

Identification of Quaternary Sediments and the Existence of Biogenic Gas Sources in the Topang Delta, Meranti, Riau

Identifikasi Sedimen Kuarter dan Keberadaan Sumber Gas Biogenik daerah Delta Topang, Meranti, Riau

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ABSTRACT: Delta Topang, located in Topang Island, Riau Province is known to have the potential of biogenic gas. This research was conducted to identify the Quaternary sediment and the existence of biogenic gas reservoir. In this research has been conducted 75 points of surface geoelectrical measurements (38 points in Parit Jawa and 37 points in Parit Bintang) and 2 points of core drilling (BH-1 in Parit Jawa and BH-2 in Parit Bintang). Total Organic Carbon was also carried out on 10 samples (5 samples from each drilling core). Based on resistivity value of geoelectrical measurements from all points, in general are determined 2 sediment types, very fine sediment (silt and clay) and fine sand. We discussed in detail only point 11 representing Parit Jawa region and point 39 representing Parit Bintang Village. Both in point 11 and point 39, very fine sediment was identified from the surface down to 59 m and 58.5 m respectively, mostly dominated by hydrous clay. Below these, very fine sediment is identified as fine sand. Core drilling BH-1 and BH-2 (40 m length each) composed of thick layer of hydrous clay from the core surface down to bottom part, intercalated with thin layers of silt and fine sand. We considered fine sand found at depths between 24 to > 90 m (from all geoelectrical measurement points) as the closure of biogenic gas. At Parit Jawa biogenic gas closures are found at 2 locations, which are in south west and north east measurement area. At Parit Bintang biogenic gas closures are found at 3 location which are one in south and two in north measurement area. Total organic carbon analyzed from BH-1 indicate the highest percentage at 26-27 m depth with percentage 71.6%. From BH-2 the highest value is indicated at 33-34 m depth with percentage 78.0%. From all this information it is known that the formation of biogenic gas from the abundance of TOC is in the layers of hydrous clay and clay where is in an anaerobic sulfate-reduction environment.

Keyword: Quaternary sediment, biogenic gas, surface geoelectrical measurement, core drilling, total organic carbon

ABSTRAK: Delta Topang, yang terletak di Pulau Topang, Distrik Rangsang, Kabupaten Meranti, Provinsi Riau pada diketahui memiliki potensi keberadaan gas biogenik. Penelitian ini dilakukan untuk Identifikasi Sedimen Kuarter dan keberadaan sumber gas biogenik. Pada penelitian ini telah dilakukan 75 titik pengukuran geolistrik permukaan (38 titik di Parit Jawa dan 37 titik di Parit Bintang). Pemboran inti dilakukan di dua lokasi antara lain BH-1 di Parit Jawa dan BH-2 di Parit Bintang. Analisa total karbon organik juga dilakukan pada 10 sampel (5 sampel dari setiap inti pemboran). Berdasarkan nilai resistivitas pengukuran geolistrik dari semua titik, secara umum ditentukan 2 jenis sedimen, adalah sedimen yang sangat halus (lanau dan lempung jenuh air) dan pasir halus. Dalam makalah ini dibahas secara rinci hanya titik 11 yang mewakili Desa Parit Jawa dan titik 39 yang mewakili Desa Parit Bintang. Baik di Point 11 dan Point 39, sedimen yang sangat halus diidentifikasi dari permukaan hingga kedalaman 59 m dan kedalaman 58,5 m, yang didominasi oleh lempung jenuh air, di bawah sedimen yang sangat halus ini diidentifikasi sebagai pasir halus. Hasil pemboran inti BH-1 dan BH-2 (masing-masing 40 m) terdiri dari lapisan tebal lempung jenuh air dari permukaan, ke bagian bawah merupakan lapisan lanau dan pasir halus. Dari pengukuran geolistrik diperoleh pasir halus yang ditemukan pada kedalaman antara 24 m hingga lebih dari 90 m adalah sumber gas biogenik. Di Parit Jawa, sumber gas biogenik ditemukan di 2 lokasi, yaitu di barat daya dan timur laut daerah pengukuran. Di Parit Bintang sumber gas biogenik ditemukan di 3 lokasi yaitu satu di selatan dan dua di daerah pengukuran utara. Total karbon organik yang dianalisis dari BH-1 menunjukkan persentase tertinggi pada kedalaman 26-27 m dengan persentase 71,6%. Dari BH-2 nilai tertinggi ditunjukkan pada kedalaman 33-34 m dengan persentase 78,0%. Dari semua informasi ini diketahui bahwa pembentukan gas biogenik dari kelimpahan TOC, berada di lapisan lempung dan lempung jenuh air di mana berada dalam lingkungan reduksi sulfat anaerob.

Kata kunci: Sedimen Kuarter, gas biogenik, pengukuran geolistrik permukaan, pemboran inti, total organic carbon

INTRODUCTION

Increasing needs towards natural oil and gas which is increasingly unavailable, requires continued research to find new energy sources. An alternative for conventional oil and gas is biogenic gas which can be managed cheaply and environmentally friendly, which expected to reduce oil energy dependence in remote coastal area. Marine Geological Institute (MGI) of Ministry of Energy and Mineral Resources has done a research, revealing biogenic gas potential area along northern coast of Java, southern coast of Kalimantan, and eastern coast of Sumatra (DESDM, 2006). Biogenic gas indications can be encountered in river delta trapped in Quaternary rocks in 30-70 metres depth (Qilun, 1995). Topang delta in Topang Island, Riau Province, is one example of delta in Indonesia which potential for biogenic gas occurrence. According to Cameron *et al.* (1982), Topang Island and its surrounding area, Rangsang Subdistrict, Meranti Regency, Riau Province, Indonesia, has Quaternary sea bottom sediments that may contain biogenic gas. The occurrence of biogenic gas in this area has been confirmed by local residents who reported the appearance of gas from their water drilling nearby their house (Samsuharto, 2015, personal communication). Based on that information, Raharjo *et al.* (2015 and 2016) have conducted research of biogenic gas in this area. In that research, the occurrence of biogenic gas was observed in two sequences from relatively shallow water depth (approximately 50 m from subsurface). Continuing that research, this study is conducted in order to understand geological conditions particularly its sedimentology related to biogenic gas indications in the

Topang Island and its surrounding sea. This research was expected to expose gas resource locations in Parit Jawa and Parit Bintang Village.

