The Study of Seafloor Tin Placer Resources of Quaternary Sediment at Toboali Waters, South Bangka

Studi Sumberdaya Timah Dasar Laut pada Sedimen Kuarter di Perairan Toboali, Bangka Selatan

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ABSTRACT: Bangka Island has primary and secondary tin deposit. However, along the history of tin mining has been done the primary tin deposit domination is less than secondary tin deposit. Secondary tin deposit is formed from Granitic S-type source rock weathering and then transported by gravity. After that, Cassiterite mineral (SnO_2) accumulates and forms a placer deposit in the study area. The thickness of sediment cover at Toboali Waters is quite diverse, with a range between 5-20 milliseconds, by knowing the quarter sediment thickness using seismic data interpretation results, is expected to give an idea about tin placer deposit potential in Toboali waters. Based on the Isochron map shows patterns of quaternary sediment thickening to the southwest, south and southeast of Bangka Island.

Keywords: *Quaternary sediment, placer deposit, isochron map, Toboali Waters*

ABSTRAK: *Pulau Bangka memiliki endapan timah primer dan endapan timah sekunder. Namun, sepanjang sejarah penambangan timah yang telah dilakukan endapan timah primer tidak mendominasi jika dibandingkan dengan endapan timah sekunder. Pembentukan endapan timah sekunder berawal dari pelapukan batuan Granit tipe-S yang kemudian mengalami transportasi akibat adanya gravitasi. Setelah itu, mineral kasiterit (SnO_2) terakumulasi dan membentuk endapan plaser di daerah penelitian. Ketebalan sedimen penutup di Perairan Toboali berkisar antara 5-20 milidetik, dengan mengetahui ketebalan sedimen kuarter berdasarkan interpretasi data hasil rekaman seismik diharapkan dapat memberikan gambaran tentang potensi endapan timah placer di Perairan Toboali. Berdasarkan atas peta isokron, memperlihatkan bahwa pola penebalan sedimen kuater ke arah baratdaya, selatan dan tenggara Pulau Bangka.*

Kata kunci : *Sedimen kuarter, endapan placer, peta isokron, Perairan Toboali*

INTRODUCTION

Bangka and Belitung Islands are known as the largest tin resources in Indonesia. Generally the islands arepassing through by tin belt stretching along 3000 kilometers from the South Mainland China to Bangka-Belitung (Aryanto, N.C.D., 2014). Bangka Island is partly made up of alluvial deposits which has the depositional pattern following recent river channel or paleochannel, constantly toward offshore pattern which indicates the direction of dispersion of deposits primer transport through the water as media, forming alluvial land constantly toward offshore (Suprapto, 2008).

Recently, the reserves of tin in Bangka-Belitung is decreasing. However, it needs a new tin reserves to maintain continuity of tin mining commodity. One of many efforts in increasing resource of tin deposit is by looking into the possibility of potential tin deposits through Quaternary sediment thickness in Toboali Waters, Bangka. By knowing the pattern of Quaternary sediment thickness, it is expected to assist in developing the potential of tin resources of study area.

Study area is located around the South China waters, belong to Toboali District, Bangka Belitung. In the western and southern parts, the study area is bordered by Bangka Strait, whereas the north by Air Gegas District and Central Bangka Regency. Furthermore, the eastern part is bordered by Lepar Island and Lepar Sea (Figure 1).

Regional geology of Bangka Island of the eastern (eastern range) and primary (main range) provinces granitoid who also composed of the same rocks on the Malay Peninsula and Sumatra. Granite Triassic age is associated with the IndoChina tin formation that stretches from the Thailand-Malaysia Gulf -the Riau Islands and Bangka-Belitung to West Kalimantan (Figure 2).

