

SEDIMENTATION AND DEPOSITIONAL ENVIRONMENT BASED ON SEISMIC AND DRILLING CORE ANALYSES IN CIMANUK DELTA INDRAMAYU, WEST JAVA

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ABSTRACT

Core drilling had been carried out in three locations such as in Brondong Village (BH-01), Pasekan Village (BH-02), and Karangsong Village (BH-03). Those three cores are similar in lithology consist of clay. They are correlated based on fragment content, such as fine sand lenses, mollusc shells, rock and carbonate materials which discovered from different depths.

Single side band of shallow seismic reflection recorded paleochannels in E sequence at the north and the west of investigated area. It's predicted the north paleo channels were part of Lawas River or Tegar River, while the west paleo channels were part of Rambatan Lama River.

Microfauna content of all those three cores indicated that from the depth of 0.00 meter down to 25,00 meters are Holocene/Recent, from 25,00 meters to the bottom are Pleistocene which were deposited in the bay to middle neritic environment.

Key words: Core drilling, seismic interpretation, Cimanuk Delta

SARI

Pemboran inti dilakukan di 3 (tiga) lokasi yaitu di Desa Brondong (BH-01), Desa Pasekan (BH-02), dan Desa Karangsong (BH-03). Ke tiga inti bor itu mempunyai kesamaan litologi yaitu lempung. Korelasi dilakukan berdasarkan kandungan fragmen seperti lensa-lensa pasir halus, cangkang moluska, material batuan dan material karbonat yang terdapat pada kedalaman yang berbeda.

Seismik pantul dangkal saluran tunggal merekam adanya alur purba pada runtunan E di bagian utara dan barat daerah penelitian. Diduga alur purba di bagian utara merupakan bagian dari tubuh Kali Lawas atau Kali Tegar, sedangkan di bagian barat sebagai bagian dari tubuh Kali Rambatan Lama.

Kandungan mikrofaunanya menunjukkan ketiga bor inti mulai kedalaman 0,00 meter sampai 25,00 meter berumur Holosen/Resen, sedangkan dari 25,00 meter sampai batas bawah pemboran berumur Plistosen yang diendapkan pada lingkungan teluk hingga Neritik Tengah.

Kata kunci: Bor inti, penafsiran seismik, Delta Cimanuk.

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INTRODUCTION

The objectives of this investigation are to find out the lithology and stratigraphy which were deposited in Cimanuk Delta. The aims are to conclude the development of Cimanuk Delta, hopefully the result of this investigation would be useful as a database for various needs such as for research and other development in the future.

Location and area of investigation

Administratively, Cimanuk Delta is part of Indramayu Regency, West Java Province, and geographically in the area of $108^{\circ}00' - 108^{\circ}30'$

E and $06^{\circ}06' - 06^{\circ}30'$ S more or less 1,359 Km^2 . (Figure 1).

Regional geology

Based on the Geological Map of Indramayu Quadrangle, scale 1 : 100,000 by Sudana and Achdan, published by Geological Research and Development Centre, Bandung, 1992, lithology of the investigated area are deposited in Quaternary. The oldest rocks unit is pleistocene conglomerate and tuffaceous sandstone of terrestrial facies. This unit is overlid by Holocene Alluvial deposits consist of flood plain deposit, coastal deposit, beach ridge deposit, fluvial deposit, and deltaic deposit.