Research area includes deltaic and oceanic coastal area of the Topang Island, administratively belongs to Rangsang Subdistrict, Meranti Regency, Riau Province. Geographically it is located in $103^{\circ}2'29.3''\text{E} - 103^{\circ}9'3.8''\text{E}$ and $0^{\circ}51'5.02''\text{S} - 0^{\circ}41'35.7''\text{S}$, included in Siak Sri Indrapura and Tanjung Pinang quadrangle maps (Figure 1).

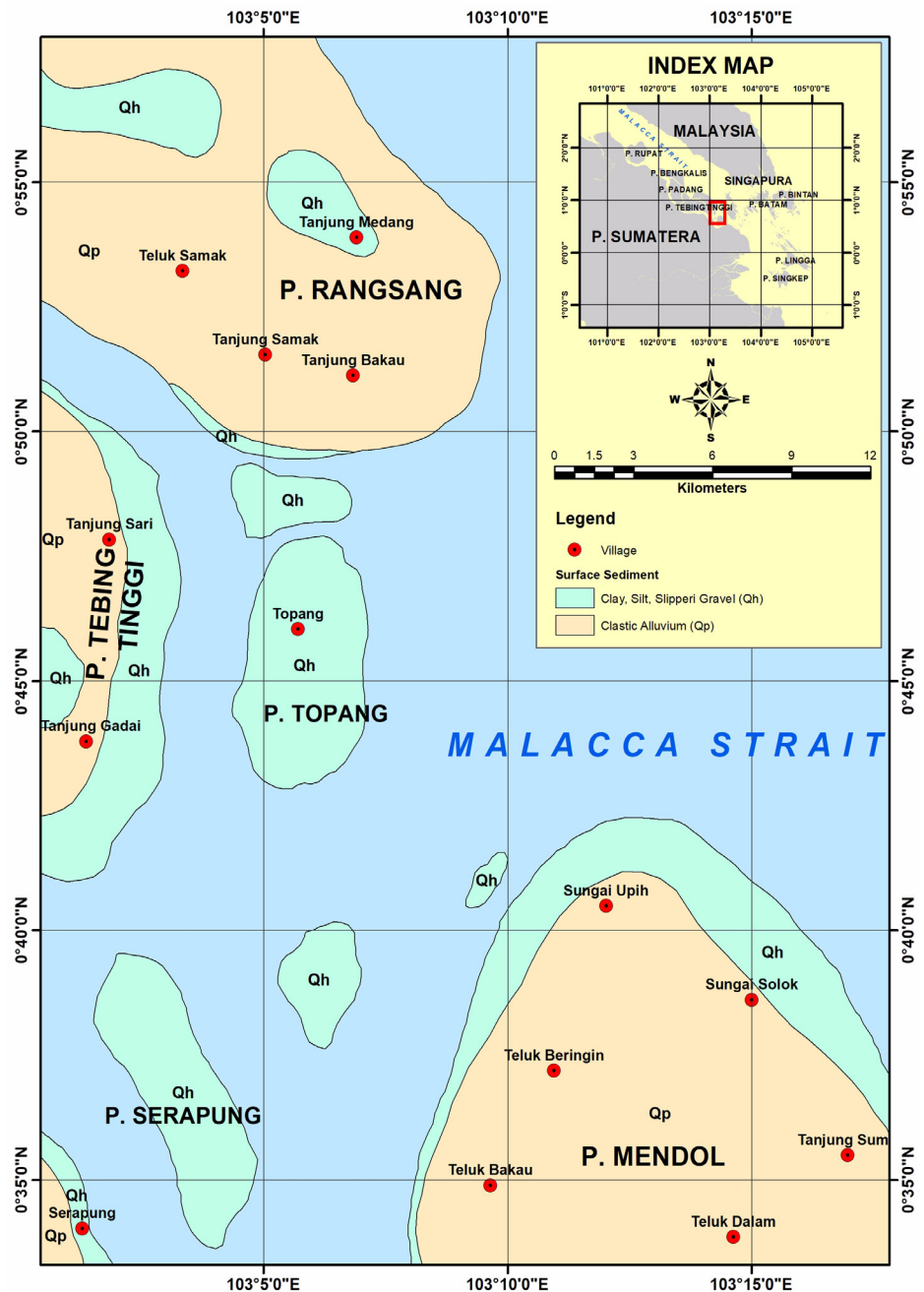


Figure 1. Geological map of research area (Cameron *et al.*, 1982). Qh = Holocene deposit sediment, Qp = Early Pliocene sediment

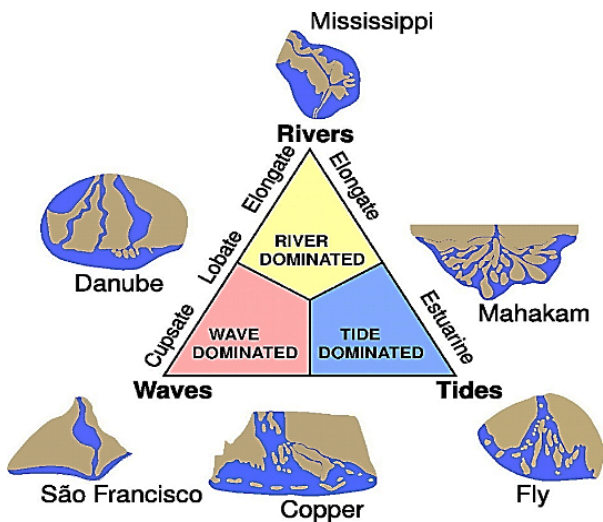


Figure 2. Delta Classification (Galloway, 1975).

Regional stratigraphy consists of Early Holocene deposits sediment (Qh) formed by clay, silt, gravel, remains of marsh plants, peats, and coral reefs which was deposited unconformably in inner sublittoral on top of Early Pliocene Sediment (Qp) which is composed of granules of weathered granite size from gravel to gravel and plant remains, (Cameron *et al.*, 1982). Delta was formed by river material supply to the coast, it caused a change of current direction that spread the flow lead to delta deposition (Boggs, 1987). Several factors controlling delta formations are climate, sediment materials, river processes, wave, tide, current, wind, shelf area, slope, tectonic, and receiving basin geometry which controls distribution, orientation, and internal geometry of delta sediments (Walker, 1984). The prominent processes controlling delta formations by Galloway (1975) : Fluvial Dominated Delta, Tide Dominated Delta, Wave Dominated Delta. In general, most delta are not controlled by single process, instead there are interactions between two or three processes (Figure 2). Sub-delta environments are delta plain, delta front, and pro delta (Coleman and Prior, 1982).