Figure 1. Map of study area and administrative boundaries (Aryanto, NCD., 2015)

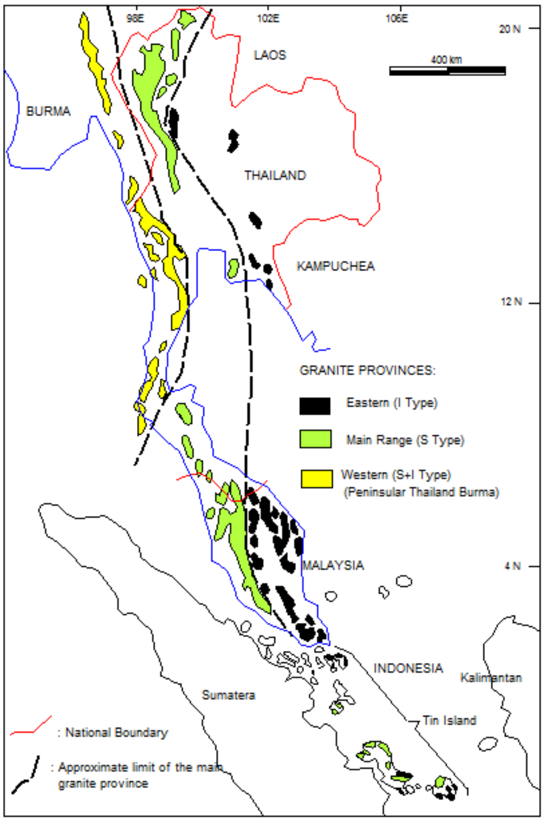

Figure 2. Granite province distribution on Southeast Tin Belt (Cobbing, et al., 1986)

According to Mitchell (1977), it was involving a collision between the two arc systems that occurs in the Triassic era, led to the expansion of areas on Sundaland and granite formation containing tin in Malaysia, Bangka and Belitung. The oldest rocks in this area is metamorphic rock of Pemali Complex (CPP) of Paleo-Perm age consist of phyllite, quartzite and schist which is intercalated by limestone lenses. On the other hand, a younger age rock of Penyabung Diabase (Permo-Triassic, PTrd) from Pemali complex consist of diabase rocks which intruded Pemali Complex; which was later this diabase is intruded by Klabat Granite (TrJkg). At the early Triassic, along with Penyabung Diabase Formation formed Tanjunggenting Formation (Trt) which consists of metamorphized sandstone, sandstone, clayey sandstone and claystone with limestone lenses interbedded; are widespread covering almost all parts of Bangka Island. At the late Triassic - Middle Jurassic, magma activities forming Klabat Granite (TrJkg) which intruded all previous lithologies. In the Pliocene Formations deposited Ranggam (Tqr) consisting of sandstone and claystone, while at the Quaternary (Holocene epoch) formed alluvial deposits (Margono et al, 1995; Figure 3).

Tin deposit

According to Schwartz (1995) placer tin deposit in Southeast Asia Tin Belt derived from primary tin mineralization. The oldest terrestrial sediments were deposited on the spacious basement. The age of this rock is Miocene-Early Pliocene to Pleistocene. These sediments, have a total thickness up to 60 meters which is covered by 25 meters alluvial or youngest marine sediments.

Tin deposit was resulted from previous host rock chemical weathering, resulting in ores concentration of tin. The tin ores was deposited in streams along the paleochannel (Padmawidjaja, 2013). Bangka Island consists of three (3) categories of sediment placer tin namely: the concentration of residual eluvial on the slopes of the river and valley (skin), placer para-alochton (kaksa) which directly covers the host rock mineralized and alluvial alochton (mincan) which forms a layer in sediments filling the valleys. The first and second deposit directly related to the primary