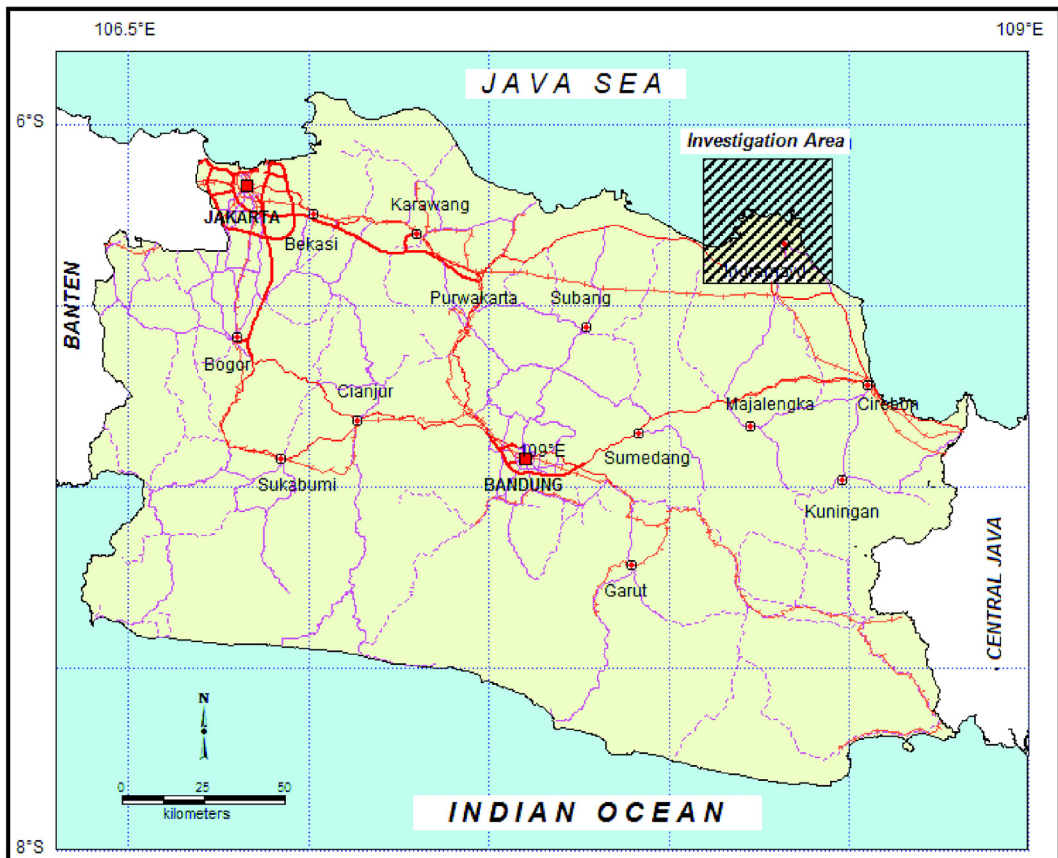


Figure 1. Key map of investigation area

Geological Map shown below is a simplified Geological Map by Sudana and Achdan (1992). The stratigraphy of the area described as follow :

Flood plain deposits consist of sandy clay, humusaceous clay, grayish to blackish brown. To the south, this unit is more tuffaceous and reddish. This unit overlies the older unit which is shown by erosional surface such as at Cibogor River and upper course of Kandanghaur River. This deposit spreads out to Cirebon and Arjawinangun Quadrangles as Alluvium.

Coastal deposits consist of silt, clay and sand containing mollusk fragments. This unit spread until the foot slope of beach ridges, distributed in the central and east coast. The areas are cultivated as rice field and salt embankment.

Beach ridge deposits consist of coarse to fine sand and clay containing mollusks. Some ridges are up to 5 m high. The ridges are only in the coastal area, which are usually parallel to each other, some of them are radial. This area had been developed as inhabitant; meanwhile the main road of Jakarta-Cirebon is also built on these beach ridges.

Fluvial deposits consist of sand, silt and clay, brown to blackish, spread out mainly along Cimanuk River.

Deltaic deposits consist of silt and clay, brown to blackish, containing a few mollusks, ostracods, planktonic and benthonic foraminiferas. The areas are including estuaries of big rivers, such as estuary of Cimanuk River to Cililin River which are cultivated as fish and shrimp ponds, the rest are mangrove.

RESEARCH METHODS

Research methods are including vessel positioning, seismic, drilling core, and laboratory. Vessel positioning method is to locate the exact position of research vessel when recording the data from single side band of shallow seismic reflection and to locate

position precisely of core drilling by means of using GPS (Global Positioning System) devices namely Garmin 210.

Seismic lines and core drilling location are determined by regional geological setting of the area. Trend of seismic lines are dominantly north – south. In order to gain the seismic data which could give geological setting configuration, seismic lines should be perpendicular to the strikes of the sediments. (Figure 3).

Core drilling method was used to take out samples of the sub-surface sediments in selected locations. The drilling devices used are 1 unit drilling machine Yanmar TF 135 H and 1 unit pumping machine Yanmar TF65R.

Laboratory method is considerably necessary to analyze micro fauna content of the core as the micro fauna content lead to the depositional environment, the age of sedimentation and the geological setting of the investigated area.