Topang Delta is classified into tide-dominated delta, derived from general view of its surface sediment. The morphology of this delta including delta plain, delta front, and pro-delta (Raharjo *et al.*, 2016).

METHODS

Surface Geoelectrical Measurement

To determine sedimentology and the depth of the sedimentary rock layers of biogenic gas, we used geoelectric method to obtain the resistivity value of each sedimentary rock as a biogenic gas carrier around Parit Jawa Village and Parit Bintang Village. In total 75 point of measurement was conducted, 38 point in Parit

Jawa and 37 point in Parit Bintang. Geoelectric measurements were performed using the Schlumberger configuration with the Syscal Junior equipment system, assuming that the surface layer is an isotropic homogeneous medium stacked vertically. Measurement at a sounding point is done by changing the distance of the electrode current and potential electrode. Transfer of the electrode distance is not done arbitrarily, but started from the distance of the small electrode and then enlarge gradually. The distance of this electrode is proportional to the depth of the detected rock layer. From the depth of the detected rock layers, the thickness and resistivity of each rock layer will be obtained.

Based on the value of electrical resistivity, rocks/minerals are classified into 3 groups (Santoso, 2002), namely:

1. Good conductor $\rho < 1,000 \text{ Ohm-m}$
2. Mid conductor $\rho = 1,000 - 5,000 \text{ Ohm-m}$
3. Isolator $\rho > 5,000 \text{ Ohm-m}$

Good conductor with value of $\rho < 1,000 \text{ Ohm-m}$, a free charge carrier moves across the conductor. The charge carrier can respond to electric fields that are almost too small and keep moving as long as the charge is affected by electric field. Mid conductor, has electrical properties between conductor and the insulator with a value of $\rho = 1,000 \text{ Ohm-m} - 5,000 \text{ Ohm-m}$. In the electric field this material behaves like a conduit. Classification of resistivity translated into sediment type was based on Telford *et al.* (1990). To get the value of apparent resistivity, an equation formulated also by Telford *et al.* (1990) is used as follows:

$$K = \frac{1}{2} \left[\frac{p^2}{a} - \frac{a}{4} \right]$$

$$\rho = K \frac{\Delta V}{I}$$

$$\rho = \pi \left[\frac{p^2}{a} - \frac{a}{4} \right] \frac{\Delta V}{I}$$

Where:

- ρ = Pseudo type prisoners
- K = Geometry factor / Constancy of spacing
- ΔV = potential difference
- I = Strong electric current
- R = ground resistance

Meanwhile, to determine the depth of the biogenic gas carrier layer is obtained from the curve and distance electrode current table as formulated as follows:

$$D = AB / 2$$

Where:

- D = Depth (meters)
- A-B = Distance between current electrodes

Coring (Core Drilling)

To confirm geoelectric result of sedimentology, and to get more information of sediment characteristic, coring was carried out along the geoelectrical lines to analyze sediment vertically and directly. Coring on geoelectrical lines helps on sediment interpretation of geoelectrical data, and sediment sampling for analysis of total organic carbon to study biogenic gas reservoir sediments. Coring was done on two locations are BH-1 (103°6'7.9" E-0°43" N) in Parit Jawa Village and BH-2 (103°5'49.7" E-0°44" N) in Parit Bintang Village (Figure 3, above), each coring was performed down to 40 m depth. This core drilling (carried out by using drilling machine Koken), resulting undisturbed sediment sample every 50 cm with core recovery between 50 cm-100 cm.

Total Organic Carbon Analysis

Laboratory analysis was also conducted particularly total organic carbon analysis (TOC)

applied to coring samples. The purpose of this analysis is to determine the amount of organic material contained in sediments related to the hydrocarbons formation. Carbon content 0% - 0.5% (poor) has no petroleum potential formation, it is considered potential if total carbon 2.0%-4% (very good), (Peter, K.E., and Cassa, M.R. 1994). About 10 samples were analyzed, 5 samples from BH-1 (20-21 m, 26-27 m, 30-31 m, 35-36 m, 38-39 m), and 5 samples from BH-2 (23-24 m, 27-28 m, 29-30 m, 33-34 m, 37-38 m). This analysis was conducted at Chemistry Laboratory of Public Service Agency of Mineral and Coal Technology – Ministry of Energy and Mineral Resources.

RESULT

Geoelectrical Data

Based on references and calibrations in the field from the core drilling samples, the resistivity values are interpreted as sediment layers. Resistivity values of more than 1 to less than 7 Ohm.m are interpreted as silt, values less than or equal to 1 are interpreted as clay layers which function as impermeable layers, resistivity values greater than or equal to 7 are interpreted as layers having coarser grain size or sand that can function as gas reservoirs (Januar and Fudianto. T., 2015). In Parit Jawa Village, surface geoelectric measurement was conducted at 38 points. In general determined 2 sediment types, are very fine sediment (silt and hydrous clay) and fine sand, fine sediment between 0 m to 24 m and fine sand found at depths between 24 m to more than 90 m. In this paper we chose only point 11 and point 39 which is very close to the core drilling location, to be discussed in detail. At point 11, the top part down to 59 m indicated by relatively lower resistivity value (0.61 Ohm.m – 6.79 Ohm.m). This might represent relatively very fine sediment type. From 0.5-9.0 m resistivity value approximately 6.79 Ohm.m might indicate silt, while from 9.0-59.0 m resistivity value relatively low which is 0.61 Ohm.m interpreted as hydrous clay (water saturated). Below 59.0 downward, resistivity value