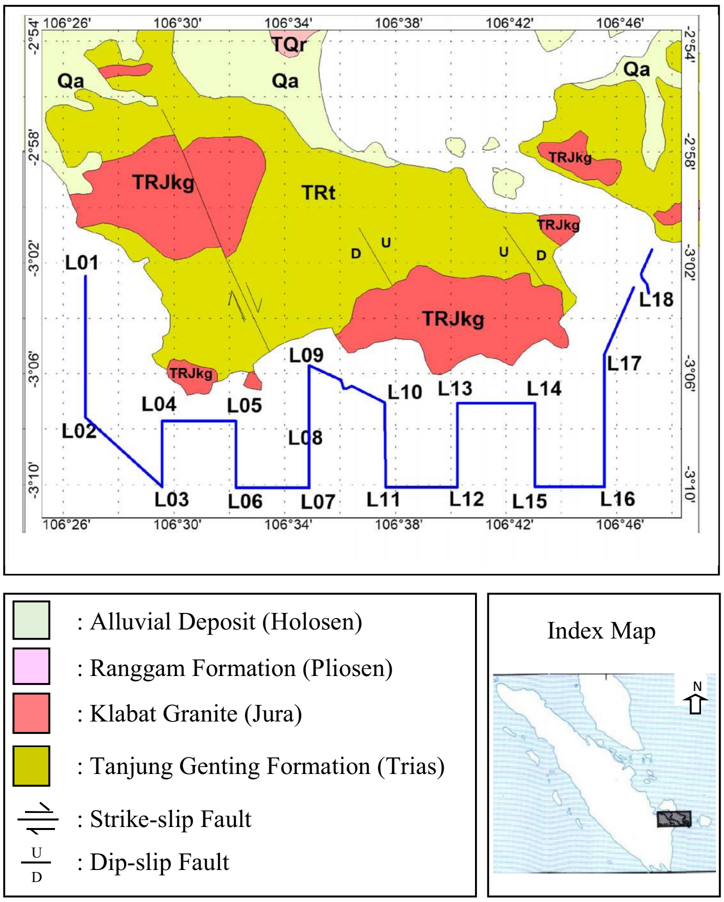

Figure 3. Geology Regional Map of South Bangka Island (Margono et al, 1995) and Track Seismic Lines in Study Area

mineralization associated with granite intrusion, while the third category is the result of weathering of host rock and primary mineralization (Herman, 2005).

Subsurface mapping

To identify quaternary sediment in the study area, subsurface mapping is required. Subsurface mapping use seismic data recording to obtain condition of the subsurface geology. According to Vail (1977) seismic reflections follow the pattern of chronostratigraphy correlation (time-stratigraphic) which could be compared to the time-transgressive lithostratigraphy unit (stratigraphic-lithological). In other words, seismic reflectors in most cases is a time line function. According to Veeken (2007), one of the basic concepts of seismic reflections sedimentary stratigraphy were observations that could be considered as timeline. More precisely, sedimentary reflections represent a short time interval during sedimentation conditions that persisted. In geological terms each reflector coincides with a shorter time period similar to the deposition conditions.

METHODS

This study was conducted by using Boomer intended to obtain the depth of igneous or metasediment rocks other than the youngest layer thickness, where heavy minerals deposited in this part. This method is a dynamic and continuously method by utilizing the reflected acoustic waves reflected by seafloor and sub-seafloor layers due to the difference in density at the boundary between the layers of sediment.

Single channel shallow seismic reflection was used to interpret the reflector pattern. The seismic records were interpreted through horizon drawings to determine the boundaries of the quaternary sediments in the study area. The upper boundary can be interpreted as the top quaternary sediment in study area, while the lower boundary can be occurred between bottom quaternary sediments and basement. The seismic interpretation results show the thickness of sediment in unit of time (isochron). The drawing of seismic horizon was based on the criteria proposed by Ringis (1986). The assumption wave velocity has proposed that all horizons of seismic is 1,500 meters / seconds.

RESULTS AND ANALYSIS

Eighteen seismic lines had been carried out in the southern part of Bangka Island with total length about 110 kilo meters. In order to generate data that represents the geological conditions around Toboali Waters, the study was conducted by seismic lines trending north-south, east-west and partly trending northwest-southeast and northeast-southwest. According to the sediment quaternary map, the entire data seismic interpretation was performed by the withdrawal of two horizons at the boundary reflections that indicate the boundary of sediment quarter itself. Based on the results of seismic interpretation the upper boundary as seabed in the study area and the lower boundary is the boundary between the sediment quaternary with basement. The direction of seismic line was corresponds with geological subsurface condition.

The thickness of sediment at Toboali Waters is quite diverse, with a range between 5-20 milliseconds. Based on the geographical position, the authors divide into three blocks. Block A (Southwest Waters of the Bangka Island) which is traversed by the line (L01-L05), in this block is represented by a line L02 visible indications of quaternary sediment deposited with a thickness ranging from 5-12.5 milliseconds. These sequences are bounded by on-lap unconformity, which is indicated by the presence of seismic reflection at the lower boundary is flatter than the sediments deposited on it (Figure 4). Block B (South Waters of the Bangka Island) is traversed by the line (L06-L14), in this block is represented by a line L06 visible indications of quaternary sediment deposited with a thickness ranging from 5-17.5 milliseconds. These sequences are bounded by on-lap unconformity, which is indicated by the presence of seismic reflection at the lower boundary is flatter than the sediments deposited on it (Figure 5).