RESULT AND DISCUSSIONS

The amount of drill holes in this investigation are three, such as Drill Hole 1 (BH 1) located in Brondong Village, $108^{\circ}21'00''$ E and $06^{\circ}17'09''$ S, Drill Hole 2 (BH-02) located in Pasekan Village, $108^{\circ}14'53''$ E dan $06^{\circ}15'31''$ S, and Drill Hole 3 (BH-03) located in Karangsong Village, $108^{\circ}20'59''$ E dan $06^{\circ}18'43''$ S (Figure 3). The description of the sediment samples of the cores as followed :

Drill Hole 1 (BH 1)

Total depth of Drill Hole 1 (BH 1) was 30 meters, surface water level 2 meters below ground surface. From 0 to 3 meters deep, the sediment consists of dark brown clay, very soft, homogenous, containing some organic material. From 3 to 4 meters deep, the sediment consists of dark grey clay with very

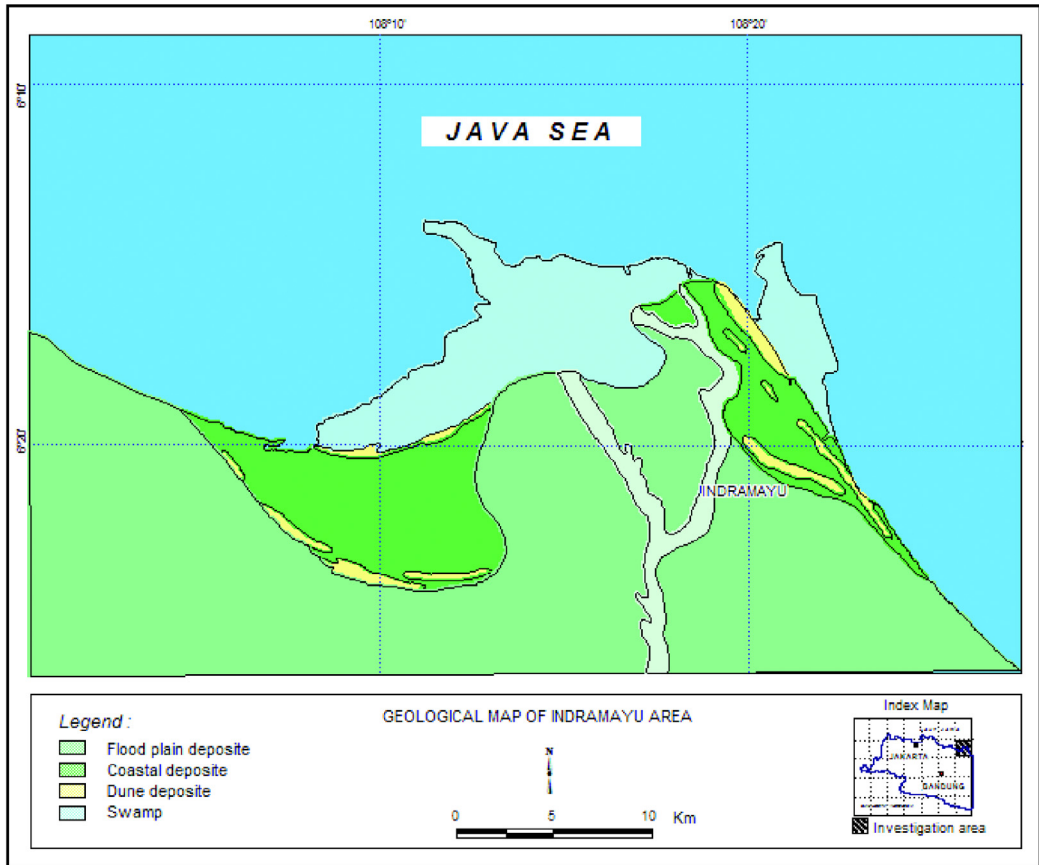


Figure 2. Geological Map of Indramayu (Sudana and Achdan, 1992)

fine sand, soft. From 4 to 6 meters deep, the sediment consists of loose black sand, containing mollusca. From 6 to 12 meters deep, the sediment consists of sticky clay, soft dark olive grey, homogeny, containing carbon material. From 12 to 13 meters deep, the core could not be taken out (loss). From 13 to 17 meters deep, the sediment consists of soft clay, sticky and homogeny. From 17 to 18 meters deep, the core could not be taken out (loss). From 18 to 20 meters deep, the sediment consists of homogeny olive grey clay, soft and sticky. From 20 to 24 meters deep, the sediment consists of dark olive grey clay, sticky, elastic, containing moderate hard rocks fragment and many mollusk shells. From 24 to

30 meters deep, the sediment consists of olive grey clay, elastic, homogeny and sticky.