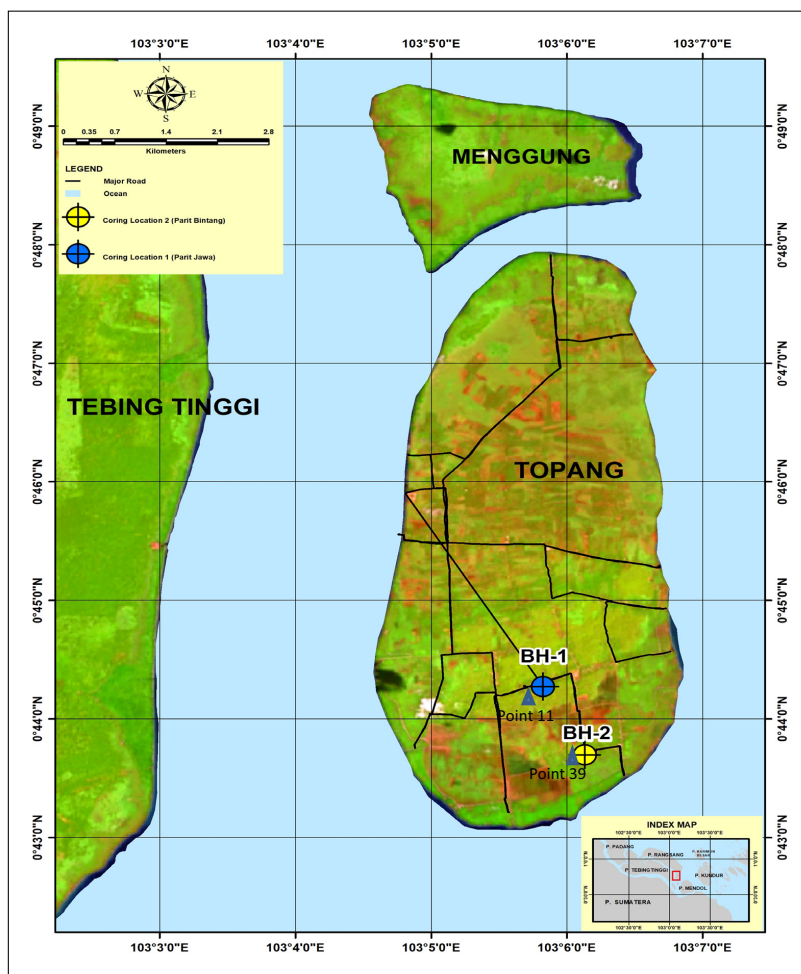


Figure 3. Core drilling in Parit Jawa Village (BH-1) and Parit Bintang Village (BH-2), Point 11 and point 39 are geoelectrical measurement point

Point 11 (Parit Jawa)

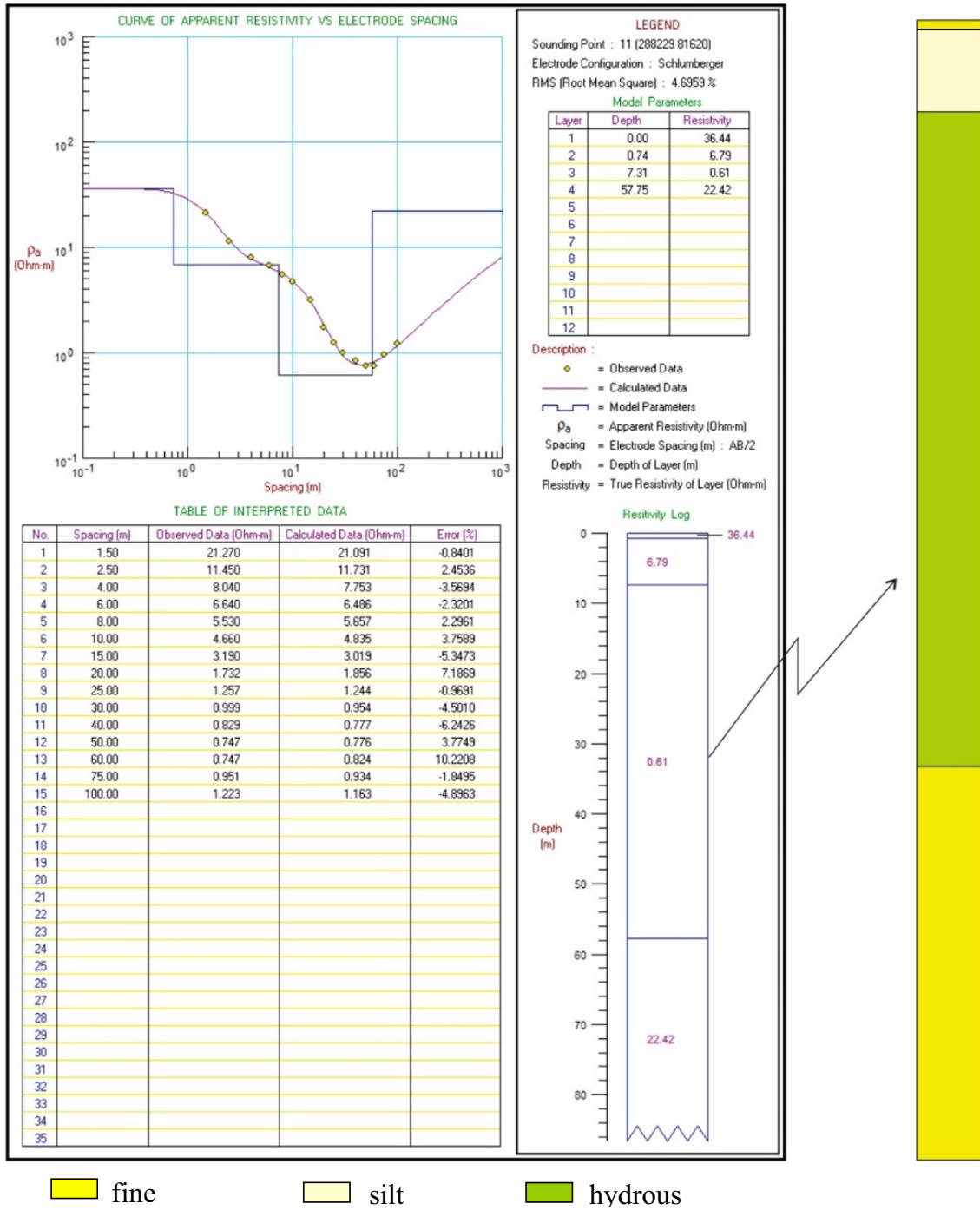


Figure 4. Interpretation of surface geoelectrical measurement of point 11 in Parit Jawa (Topang Island)

increase up to 22.42 Ohm.m, this might indicate fine sand type (Figure 4). In Parit Bintang, 39 point measurements were conducted, with similar consideration as in Parit Jawa Village, we chose measurement point 39 to be studied. Similar to Point 11, resistivity value at the top part down to 56m are relatively lower, interpreted as very fine sediment type. Resistivity value from 0.3-8.5 m is 1.74 Ohm.m, slightly higher than that at intervals 8.5-58.5 m with resistivity value 0.82 Ohm.m. The top part might indicate silt sediment, while lower resistivity value at 8.5 – 58.5 m is interpreted as hydrous clay which is water saturated. Below 58.5m downward, resistivity value is higher (19.8 Ohm.m) interpreted as fine sand (Figure 5).