Block C (Southeast Waters of the Bangka Island) traversed by the line (L15-L18), in this block is represented by a line L15 visible indications of quaternary sediment deposited with a thickness ranging from 5-17.5 milliseconds. These sequences are bounded by the reflector chaotic patterns on the bottom, it was allegedly that the rocks beneath it is already a basement and is estimated to have different characteristics (Figure 6).

The results of seismic interpretation of the entire line processed into isochron map (map of sediment thickness in time). Isochron map indicate patterns of quaternary sediment thickening to the southwest, south and southeast of Bangka Island.

DISCUSSIONS

The quaternary sediment thickness map in Toboali Waters, which was resulted from seismic stratigraphy analyses, shows several points of paleochannel which is formed at some period of shrinkage of the sea at late Pleistocene. The filled sediment is assumed as a result of weathering of granitoid rocks that containing mineral cassiterite (SnO_2). The results of seismic interpretation from the entire line then processed into isochron map.

On the isochron map, three blocks are recognized based on their geographic position. Block A (Southwest Waters of the Bangka Island) has thin sediment thickness and relatively not equally varied with different contours that are not too significant. In this

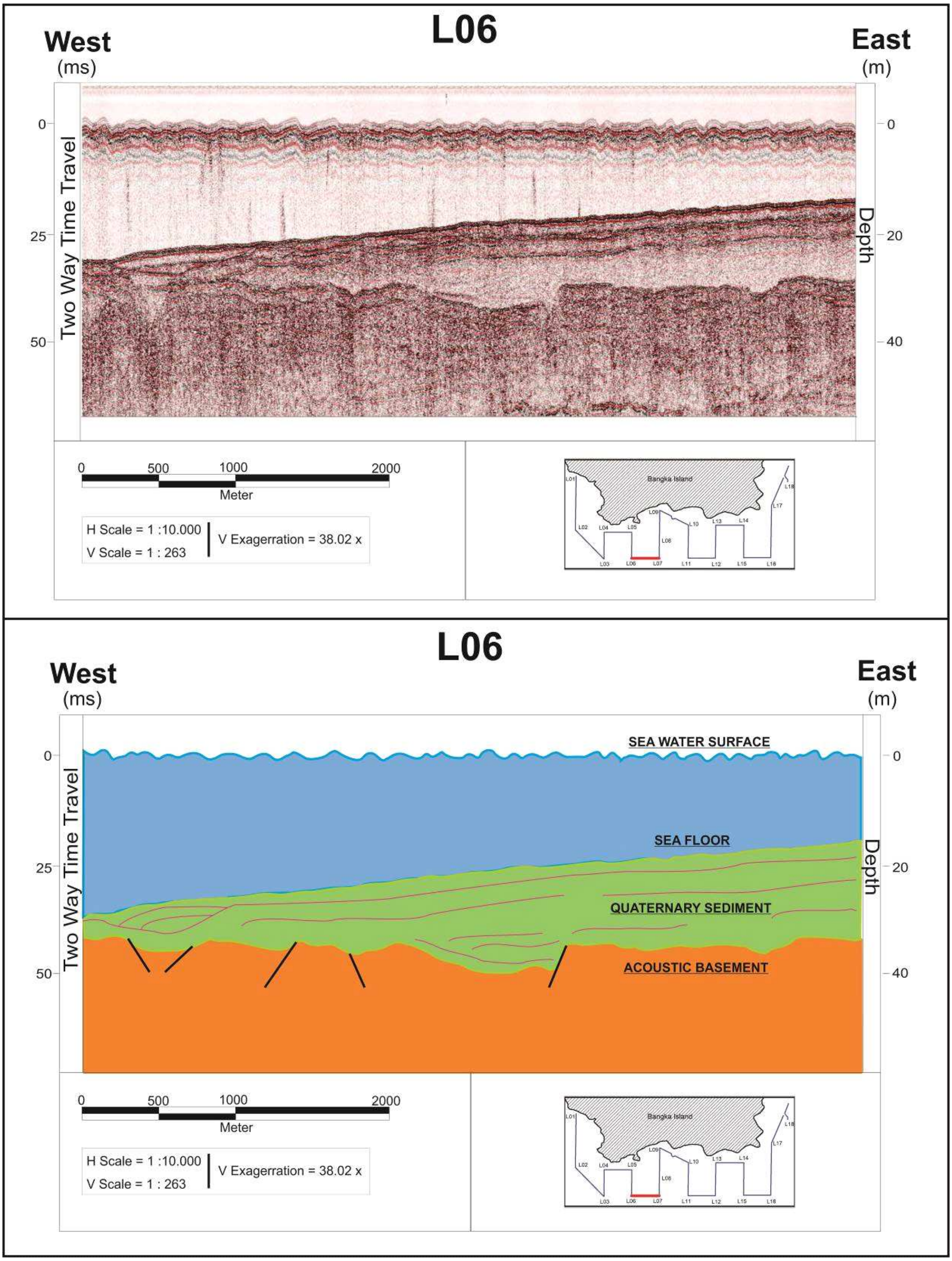

Figure 4. L02 Seismic Profile

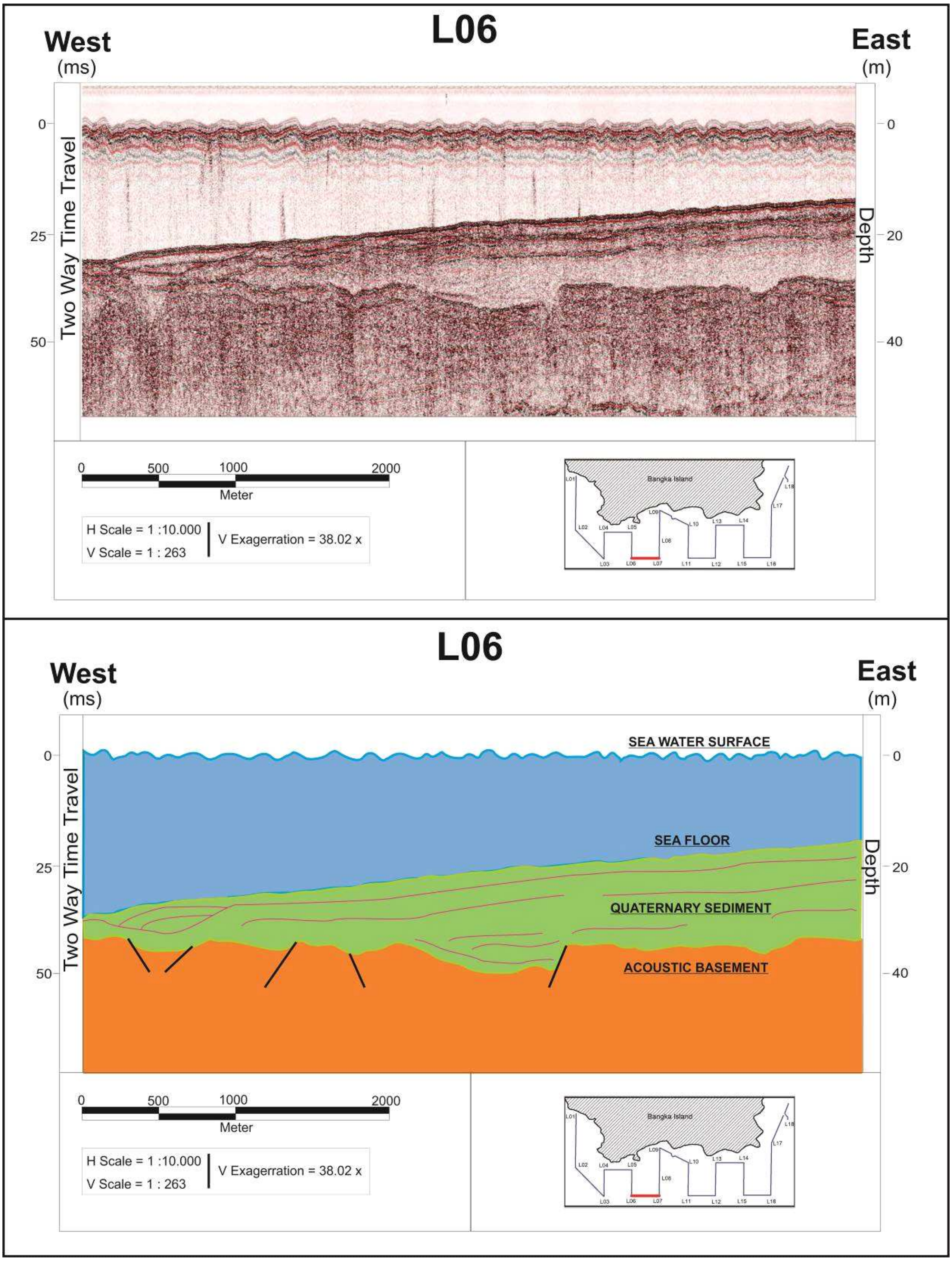

Figure 5. L06 Seismic Profile

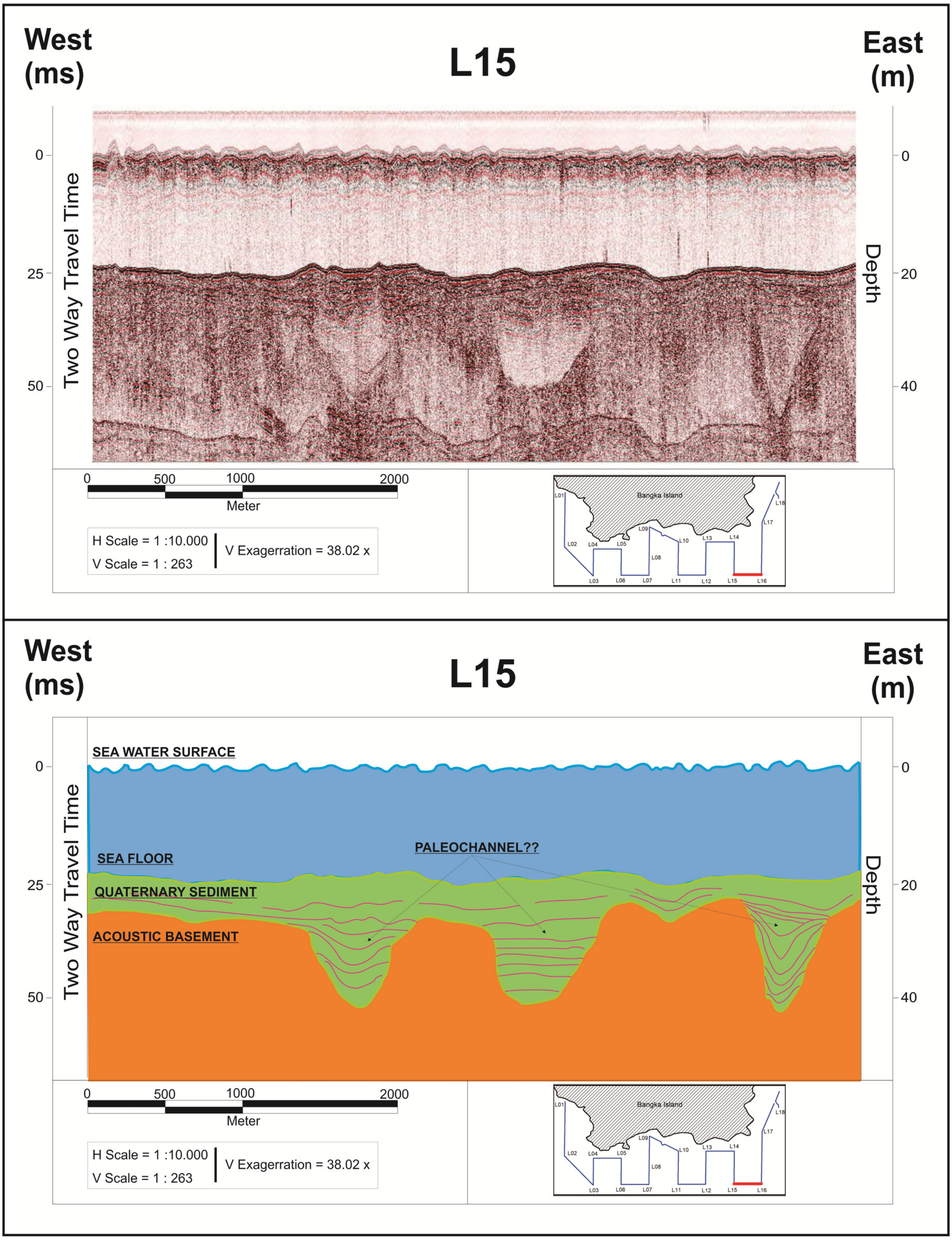

Figure 6. L15 Seismic Profile

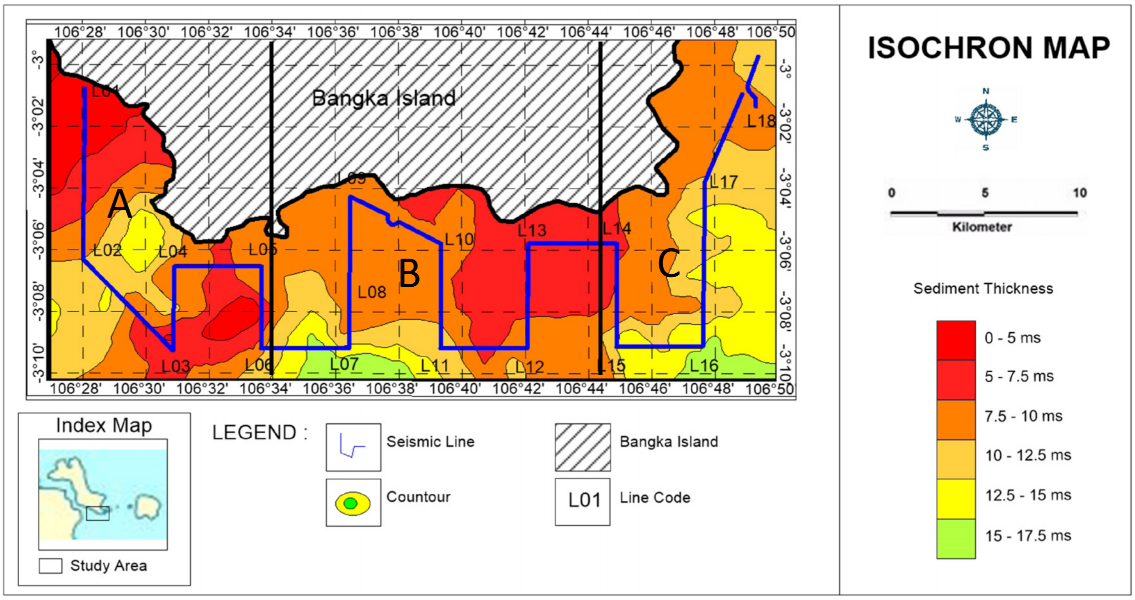

Figure 7. Isochron Map

case it is estimated that deposition process in block A is relatively stable at the current pace quiet, but on the L02 (figure 4) shows that the sediment quarter