Chapter 45
Geochronology of ^{210}Pb in Sediments of Sepang Besar River, Malaysia

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Abstract Geochronological studies to determine pattern and rate of sediment deposition is still lacking in Malaysia. The aim of this study is to investigate geochronological pattern of ^{210}Pb in core sediments of the Sepang Besar River. Sediment cores were collected from rivermouth, middle course and upper course of the river. Sediment cores were cut at 2 cm interval for each layer, treated with established method and analyzed by beta spectrometry. Results showed the activities of ^{210}Pb along Sepang Besar River varied at a wide range. Significantly lower ^{210}Pb activity was found at the rivermouth as compared to middle and upper courses of Sepang Besar River. This could be due to the geology of the watershed and chemical weathering conditions around the area.

Keywords Geochronology · ^{210}Pb · Core sediment · Beta spectrometry · Sepang Besar River

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Highlights

- Activities of ^{210}Pb along Sepang Besar River are widely varied.
- Lower ^{210}Pb activities at rivermouth; higher at inner course of Sepang Besar River.
- Watershed's geology and chemical weathering conditions affect the ^{210}Pb activities.

Introduction

The radionuclides dating using ^{210}Pb have been used for more than two decades to provide geochoronology of annually deposited sediment and to construct pollution histories (Benoit and Rozan 2001). Zulkifli et al. (2010a, b) has reported worlwide scientists concern on resuspension of bottom sediments (polluted layer) in recent years due to sediments dredging and coastal reclamations. The isotopes ^{210}Pb (T1/2 = 22.3 yrs) is a decay product of ^{222}Rn which escapes from the earth crust to the atmosphere. ^{210}Pb short residence on atmosphere, falls into lake or river and tends to bury and permanently fixed on sediment particles as solid fallout (Althammer et al. 2010). ^{210}Pb has been widely used as marine tracers of particles/water transport and particulate scavenging (Benoit and Rozan 2001). The usage of tracer such as ^{210}Pb allows tracing the history and sources of pollution on studied area (Gelen et al. 2003).

The area around Sepang Besar River has been fully utilized for agriculture, animal farming, residential, aquaculture, ecotourism and power plant activities. The pollutants from anthropogenic activities could be accumulated in the sediments (Zulkifli et al. 2010a, b). Ismail and Ramli (1997) reported this river received high anthropogenic input of heavy metals in 1990s originated from massive pig farming activities. However, the outbreak of Japanese encephalitis (JE) in 1998 has caused pig farming activities to be closed. In order to understand the heavy metals enrichment in the sediments, geochronology of sediment should be studied. Thus, the aim of this study to investigate geochronological pattern of ^{210}Pb in core sediments of the Sepang Besar River.

Materials and Methods

The Sepang Besar River is located at the state boundary of Selangor and Negeri Sembilan, Malaysia. The core sediments were collected from three locations along Sepang Besar River as shown in Fig. 45.1. The sediment core samples were collected by using the 1 m hand corer (6 cm inner diameter). The corer was hand-pushed into the bottom sediment, capped and retrieved. The core samples were