The sand layer in Parit Jawa and Parit Bintang are determined from geoelectrical measurement by resistivity value and also its depth is known (Table 1). The depth of the sand layer in Parit Jawa is generally found at depth between 40 m – 166 m, shallow depths are in the northwest and deepest regions in the northeast. The depth of the sand layer in Parit Bintang is generally found at depth between 34 m – 146 m, shallow depths are in the north and south region the deepest regions are in the center region. We apply these sand layer depth as contour map can be observed at Figure 6 and 7 (below). Manifestations of gas mostly accumulate in porous sediments from sand types, which can be referred to as reservoirs filled with gas (closure). This closure is an important part where the gas is stored from the origin of its formation in clay sediments which are rich in organic material. In this study the closure described is the result of geoelectric measurements around the appearance of gas manifestations based on information from the local residents and have been proven by trying to burn. The gas was released in Parit Jawa due to manual drilling activities by residents to look for sources of clean water, gas appears on the surface after drilling ± 50 m deep. Shallow gas manifestations appear visible from the presence of air bubbles that appear in the surface water. In the second point, the emergence of the manifestation of the gas is beside the mosque which enters the Parit Bintang. Manifestations of gas that appears next to the mosque is also due to drilling ± 60 m deep. The depth contour map is made from the depth of the sand layer by each geoelectric measurement point. Based on the depth contour map, it can be interpreted where the possible closure of the trapped gas is located.

Core Drilling Data

This drilling location was chosen based on information from local residents with the appearance of flammable gases. This drilling takes a sample every 1-1.5 meters based on the nature of the sediment where

solid sediments are taken every 1 meter and soft sediments are taken up to 1.5 meters. At some depth 50 cm undisturbed sediment samples were taken. Drilling was carried out in two locations BH-1 (103°6'7.9"E-0°43' N) in Parit Jawa Village and BH-2 (103°5'49.7"E-0°44' N) in Parit Bintang Village (Figure 3), each coring was performed down to 40 m depth.

In general, both BH-1 and BH-2 are dominated by hydrous clay which found from the top part of the core down to the bottom part. Silt and fine sand are found in thin interval at the top part of the cores. Clay as dominant sediment type at BH-1 and BH-2 is identified as hydrous clay bright gray, soft, mushy, and water saturated. Silt are found as dark gray, contained of organic material. Silt are found at 6.5 – 7.5m at BH-1, while at BH-2 it is found at 5-7.5m depth interval. Thin layer of fine sand is also determined particularly at interval 7.5 – 13.5m at BH-1, at BH-2 it is found at 8 m down to 14.5m depth interval. Below 13.5 m of BH-1 and 14.5m of BH-2 composed of hydrous clay, downward to the bottom part of both cores.

Total Organic Carbon

The total organic carbon was analyzed was 10 samples each of 5 samples from BH-1 and BH-2. Carbon content 0% - 0.5% (poor) has no petroleum potential formation, it is considered potential if total carbon 2.0%-4% (very good) (Peter, and Cassa, 1994). The swamp environment with dominant organic clay wherein interspersed with marine mud shows abundant indications of biogenic gas (Kurnio *et al.*, 2009). Analysis of methanogenic bacteria to identify the presence of anaerobic bacteria as forming of methane gas in gaseous sediment samples. Examples of sediments analyzed are clay and silt from drill holes that have methane gas indications (Raharjo *et al.*, 2014). Total organic carbon analysis from BH-1 indicate value from 54.4% to 71.6%, the lowest value is at 38-39 m is 54.4%, while the highest value indicated at 26-27 m depth with percentage 71.6% (Table 2). The highest percentage value is at a depth of 26-27 m formed in hydrous clay sediment, bright gray, soft, mushy, organic content, water saturated. Total organic carbon analysis from BH-2 indicate value from 56.0% to 78.0%, the lowest value is at 37-38 m is 56.0%, while the highest value indicated at 23-34 m depth with percentage 78.0% (Table 3). The highest percentage value is at a depth of 33-34 m formed in clay sediment, greenish gray, solid. At this research site the formation of methane gas occurs in organic clay sediments which are in an anaerobic sulfate-reduction environment. In the marine environment, sulfate reduction becomes the dominant form of respiration after the creation of anaerobic conditions due to the relatively high concentration of sulfate in normal seawater (0.028 M).

Point 39 (Parit Bintang)