in study area have thickening. This is due to increasing of accumulation sediment from the land into area around the Cape Langgan to offshore. While in the east of line L02 thinning sediments suspected because of the granitoid outcrops are constantly up towards the beach. In addition it is estimated that the influence of the strong current so that the sediment is exposed to erosion.

In block B (South Waters of the Bangka Island) there is a sediment thickness is quite varied, resulting in a steep contour shape. On the L06 (figure 5) can be seen that their abundant supply of sediment, causing thickening of the sediments in the south. Block C (Southeast Waters of Bangka Island) has a thick sediment. On the L15 (figure 6) shown that the deepening of acoustic basement which showed some paleochannel. This paleochannel has thick sediment supply. More studies need to drill in order to obtain accurate data on reserves of tin contained. So it can be known with certainty about the potential of tin reserves in the study area.

CONCLUSION

Quaternary sediments of the study area depicted on the isochron map has thickness of up to 17.5 meters, which allows there are some heavy mineral deposits that have potential of tin resources. For further study is required well data, that can be used to calculate measured volume of tin reserves in the study area.

The thickness of sedimentary cover is relatively thin at both promontory of the study area, Cape Baginda on the east side and Cape Langgan on the west side. It is suspected that the granitoid outcrops on its coast and offshore. Toward offshore, the thickness of the sedimentary cover thickened due to intensified sedimentation process derived from the major rivers in the southern part of mainland Sumatra in the west side.

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