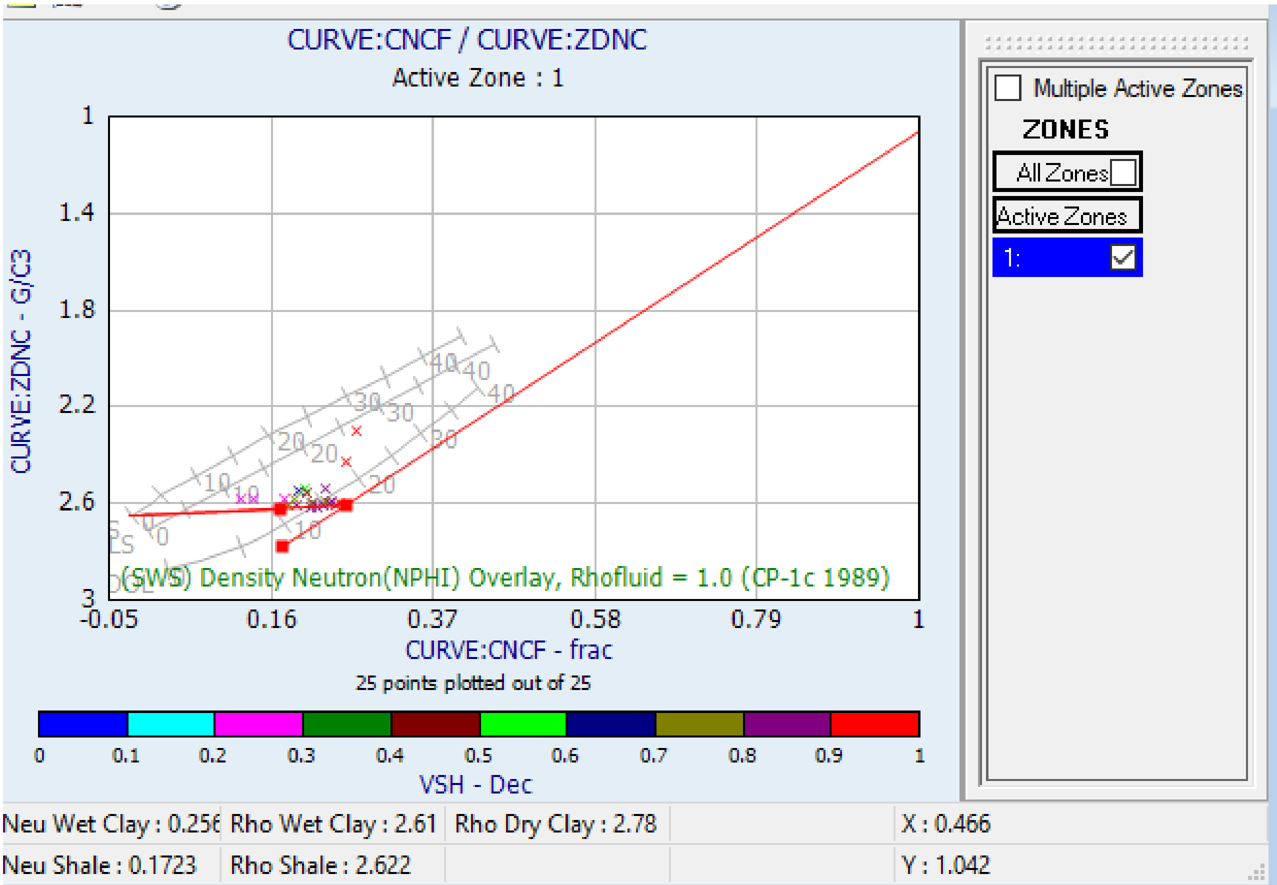


Figure 6. Crossplot NPHI/RHOB of K-2 Field

Figure 7. PHI Histogram of K-2 Field

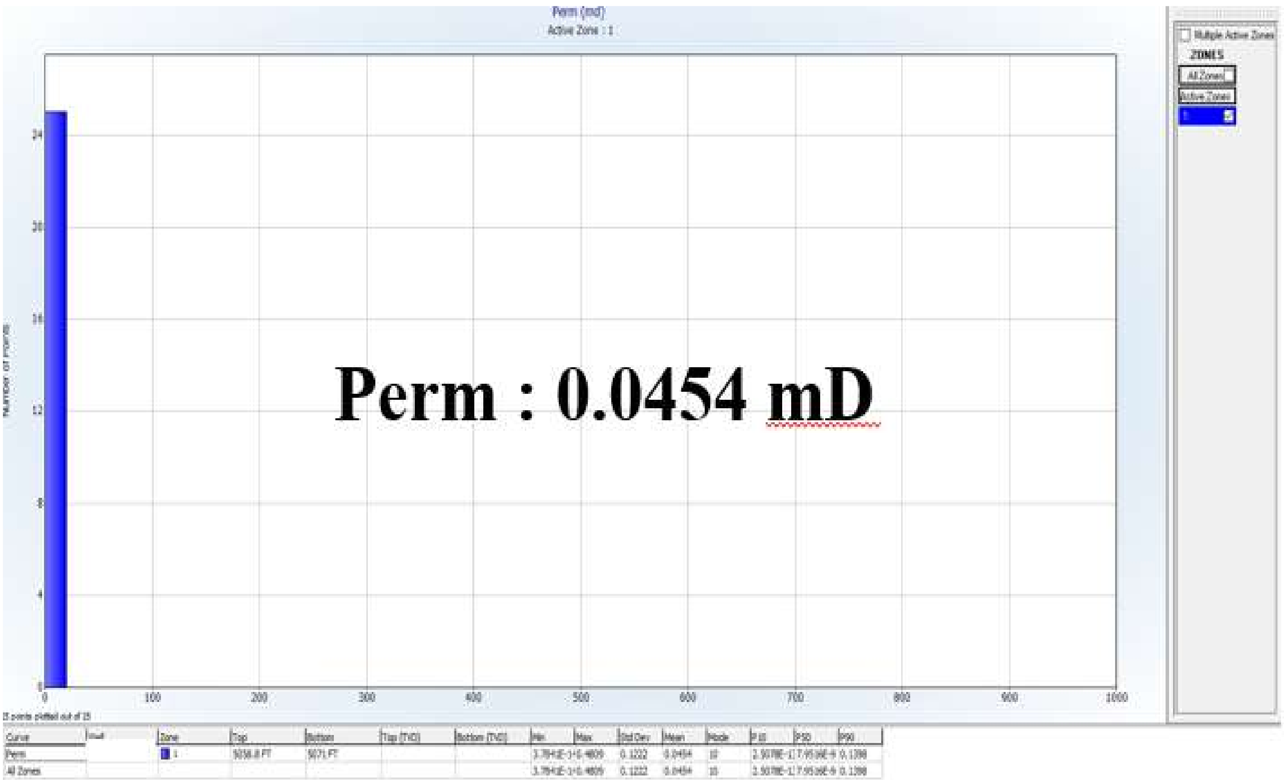


Figure 8. Perm Histogram of K-2 Field

A comprehensive plot of the petrophysical analysis for the K-2 caprock is presented below:

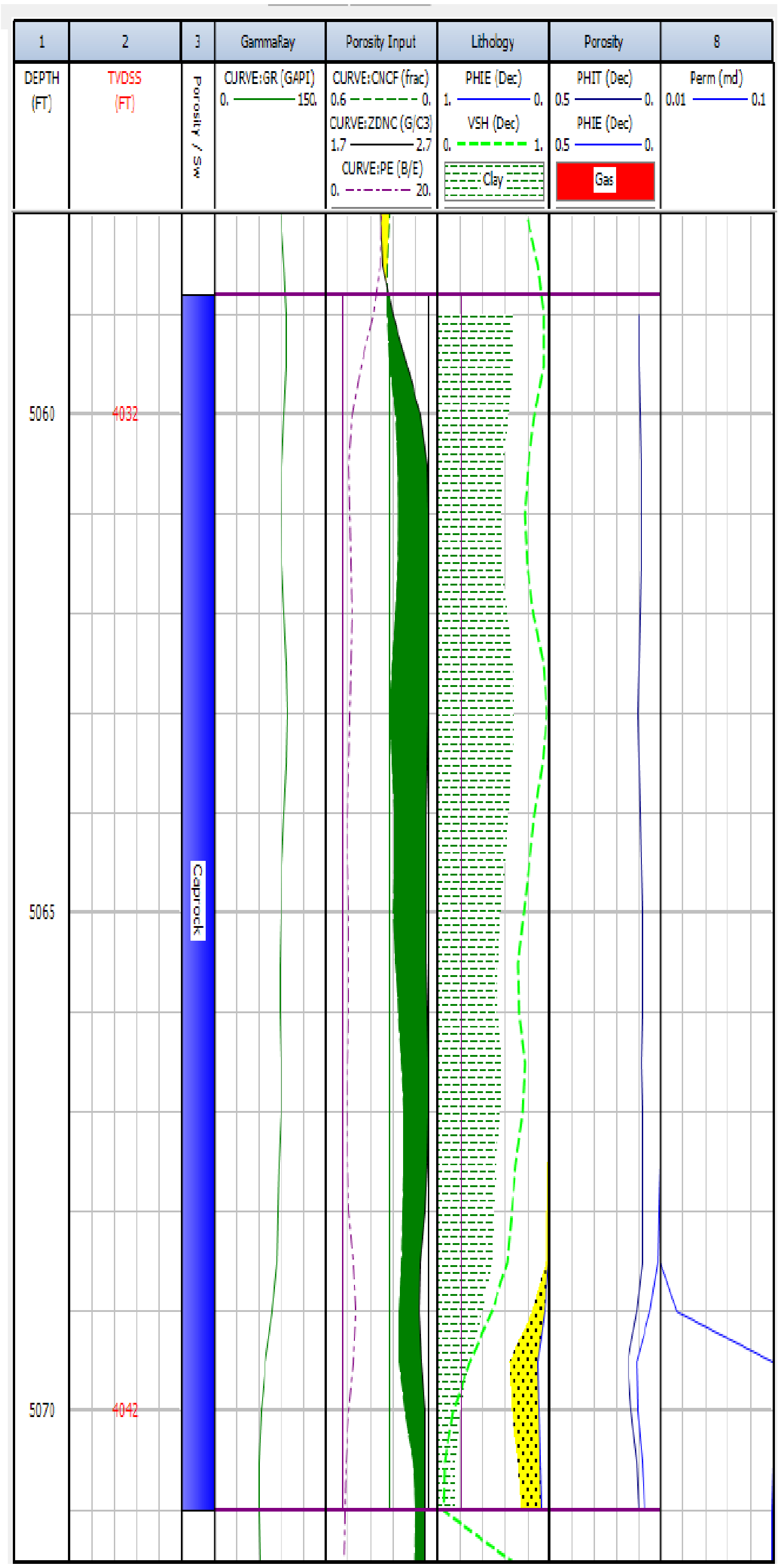


Figure 9. Comprehensive Plot of Caprock Analysis for K-2 Field

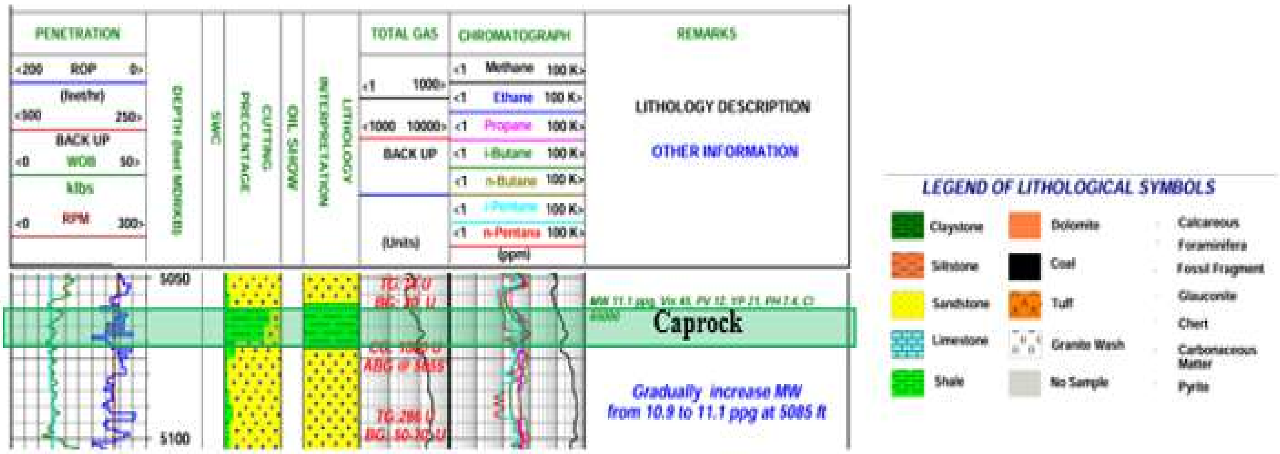


Figure 10. Mud Log Data of K-2 Field

buoyancy pressure (Pb) derived from Indonesian field data. The diagonal solid line represents the ideal case where Pd = Pb, while the dashed lines indicate ±20% tolerance margins. Most data points fall on or above the Pb = Pd line, meaning the predicted displacement pressures are generally equal to or exceed the buoyancy pressure—a critical criterion for validating seal assessment.

Based on Table 6, fields T-1, S-1, and NEJ-2 indicate very high displacement pressures (above 5000 psi), suggesting tight formations with fine pore systems that act as effective barriers to fluid flow, thereby reducing the risk of breakthrough. In contrast, fields like T-2, WJ-1, NEJ-1, and CS- 1 exhibit very low displacement pressures (below 100 psi), indicating more permeable and porous formations where fluids can move easily. Therefore, careful consideration is required when injecting CO_2 into these reservoirs, as the low displacement pressure values may increase the risk of premature CO_2 breakthrough.

Seal assessment based on caprock quality index (CQI)

In this study, a new terminology called the caprock Quality Index is introduced. This index combines the newly empirical P_d equation and caprock thickness(h). CQI reflects the overall ability of a caprock to prevent fluid migration, such as CO_2. CQI calculated using the following equations.

$$CQI = \widehat{P_d} \times \hat{h} \quad (15)$$

$$\widehat{P_d} = \frac{P_d}{P_{d\,max}} \quad (16)$$

$$\hat{h} = \frac{h}{h_{max}} \quad (17)$$

$\widehat{P_d}$ is displacement pressure normalization and $\hat{h}$ is caprock thickness normalization. Normalization is applied to maintain balanced contributions from all components in the CQI formula, avoiding dominance by any one parameter. The calculated CQI values for the Indonesian field are shown in Table 7.

Notably, fields such as S-1 exhibit exceptionally high CQI values, approximately 0.2, respectively, reflecting their outstanding seal assessment and rendering them highly suitable for applications that demand reliable containment, such as geological carbon storage. Field B-1, with a CQI of around 0.1, also demonstrates strong caprock characteristics, although it ranks slightlylower than the S-1 fields. A significant drop in CQI values is observed beyond these top- performing fields, with the majority—such as SA- 2, SA-5, T-1, SA-3, SA-4, and K-1—showing moderate to low values, and the other field presenting extremely low CQI values on the order of 10^{-3} to 10^{-5}, which suggests inadequate sealing capacity and potential ineffectiveness for containment purposes. Therefore, the CQI not only facilitates