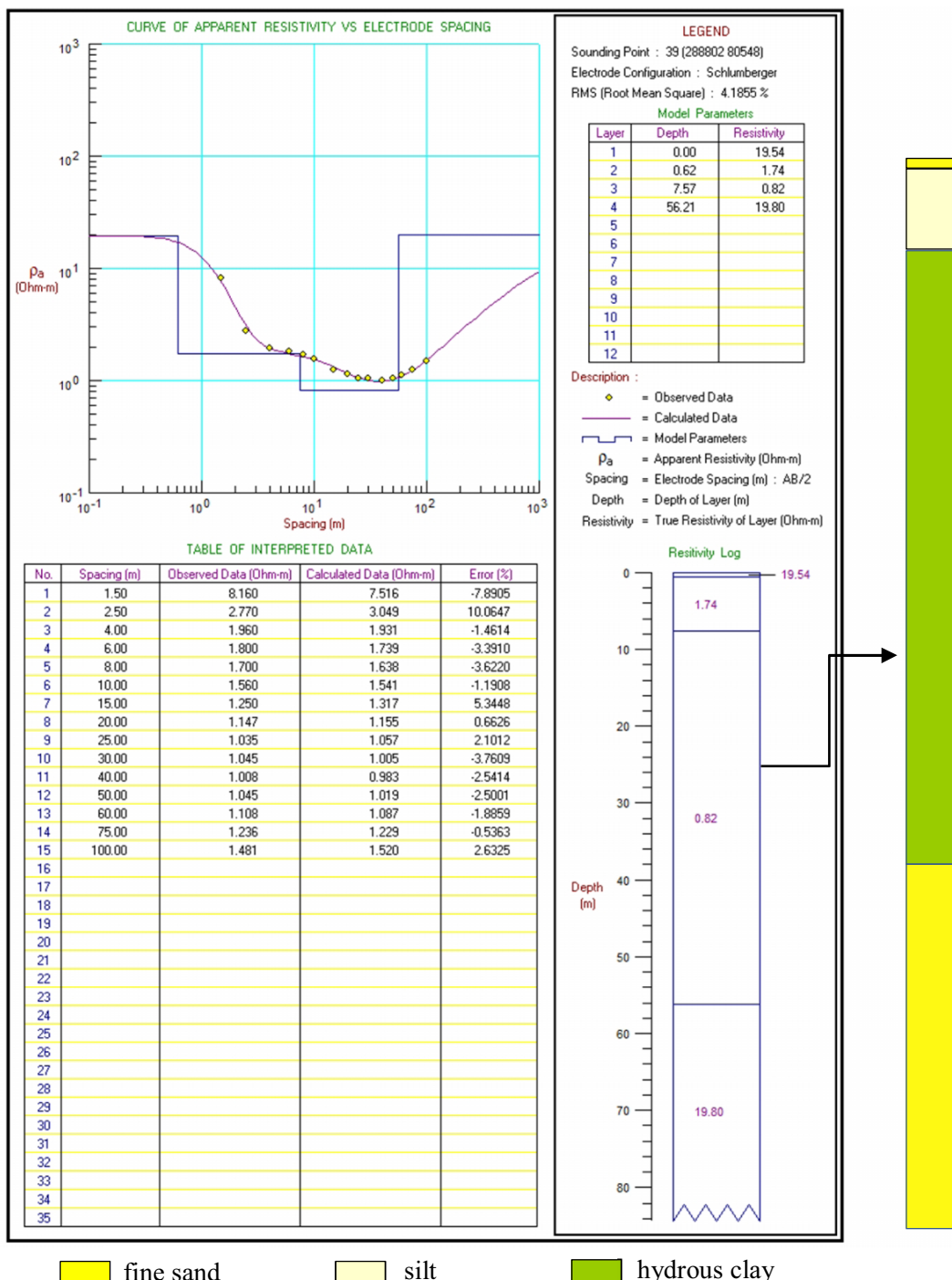


Figure 5. Interpretation of surface geoelectric measurement of point 39 in Parit Bintang (Topang Island)

Table 1. The relationship between resistivity values and interpretation fine sand sediment depth

| Location | Point Measurement | Resistivity (Ohm.m) | Depth (m) |
|---------------|-------------------|---------------------|-----------|
| Parit Jawa | 1 | 25.36 | 62 - 90 |
| | 2 | 19.76 | 53 - 78 |
| | 3 | 19.77 | 68 - 102 |
| | 4 | 19.68 | 71 - 106 |
| | 5 | 20.15 | 68 - 100 |
| | 6 | 19.81 | 73 - 108 |
| | 7 | 19.50 | 92 - 138 |
| | 8 | 19.68 | 62 - 92 |
| | 9 | 19.17 | 120 - 166 |
| | 10 | 19.75 | 80 - 120 |
| | 11 | 22.42 | 58 - 85 |
| | 12 | 19.84 | 62 - 90 |
| | 13 | 20.20 | 62 - 92 |
| | 14 | 20.81 | 86 - 128 |
| | 15 | 20.08 | 70 - 104 |
| | 16 | 20.04 | 56 - 84 |
| | 17 | 21.25 | 61 - 90 |
| | 18 | 65.89 | 24 - 36 |
| | 19 | 19.75 | 72 - 106 |
| | 20 | 31.21 | 42 - 60 |
| | 21 | 21.31 | 40 - 59 |
| | 22 | 36.10 | 56 - 82 |
| | 23 | 45.14 | 39 - 58 |
| | 24 | 20.11 | 50 - 74 |
| | 25 | 20.90 | 63 - 94 |
| | 26 | 20.12 | 82 - 124 |
| | 27 | 21.19 | 56 - 82 |
| | 28 | 19.95 | 58 - 86 |
| | 29 | 20.33 | 49 - 73 |
| | 30 | 14.19 | 88 - 132 |
| | 31 | 19.85 | 60 - 90 |
| | 32 | 24.37 | 60 - 88 |
| | 33 | 20.89 | 52 - 78 |
| | 34 | 19.93 | 54 - 80 |
| | 35 | 20.04 | 52 - 78 |
| | 36 | 20.93 | 72 - 108 |
| | 37 | 20.20 | 82 - 122 |
| | 38 | 23.12 | 56 - 82 |
| Parit Bintang | 39 | 19.80 | 56 - 82 |
| | 40 | 20.01 | 56 - 82 |
| | 41 | 20.08 | 56 - 84 |
| | 42 | 20.03 | 56 - 84 |
| | 43 | 20.14 | 57 - 82 |
| | 44 | 20.03 | 54 - 80 |
| | 45 | 19.71 | 63 - 94 |
| | 46 | 19.37 | 64 - 94 |
| | 47 | 19.63 | 61 - 90 |

Table 1. *Continuous*

| | | | |
|--|----|-------|----------|
| | 48 | 19.58 | 60 - 88 |
| | 49 | 20.10 | 60 - 88 |
| | 50 | 20.02 | 59 - 84 |
| | 51 | 20.86 | 51 - 76 |
| | 52 | 20.17 | 65 - 96 |
| | 53 | 19.16 | 101-146 |
| | 54 | 19.73 | 70 - 104 |
| | 55 | 19.61 | 77 - 116 |
| | 56 | 19.91 | 56 - 82 |
| | 57 | 19.83 | 58 - 86 |
| | 58 | 19.78 | 56 - 84 |
| | 59 | 21.64 | 34 - 50 |
| | 60 | 19.76 | 63 - 94 |
| | 61 | 19.78 | 65 - 96 |
| | 62 | 20.02 | 56 - 84 |
| | 63 | 20.01 | 57 - 86 |
| | 64 | 19.99 | 60 - 90 |
| | 65 | 19.25 | 66 - 100 |
| | 66 | 20.41 | 52 - 76 |
| | 67 | 19.87 | 62 - 90 |
| | 68 | 20.10 | 57 - 86 |
| | 69 | 19.93 | 63 - 94 |
| | 70 | 22.34 | 42 - 64 |
| | 71 | 20.33 | 54 - 80 |
| | 72 | 22.40 | 45 - 62 |
| | 73 | 19.80 | 59 - 88 |
| | 74 | 20.03 | 58 - 86 |
| | 75 | 19.87 | 58 - 86 |