Drill Hole 2 (BH 2)

Total depth of Drill Hole 2 (BH 2) was 40 meters, surface water level 2 meters below ground surface. From 0 to 4 meters deep, the sediment consists of very dark brown clay, very soft, homogeny, containing some organic material. From 4 to 5 meters deep, the sediment consists of clay to fine sand, olive, slightly hard. From 5 to 6 meters deep, the sediment consists of fine sand, slightly hard, dark olive grey, containing quartz and carbon. From 6 to 24 meters deep, the sediment consists of olive soft clay, homogeny and

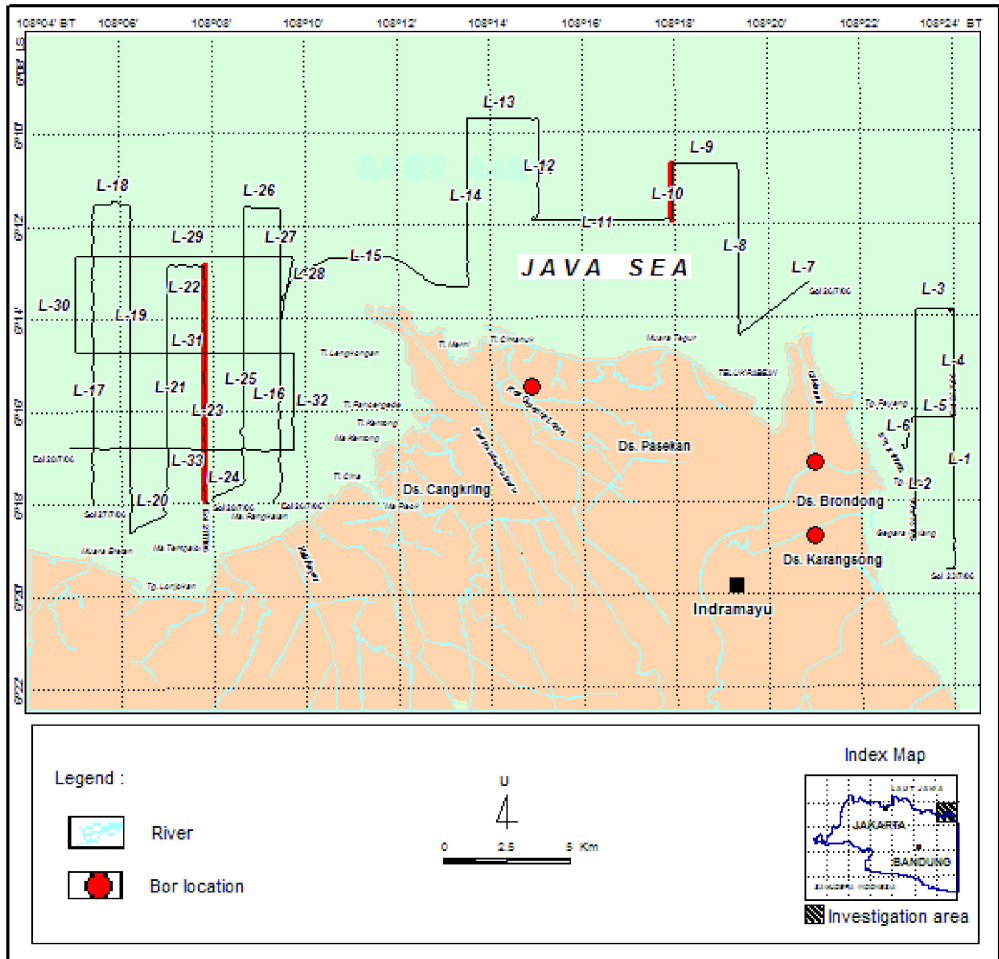


Figure 3. Map of seismic lines and core drilling locations

sticky. From 24 to 25 meters deep, the sediment consists of soft clay, homogeny, dark grey, sticky, containing limestone fragment. From 25 to 28 meters deep, the sediment consists of soft clay, homogeny, olive and sticky. From 28 to 31 meters deep, the sediment consists of olive clay, elastic, containing rocks fragment, sand lenses and oyster shells. From 31 to 32 meters deep, the sediment consists of soft clay, homogeny, olive and sticky. From 32 to 33 meters deep, the sediment consists of dense clay, olive, containing oyster shells and mollusks