Table 5. Summary of Caprock Analysis in Indonesian Field Data

Basin	Field	Caprock thickness (ft)	k(mD)	ϕ (%)
North Sumatra	NS-1	46.5	0.0644	4.23
	NS-2	43	0.0518	2.8
South Sumatra	SS-1	18.5	0.0003	0.38
	SS-2	21.5	0.0000082	0.8
Central Sumatra	CS-1	109.5	0.06	1.7
Sunda Asri Basin	SA-1	82.25	0.0001	1.2
	SA-2	398.58	0.0000195	0.88
	SA-3	230.5	0.00004122	1.16
	SA-4	186	0.000022	0.99
	SA-5	355.28	0.000009685	0.63
West Natuna	WN-1	45.3	0.0001	0.28
North East Java	NEJ-1	74	0.034	0.74
	NEJ-2	701	0.000046	1.2
	NEJ-3	93.5	0.0054	3.49
West Java	WJ-1	154	0.1548	1.91
	WJ-2	106.5	0.0633	3.21
Banggai	B-1	966.5	0.000028	0.67
Tarakan	T-1	119.98	0.00000047	0.29
	T-2	984.8	0.18	0.53
Kutai	K-1	1946.1	0.0751	5.3
	K-2	12.2	0.0454	1.86
Salawati	S-1	462	0.000001015	0.52

Table 6. Summary of Caprock Analysis in Indonesian Field Data

Basin	Field	Calculated displacement pressure (psi)	Pb total (psi)
North Sumatra	NS-1	139.86	28.27
	NS-2	128.11	27.92
South Sumatra	SS-1	529.69	39.84
	SS-2	3741.1	14.3
Central Sumatra	CS-1	95.8	59.13
Sunda Asri Basin	SA-1	1456.99	14.44
	SA-2	2644.39	4.56
	SA-3	2138.12	6.47
	SA-4	2641.01	85.99
	SA-5	3117.33	14.1
West Natuna	WN-1	756.91	50.46
North East Java	NEJ-1	85.08	68.9
	NEJ-2	2066.4	206.79
	NEJ-3	391.31	219.5
West Java	WJ-1	65.9	46.99
	WJ-2	124.49	72.05
Banggai	B-1	1987.64	29.64
Tarakan	T-1	8579.45	10.22
	T-2	34.58	34.92
Kutai	K-1	144.45	180.54
	K-2	113.09	6.76
Salawati	S-1	7891.41	111.5