Table 2. TOC content from BH-1

| No interval samples | TOC (%) |
|---------------------|---------|
| BH-1 20-21 m | 63.0 % |
| BH-1 26-27 m | 71.6 % |
| BH-1 30-31 m | 70.0% |
| BH-1 35-36 m | 65.4 % |
| BH-1 38-39 m | 54.4 % |

Table 3. TOC content from BH-2

| No interval samples | TOC (%) |
|---------------------|---------|
| BH-2 23-24 m | 68.0 % |
| BH-2 27-28 m | 64.6 % |
| BH-2 29-30 m | 70.6 % |
| BH-2 33-34 m | 78.0 % |
| BH-2 37-38 m | 56.0 % |

DISCUSSION

Based on the results of surface geoelectric measurements in the field sediment layer is known, the resistivity value of the grained or sand sedimentary layer is between 19.84 Ohms. m - 45.14 Ohm.m. After knowing the resistivity value of the sand sediment layer, then made a correlation to know closure of the sand sediment.

Closure zone identification based on geoelectric resistivity value and gas seepage (below) in Parit Jawa Village.

In the Parit Jawa village area, it is interpreted that there are two closures which are located in the northeast (point 8) and southwest of the region where geoelectric measurements are taken. The outer closures are in the southwest including the measurement points 11, 12, 18, 20, 22 and 23 (Figure 6), represented by point 11, because this point is near the core drilling (BH-1) where it is known from the local residence that there is a

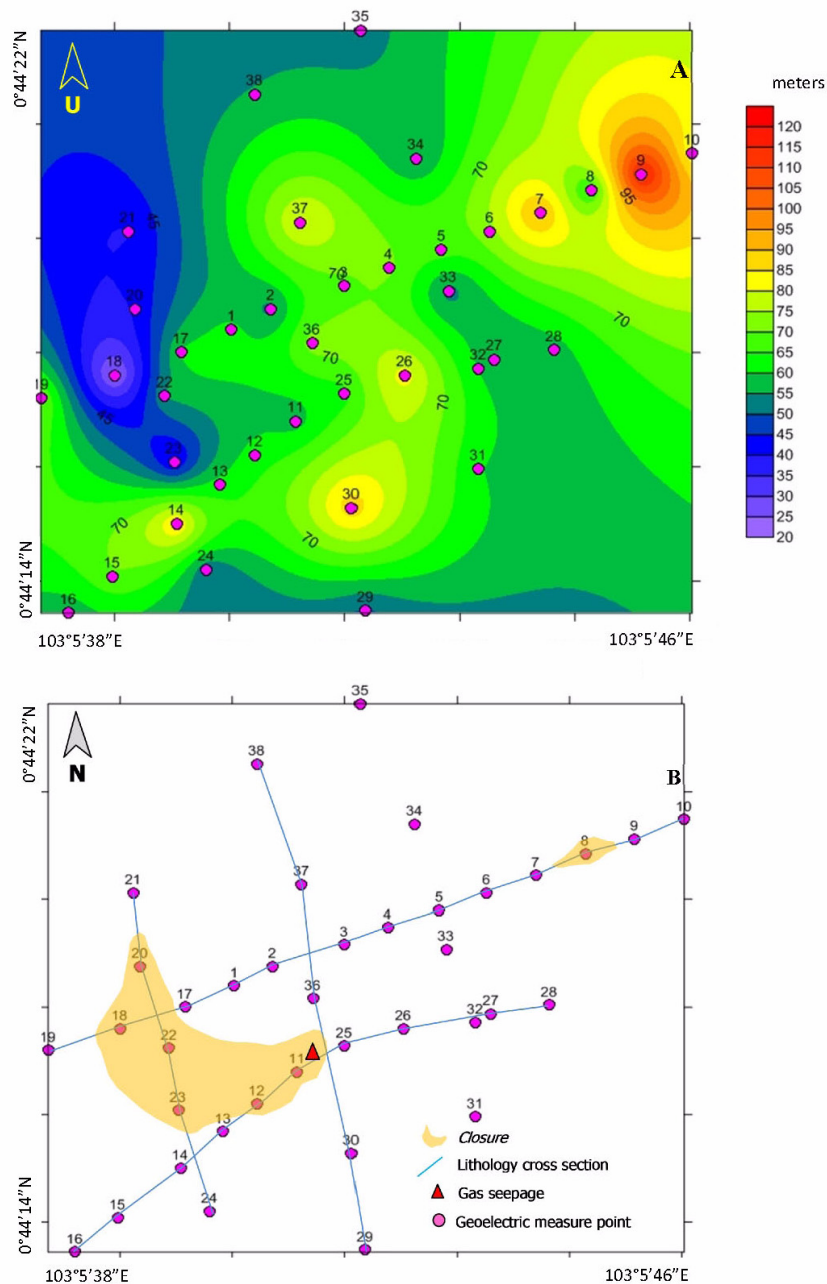


Figure 6. Depth contour of sand sediment layer map derived from geoelectrical interpretation (above). Closure zone identification based on geoelectric resistivity value and gas seepage (below) in Parit Jawa Village.