fragment. From 33 to 37 meters deep, the sediment consists of soft clay, homogeny, olive and sticky. From 37 to 38 meters deep, the sediment consists of olive clay, soft, containing rocks fragment. From 38 to 40 meters deep, the sediment consists of soft clay, homogeny, olive and sticky.

Drill Hole 3 (BH 3)

Total depth of Drill Hole 3 (BH 3) was 40 meters, surface water level 2 meters below ground surface. From 0 to 3 meters deep, the sediment consists of very dark brown clay,

very soft, homogeny, containing some organic material. From 3 to 4 meters deep, the sediment consists of clay to fine sand, olive, slightly hard. From 4 to 24 meters deep, the sediment consists of olive soft clay, homogeny and sticky. From 6 to 24 to 25 meters deep, the sediment consists of soft sticky clay, dark grey, homogeny, containing limestone fragment. From 25 to 26 meters deep, the sediment consists of olive soft clay, homogeny and sticky. From 26 to 27 meters deep, the core could not be taken out (loss). From 27 to 32 meters deep, the sediment consists of olive soft clay, containing rocks fragment. From 32 to 33 meters deep, the sediment consists of dense clay, olive containing oyster shells and mollusk fragment. From 33 to 40 meters deep, the sediment consists of soft clay, olive, containing rocks fragment. (Figure 4).

When those three sections of drilling cores are correlated, it would be obvious that those cores are similar in lithology. All of them consist of clay. The differences are only in fragment content, by mean of the existences of sand lenses, fine sands, mollusk shells, rock and carbonate material, as shown in Figure 4.

Even in the Geological Map of Indramayu (Sudana and Achdan, 1992) stated that both benthonic and planktonic foraminiferas were discovered, within current investigation only planktonic foraminiferas were discovered. Beside benthonic foraminiferas, fragment of mollusk shells such as gastrophods, pelecypods and very few ostrakods were also discovered.

Microfauna analyses of the cores indicated the sedimentation processes occurred during Plistocene to Recent/Holocene, in the environment of bay to Middle Neritic, the depth less than 100 meters.

In section 1 (BH 1), from the surface to the depth of 24 meters, the sediment was deposited in Recent/Holocene. From the depth of 24 meters to the bottom was deposited in Pleistocene, in the environment of bay to

Middle Neritic. In section 2 (BH 2), from the surface to the depth of 25 meters, the sediment was deposited in Recent/Holocene. From the depth of 25 meters to the bottom was deposited in Pleistocene, in the environment of bay to Middle Neritic. In section 3 (BH 3), from the surface to the depth of 25 meters, the sediment was deposited in Recent/Holocene. From the depth of 25 meters to the bottom was deposited in Pleistocene, in the environment of bay to Middle Neritic. (Astawa, I N., 2006).

On the record of single side band of shallow seismic reflection in E sequence at the north and the west of investigated area showed paleo channels. These paleo channels more likely related to the rivers estuaried in Cimanuk Delta. Paleo channels in the north were predicted part of Lawas River or Tegur River, while the west paleo channels were predicted part of Rambatan Lama River (Figure 5).

Based on the assumption of velocity of seismic refraction in sea water 1,500 meters per second, while within sediment 1,600 meters per second, it could be concluded that the paleo channels were more or less in 32 meters deep, the distance from the shore line was around 10-16 kilometers. Based on the micro fauna analyses, the sediment from the depth of 32 meters is deposited in the Pleistocene. From those data, it could be concluded that during Pleistocene in Cimanuk Delta there were the processes of sedimentation in the environment of shallow marine (the depth was a round 32 meters).

Based on seismic record interpretation and description of core sample was taken from borehole, the sediment which were deposited as F and G sequence interpreted dominated by clay which in some areas containing lenses of fine sands, mollusc shells, rock and carbonate material. Contact between E and F sequence is unconformity as erosional truncation while contact between F and G sequence is downlap (Astawa, I N.,2007).