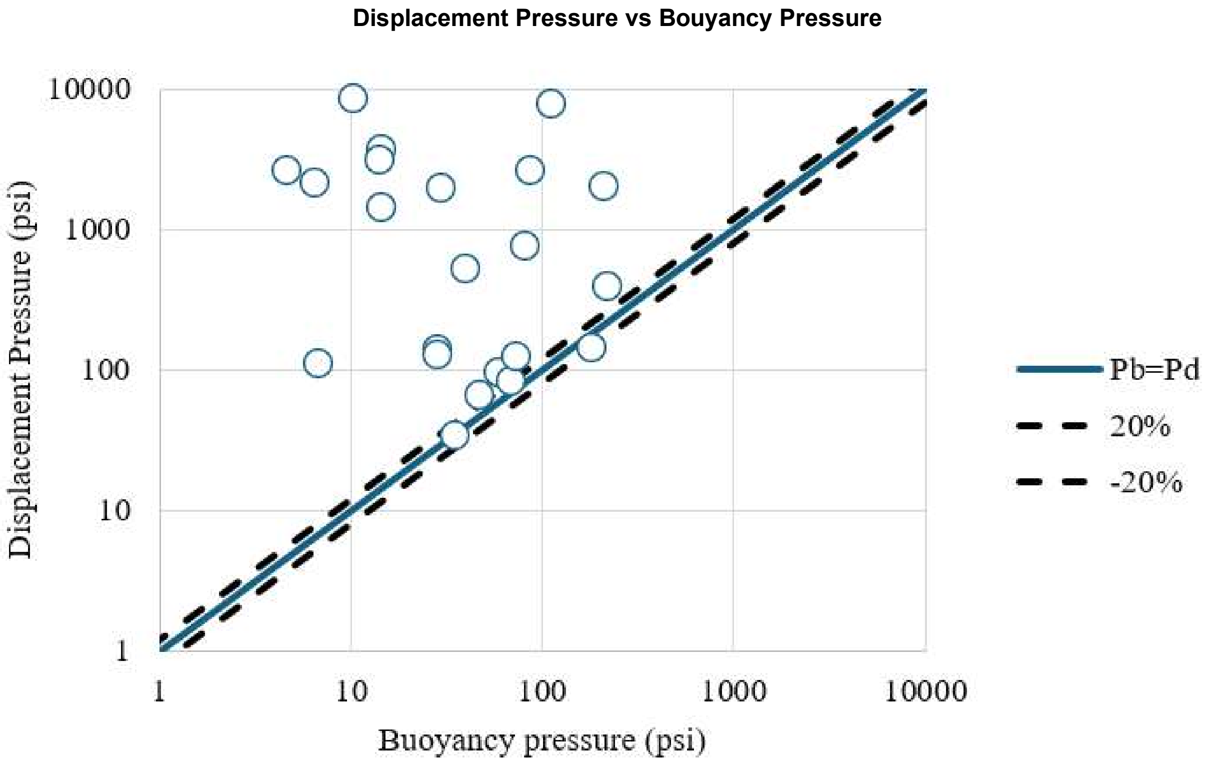


Figure 11. Comparison between displacement pressure (Pd) calculated and the buoyancy pressure (Pb)

the identification of high-potential fields for secure subsurface storage or reservoir development but also highlights the need for cautious assessment and risk mitigation in such fields. These features make it an essential tool for informed decision-making in geological and reservoir engineering studies. Figure 12 indicates the presence of basins with relatively high displacement pressure values but low caprock quality index (CQI).

This condition may result from lithological heterogeneity within the caprock zone, which is partially composed of shale and includes other lithologies such as clay, silt, and minor sandstone. These lithological variations influence the estimation of displacement pressure and ultimately affect the outcome of the seal assessment. In the future, if more data become available, a lithology sensitivity analysis can be conducted. This analysis will help evaluate how lithological variability affects the estimated Pd and the resulting caprock quality index (CQI).In addition, caprock thickness is also a key consideration in this seal assessment. A thin caprock reduces the total volume and capacity to retain fluids, thereby decreasing its effectiveness as a barrier despite having high intrinsic sealing properties. Therefore, a low CQI in a caprock with high Pd indicates that inadequate thickness or lithological heterogeneity limits its long-term sealing function, making it less ideal as a candidate for CO_2 storage.

CONCLUSION

The empirical equation approach has proven effective for conducting CO_2 storage screening based on available data, making it a viable preliminary alternative when laboratory data are limited. CO_2 storage screening is carried out by evaluating the caprock quality index (CQI), a parameter influenced by both displacement pressure and the thickness of the caprock. Based on the

Table 7. Caprock Quality Index (CQI) of Indonesian Field

Basin	Field	$\widehat{P_d}$	$\hat{h}$	CQI
North Sumatra	NS-1	0.0163	0.02389	0.00039
	NS-2	0.01493	0.0221	0.00033
South Sumatra	SS-1	0.06174	0.00951	0.00059
	SS-2	0.43605	0.01105	0.00482
Central Sumatra	CS-1	0.01117	0.05627	0.00063
Sunda Asri Basin	SA-1	0.16982	0.04226	0.00718
	SA-2	0.30822	0.20481	0.06313
	SA-3	0.24921	0.11844	0.02952
	SA-4	0.30783	0.09558	0.02942
	SA-5	0.36335	0.18256	0.06633
West Natuna	WN-1	0.08822	0.02328	0.00205
North East Java	NEJ-1	0.00992	0.03803	0.00038
	NEJ-2	0.24085	0.36021	0.08676
	NEJ-3	0.04561	0.04805	0.00219
West Java	WJ-1	0.00768	0.07913	0.00061
	WJ-2	0.01451	0.05473	0.00079
Banggai	B-1	0.23167	0.49663	0.11506
Tarakan	T-1	1	0.06165	0.06165
	T-2	0.00403	0.50604	0.00204
Kutai	K-1	0.01684	1	0.01684
	K-2	0.01318	0.00627	0.00008
Salawati	S-1	0.9198	0.2374	0.21836