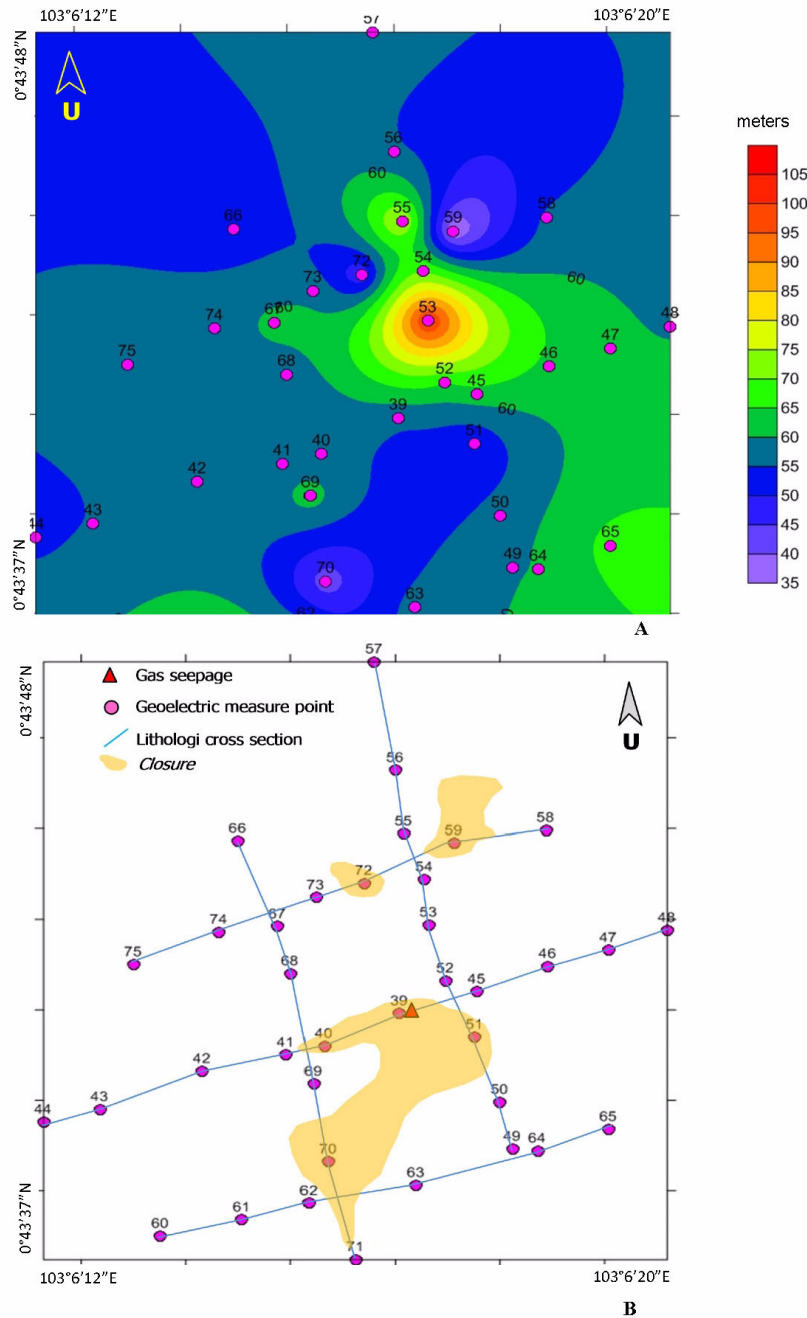


Figure 7. Depth contour of sand sediment layer map derived from geoelectrical interpretation (above). Closure zone identification based on geoelectric resistivity value and gas seepage (below) in Parit Bintang Village.

biogenic gas seepage. In this closure area, manifestations of gas seepage manifest at the surface (near point 11).

In the area of the Parit Bintang village, interpreted that there are three closures, which are spread in the north and south of the area to be measured. The two closures in the north are relatively small, namely at points 59 and 72, while the closure in the south though only one but relatively wide, which includes

measurement points 39, 40, 51, 70 and 71 (Figure 7), represented by point 39, because this point is near the core drilling (BH-2) where it is known from the local residence that there is a biogenic gas seepage.. A large closure at this location also found a manifestation of gas seepage on the surface, which is found around point 39. Total Organic Content (TOC) was used to learn about content of hydrocarbon-related organic material in sediments. Geochemical analysis was done to 5

samples of sediment from BH-1 and 5 samples from BH-2 from 20 meters to 40 meters depth. Lab analysis shows organic material dominantly appear in each sample. Sediment which has potential to form hydrocarbon is considered good if *Total Organic Content* (TOC) is bigger than 2.0 % (Peter and Cassa, 1994). From samples taken shows organic over content above 50%, so has potential to form hydrocarbon which is biogenic gas. Sediment in research area is considered excellent source potential to be biogenic gas source rock. From the resistivity interpretation section it can be seen the relationship between the sediment layer from resistivity value and the sediment depth were reaching more than 80 m depth. An example is shown in a table of grained or sand sedimentary layers from geoelectric measurements in the field (Table 1). It can be said that sedimentary layers in grained or dominant fine sand areas are at depths between 58.5-80.0 m. The resistivity value in several measurement points that have been interpreted as a sedimentary layer is then correlated to form a cross section like Figure 4 and 5.

CONCLUSIONS

In the Parit Java Village, from the surface down to 59m depth interval interpreted as very fine sediment indicated by relatively lower resistivity value (0.61 – 6.79 Ohm.m). Below 59m with resistivity value 22.42 Ohm.m is interpreted as fine sand.

In Parit Bintang, also indicated relatively lower resistivity from the top part down to 58m depth that interpreted as very fine sediment (0.82 – 1.74 Ohm.m). Below 58m, resistivity value are higher (19.8 Ohm.m) that interpreted as fine sand as well.

Closure at Parit Jawa interpreted that there are two closures which are located in the northeast (point 8) and southwest (points 11, 12, 18, 20, 22 and 23) of the region where geoelectric measurements are taken.

Closure at Parit Bintang interpreted that there are three closures, which are spread in the north and south of the area to be measured. The two closures in the north are relatively small, namely at points 59 and 72, while the closure in the south though only one but relatively wide, which includes measurement points 39,40,51,70 and 71.

The total organic carbon analysis results from BH-1 have a value from 54.4% to 71.6%, the abundance is at a depth of 26 m -39 m formed in sediments hydrous clay, bright gray, soft, mushy, organic content, water saturated. BH-2 indicate value from 56.0% to 78.0%, the abundance is at a depth of 23 m -34 m formed in sediments clay, greenish gray, solid.

From all of the information it is known that the formation of biogenic gas from the abundance of TOC is in the layers of hydrous clay and clay where the

environment is an anaerobic sulfate-reduction environment. Biogenic gas can be stored or trapped in sedimentary pocket in the form of fine sand.

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