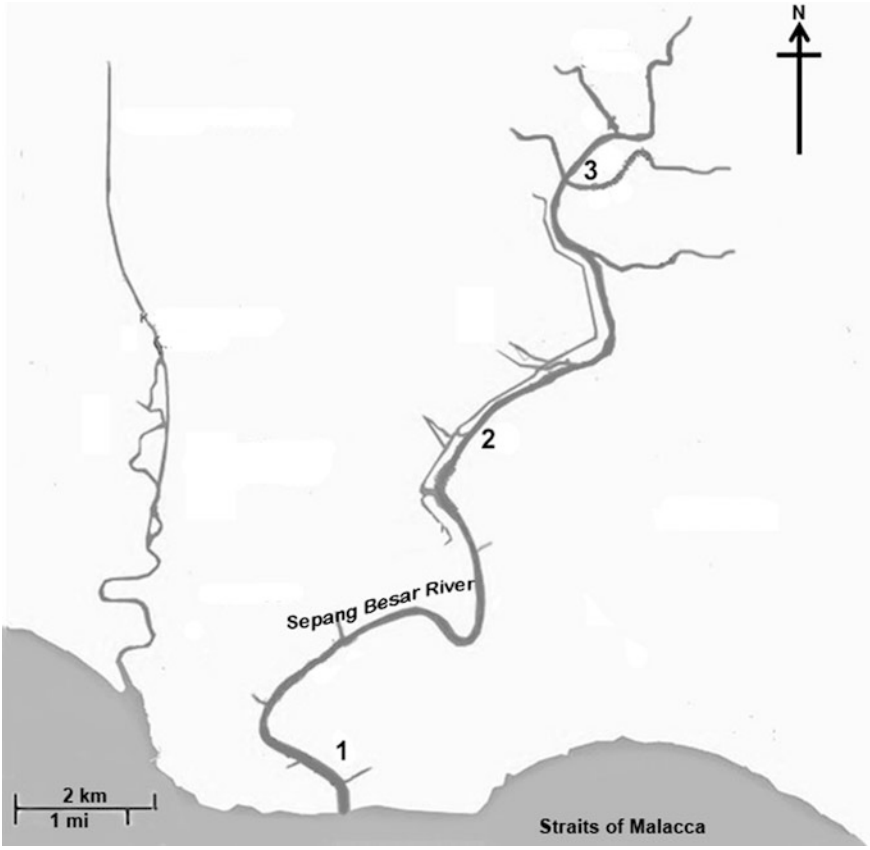

Fig. 45.1 Map of sampling locations along the Sepang Besar River, Malaysia

directly brought back to laboratory and stored in a freezer at −20 °C to prevent any chemical or biological reactions prior further analyses. Laboratory analysis started by thawing the core sediments. Each core was sliced into 2 cm intervals from surface to bottom of the core. All core sections were dried in an air-circulating oven at 60 °C to a constant weight and homogenized through a 250 μm mesh size sieve for analysis ^{210}Pb radionuclide dating. The digestion of sediment for radionuclide purposes was modified from Theng and Mohamed (2005). In general, about 5 g of homogenized core sediment sample was taken and spiked with 1.0 mL of $PbNO_3$ (20 mg/mL) and 1.0 mL of $FeCl_3$ (19.8 mg/mL). In the laboratory, samples were digested with a hot plate for 3 h. Then, the samples were filtered through membrane filter paper (0.45 μm pore size, 47 mm diameter) with a flow rate less than 10 $mL.min^{-1}$. The filtreate was acidified with 65 % concentrated HNO_3 till pH < 2 and spiked with iron carrier solution. The samples were centrifuge for 3 min at 4000 rpm. After that, the solution pH was increased to pH 10. The precipitate was filtered and redissolved in 1.0 M HNO_3. The ^{210}Pb was deposited on a platinum bucket and redissolved with concentrated H_2SO_4 before filter with 0.45 μm filter paper. The precipitation of ^{210}Pb effluence was counted with beta (β) spectrometry to determine the activity of ^{210}Pb.

Results and Discussion

Three sampling locations have been selected, representing the behavior of the sediment. The activities of dissolved and particulate ^{210}Pb from three stations of Sepang Besar River were measured and corrected for the recovery. The sampling location, sample intervals and ^{210}Pb activity concentration are shown in Table 45.1. Based on the data shown in Table 45.1, the activities of ^{210}Pb in Sepang Besar River estuary showed a wide variation and this was probably due to the geology of the watershed and chemical weathering conditions. In Station 1, the ^{210}Pb activity concentration was varied between 6.16 ± 1.68 Bq/kg and 24.52 ± 7.64 Bq/kg. In Station 2, the ^{210}Pb activity concentration was varied between 171.14 ± 111.90 Bq/kg to 595.19 ± 159.75 Bq/kg, whereas the ^{210}Pb activity in Station 3 was between 185.56 ± 49.01 Bq/kg to 883.15 ± 303.55 Bq/kg. The activity of ^{210}Pb was lower in Station 1 as it faces the river mouth of the river. The ^{210}Pb activity in Station 1 was influenced by strong tides activities that occur daily as compared to ^{210}Pb activity concentration in Station 2 and Station 3.

In Station 1, the ^{210}Pb activites were higher on the surface layer (0–2 and 2–4 cm depth) of the core sediment. Based on personal observation, the sediment in this area was free from sheltered mangrove forest as compared to sediment collected from Station 2 and Station 3. The core sediment in Station1 received the highest amount was probably due to supply of deposition at atmospheric ^{210}Pb

Table 45.1 Activities of ^{210}Pb (Bq/kg) in the sediment cores of Sepang Besar River

Depth (cm)	Station 1	Station 2	Station 3
0–2	24.49 ± 6.82	179.89 ± 47.87	271.10 ± 71.03
2–4	24.52 ± 7.64	426.74 ± 111.90	303.39 ± 79.49
4–6	15.30 ± 4.62	171.14 ± 44.78	187.91 ± 50.68
6–8	15.59 ± 4.46	2541.12 ± 696.35	864.06 ± 236.29
8–10	18.81 ± 5.57	545.35 ± 144.94	185.56 ± 49.01
10–12	9.67 ± 2.61	541.85 ± 142.42	187.08 ± 49.79
12–14	14.41 ± 4.33	195.75 ± 51.90	813.25 ± 231.18
14–16	6.70 ± 1.81	553.04 ± 146.39	566.12 ± 152.09
16–18	6.16 ± 1.68	288.39 ± 76.77	524.15 ± 137.72
18–20	9.38 ± 2.64	551.08 ± 145.63	531.81 ± 165.65
20–22	8.09 ± 2.27	482.62 ± 131.41	479.95 ± 143.08
22–24	13.07 ± 3.84	515.85 ± 137.51	883.15 ± 303.55
24–26	n.a.	595.19 ± 159.75	563.59 ± 170.31
26–28	n.a.	528.04 ± 143.25	n.a.
28–30	n.a.	523.46 ± 145.80	n.a.

Remark: n.a. refers to not available

originated from the decay of ^{222}Rn (Yang and Lin 1992). Flying ashes from combustion of coals at the nearby power plant could potentially deposited into the sediment. The ^{210}Pb activities in both surface layer (0–2 and 2–4 cm depth) of Station 2 and Station 3 were higher than in Station 1 but based on ^{210}Pb count activities, it shows that ^{210}Pb activities were lowest among the same station. The core sediment collected in this area was covered with sheltered mangrove plants, so the tendency of ^{210}Pb particulate escape to the atmosphere to sink on sediment was low. The high ^{210}Pb activities reported in this study was probably due to supply of ^{210}Pb as these stations were in vicinity to the agricultural lands. The main agricultural activity that occurs in this area was oil palm plantation. Besides that, this area also received both domestic and industrial waste from nearby residential areas as the wastes released into this river. The ^{210}Pb activities reported in this study was same as a study reported by Theng and Mohamed (2005) in Kuala Selangor estuarine.

Conclusion

Inner course of Sepang Besar River has higher ^{210}Pb activities than rivermouth due to tidal actions. Further investigations are needed in order to related with deposition of pollutants.

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