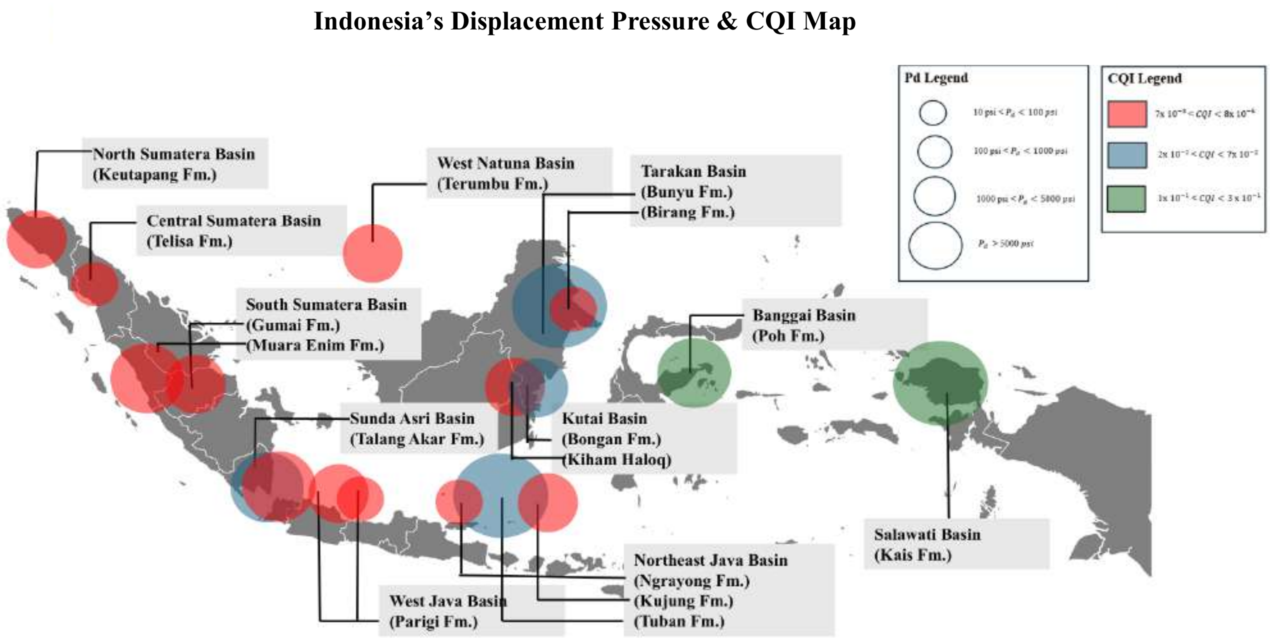


Figure 12. Indonesia's displacement pressure & CQI map

CQI values, the basins identified as highly suitable for CO_2 storage are the Banggai Basin, the Salawati Basin, and the Northeast Java Basin with the Tuban Formation.

CO_2 storage screening in this study is not conclusive. With the availability of more comprehensive data, in the future, the estimated CO_2 storage potential of each basin may improve, possibly leading to a reassessment of which basins are considered most suitable for CO_2 storage.

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GLOSSARY OF TERMS

Symbol	Definition	Unit
$P_{c_{bc}}$	Capillary pressure of brine-CO_2 systems are known as displacement pressure	psi
γ	Interfacial tension	dynes/cm
θ	Contact angle between wetting fluid and solid surface	
$P_{c_{am}}$	Capillary pressure for air-mercury system	psi
γ_{am}	Interfacial tension for air-mercury system	dynes/cm
γ_{bc}	Interfacial tension for brine-CO_2	dynes/cm
θ_{bc}	Contact angle of brine-CO_2	
θ_{am}	Contact angle of air	
R	Capillary pore throat radius	cm
τ	Tortuosity	Dimension less
h_{oil}	Oil column	cm
h_{gas}	Gas column	cm
ρ_w	Water density	g/cm^3
ρ_{CO_2}	Density of CO_2	g/cm^3
g	Gravitation	cm/s^2
h	Hydrocarbon Column	cm
$\emptyset_{N(total)}$	Total porosity	
$\emptyset_e$	Effective porosity	
$\emptyset_e$	Shale volume	
ρ_{ma}	Matrix density	g/cm^3
ρ_b	Bulk density	g/cm^3
ρ_{fl}	Fluid density	g/cm^3
Swi	Irreducible water saturation	g/cm^3
P_i	Initial pressure	psi

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