[ENV05] The determination of ^{230}Th in the sediments: Sedimentation in Matang Mangrove Forest, Taiping, Perak

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Introduction

Mangrove forests are a buffer zone between the coast and the ocean. One of the important functions is to provide a mechanism for trapping sediment. Suspended sediment is introduced to coastal areas by river discharge, dumping of dredged material and resuspension of bottom sediment by waves and ships (Wolanski, 1994). However, the sedimentary processes on Malaysian mangroves are not well documented.

The measurement of ^{230}Th concentrations in deep sea sediments provides one method of developing accumulation histories. ^{230}Th is formed at a constant rate in the water column from the decay of ^{238}U and is rapidly scavenged and incorporated into the underlying sediments. ^{230}Th is a valuable tracer of the processes whereby reactive elements are scavenged from seawater and produced at a constant rate throughout the oceans. This led to hydrolyzed of ^{230}Th and subsequently removed to sediments on a time scale of a few decades in the deep ocean and weeks to months in surface water, transported to some depositional sink. Th excess has been widely used to date sediment horizons and estimate average accumulation rates (Scholten *et al*., 1990). The ^{230}Th half-life of 75200 years gives sensitivity up to 300000 year timescale. Hence this makes it ideal for reconstruction of the depositional history during the Late Quaternary climates cycles.

Material and Methods

Sampling

Two 100cm sediment cores were collected with a D-section corer at the Matang Mangroves Forests, Taiping, Perak (Figure 1). The cores were cut into segments approximately 5 cm interval, labeled, dried and stored until the analysis.

Analytical Method

The digestion of the sediment samples and analyses of Th were carried out using the published methods with some modifications (Noriki *et al*., 1980; Gupta and Bertrand, 1995; Yunus, 1999).

The digestions method involved heating of 50 mg of the finely powdered sample in a sealed Teflon vessel with a mixed acid solution of concentrated HF, HNO_3 and HCl. The Teflon vessels were put into an oven at 150°C for 5 hours. After cooling, a mixed solution of boric acid and EDTA was added and the vessels were then heated again at 150°C for another 5 hours. The content of the vessels were transferred into a 10 ml polypropylene test tube and was diluted to 10 ml with double distilled water. A clear solution with no residue should be obtained at this stage. A laboratory standard material of the deep sea sediment, HA, was also subjected to the same procedure. The relative 1 σ values of replicate determinations of a sample were less than 3%.

Analytical method of ^{230}Th for the determination of sedimentation rate was carried out according to the published method (McCabe *et al.,* 1979; Tsunagai and Yamada, 1979; Harada and Tsunogai, 1985; Yunus, 1999) with some modifications. 1 to 2 g of dry sediments were digested with a mixed acid solution of concentrated HF, HNO_3 and HCl. The solution containing Th was heated to make the solution clear before being treated with cation exchange resins for the separation and purification. The effluent containing Th was then heated to dryness and dissolved in 5% HNO_3. The concentrations of ^{230}Th and ^{232}Th were then measured with ICP-MS.

Results and discussions

In this study, $^{230}Th_{excess}$ method was applied to the samples to determine the sedimentation rates (Mangini and Stoffers, 1990). The amounts of $^{230}Th_{excess}$ were calculated using following equation:

$$\mathbf{^{230}Th_{excess} = {}^{230}Th_{total} - (0.8 \times {}^{232}Th_{total}) - {}^{234}U(1 - \exp\{-\lambda_{230}t)}$$

where ^{230}Th total and ^{232}Th total are the measured concentrations of ^{230}Th and ^{232}Th, respectively and ^{234}U and λ^{230} are the concentrations of ^{234}U of which radioactivity is assumed toe be 1.1 times the ^{238}U concentration and the decay constant of ^{230}Th (9.24×10^{-6} yr), respectively.

The sedimentation rates can be calculated from the following equations:

$$\textbf{Sedimetation rate, } \mathbf{S = \lambda^{230} / b}$$

Where b is a gradient of the best fit curve in the plot of logarithmic concentrations of $^{230}Th_{excess}$ alone and the $^{230}Th_{excess}$ / ^{232}Th ratio.

As shown in figure 2 and Figure 3, the finally obtained sedimentation rate in the study areas are 0.71 cm/yr and 0.68 cm/yr. According to the results, we can determine the age of the Matang Mangrove Forests around 126 years to 134 years.

The sedimentation rates of these areas are considered high if compared to those that were at the East Coast of Peninsular Malaysia. For examples, the sedimentation rate of Nenasi mangrove forest, Pahang (Clarence, 2002) was 0.52 cm/yr and 0.53 cm/yr and the sedimentation rate at Kemaman mangroves forests, Terengganu by Marcel, 2000 was only at 0.65 cm/yr and 0.66 cm/yr. The same method of analysis is the same.

The high sedimentation rate of the Matang mangroves forest shows that these areas are in a constant sedimentation. This might be the location of the project that was situated at the West Coast of Peninsular Malaysia. The Matang mangrove forest is situated near the Straits of Malacca. The Straits of Malacca is situated in between Sumatra and West Peninsular Malaysia. This area is 65000km^2 and with 800 km long. However, the width of the straits is only 65 km. Therefore, the Strait of Malacca is the narrowest and longest straits in the world. Because of its unique location, there's two tidal occur in a day where it encourages the sedimentation processes. Besides that, the project location is situated near the estuary, which provides it with 2 sediment sources, fluvial and tidal (Kamaruzzaman *et al.,* 2000). In addition to these, the roots of *Rhizophora Sp.* are knows as efficient sediment trappers. Therefore, this also contributes to the high sedimentation rates in the Matang mangrove.

Conclusions

The estuarine mangrove at Matang Mangroves forests is an unique mangroves forests as compare to other mangrove forest in Peninsular Malaysia. This is because of its location at the Straits of Malacca and also in an estuary. Therefore, the sedimentation rate of this area is higher as compare to other mangroves. However, the sedimentation rates can be obtained by calculating a best fit exponential regression line based on $^{230}Th_{excess}$ versus depth file profiles. The variations in $^{230}Th_{excess}$ activities are caused by climatically-induced changes in the sedimentation rates.

The sedimentation rates of 0.71 cm/yr and 0.68 cm/yr shows a relatively high values that indicate this mangrove may still be prograding and in an immature stage. This finding suggests that the mangrove forests are not just passive colonizers of mud banks but actively capture mud to create their own environments. Therefore, we can conclude that mangroves are an important sink for fine sediment from rivers and coastal waters.

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