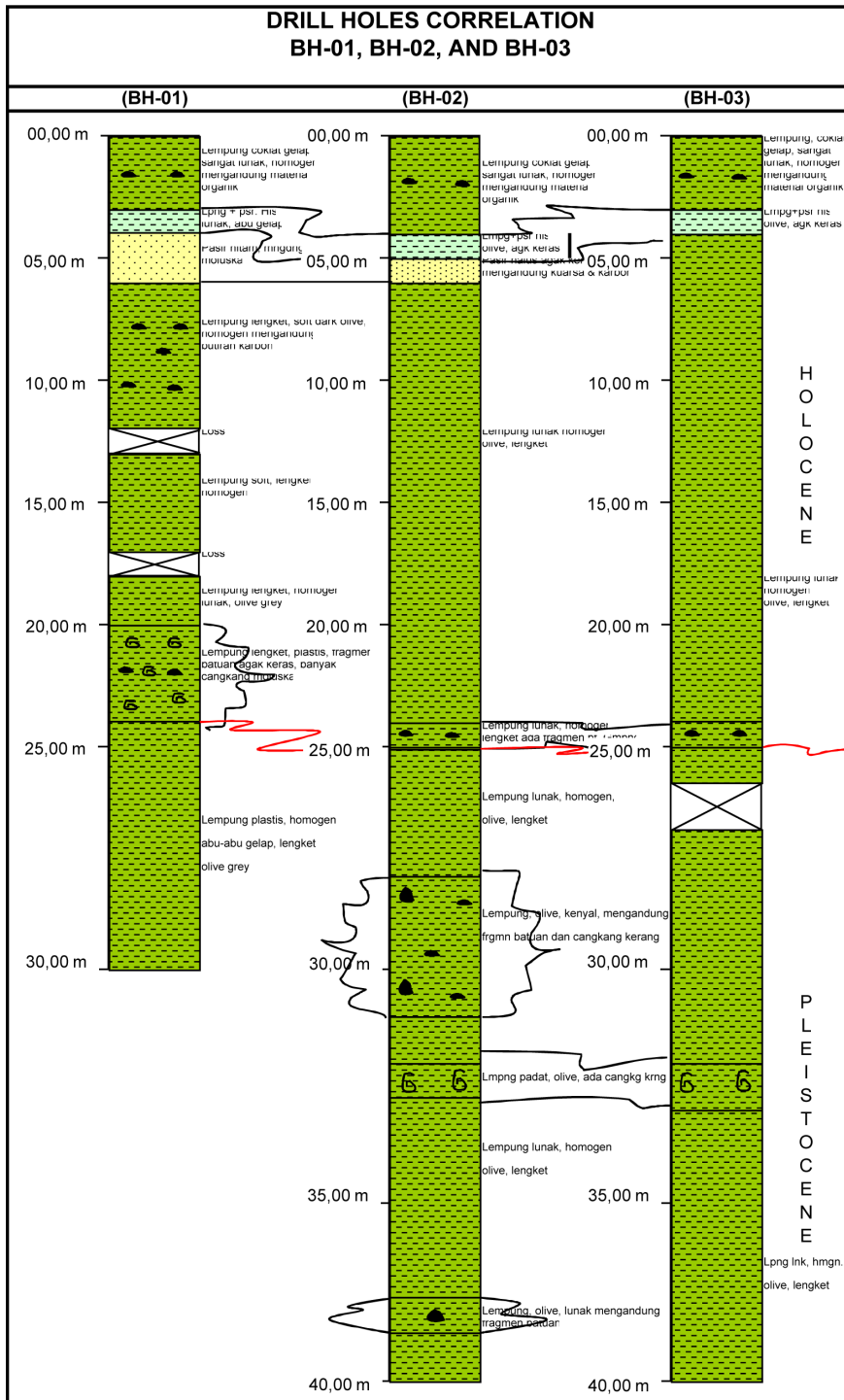


Figure 4. Drill holes correlation BH-01, BH-02 dan BH-03

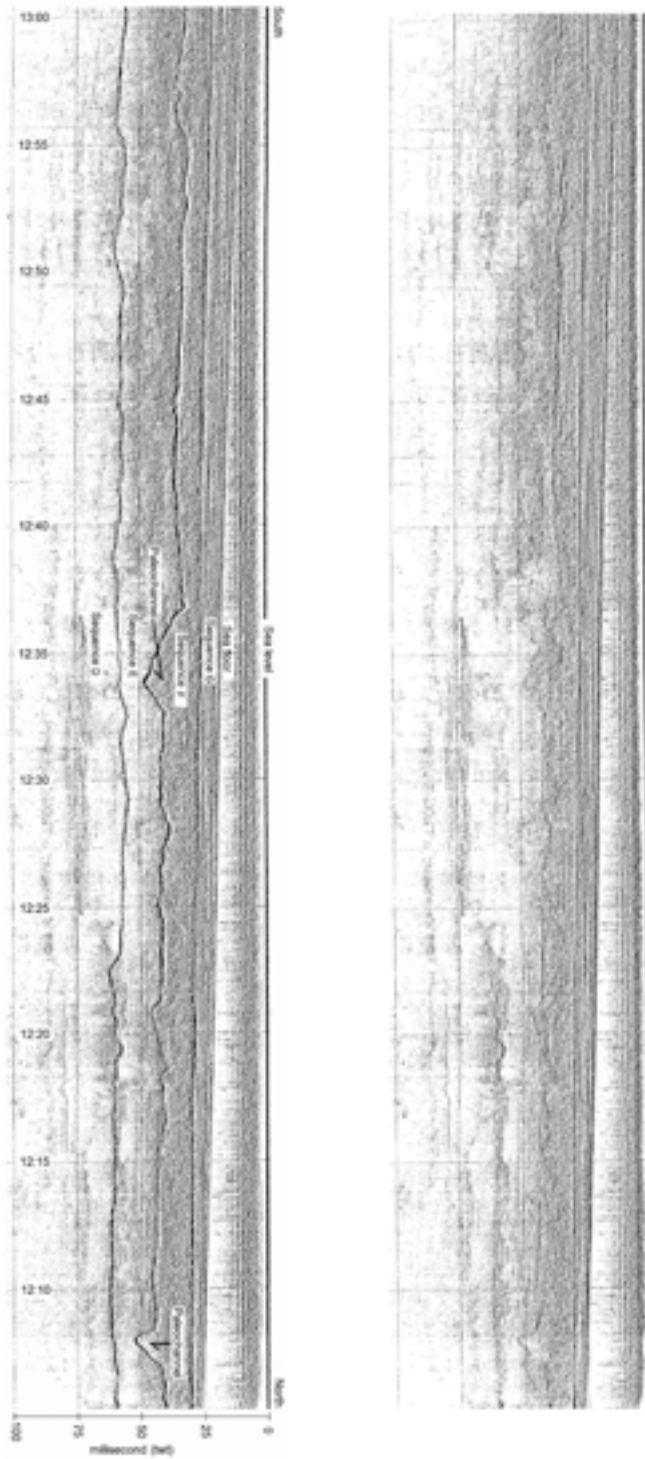


Figure 5. Seismic record and interpretation (Section 23).

CONCLUSION

From the megascopic description of sediment samples of drilling cores BH-01, BH-02, and BH-03, it could be conclude that those cores are similar in lithology, consist of clay. In the certain depth, there were sand lenses, fine sands, mollusk shells, rock and carbonate material, as shown in Figure 4.

Microfauna analyses of all three cores are as follow :

- From 0 to 25 meters deep, the sedimentation processes occurred during Plistocene to Holocene/Recent, from 25,00 meters to the bottom are Pleistocene which were deposited in the bay to Middle Neritic, the depth less than 100 meters.
- The record of seismic reflection in E sequence at the north and the west of investigated area showed paleo channels. Paleo channels in the north were predicted part of Lawas River or Tegur River, while the west paleo channels were predicted part of Rambatan Lama River.
- Based on the calculation of velocity of seismic refraction in sea water 1,500 meters/second, while within sediment 1,600 meters per second, it could be concluded that the paleo chanelns were more or less in 32 meters deep.
- When seismic data records are compared with core samples from drilling result, whereas in the depth of 32 meters consist of Pleistocene sediment, it means in Pleistocene in Cimanuk Delta occurred transgression which was followed by sedimentation. In the seismic data records the sediment is represented by sequence F and G. Contact between E and F is unconformity, in the stratigraphical seismic known as erosional truncation, while contact between F and G is downlap.

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