SEDIMENTATION RATE AT SETIU LAGOON USING NATURAL RADIOTRACER ^{210}Pb TECHNIQUE

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For the nation

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ABSTRACT

This study was conducted to determine the sedimentation rate of soil at Setiu Lagoon by using natural radiotracer ^{210}Pb. The area covers a 10 km length lagoon involving 5 sampling stations of approximately 2 km apart. The sediment samples were collected using a corer box comprising of a meter long transparent PVC plastic pipe inserted manually into the sediment bed 2 m below the water surface. The sediment core extracted were then cut into several 5 cm interval, labeled and stored in a close beaker. A total of 24 samples were collected from the 5 sampling stations. The measurement of ^{210}Pb activity was made using Hyper Purity Germanium (HPGe). The total activity of ^{210}Pb was measured from gamma ray peak of energy 46.5 keV and supported ^{210}Pb by the weighted average decay of ^{226}Ra daughters at 295, 351 and 609 keV. Unsupported ^{210}Pb was calculated as the difference between the total and the supported ^{210}Pb activity. Two models were used in this study to calculate the sedimentation rate; the Constant Initial Concentration (CIC) and Advection-Diffusion Equation (ADE) model. The results show that, there are differences in sedimentation rate values of each model for each station. The sedimentation rates obtained using CIC model varies from 0.08 to 0.37 cm/yr whereas ADE model varies from 0.43 to 0.93 cm/yr.

ABSTRAK

Kajian ini dijalankan untuk menentukan kadar pemendapan tanah di Setiu Lagun menggunakan radionuklid ^{210}Pb semulajadi. Kawasan ini meliputi 10 km panjang lagun yang melibatkan 5 stesen persampelan yang jarak antara satu sama lain adalah dianggarkan 2 km. Sampel sedimen telah diambil dengan menggunakan *corer box* yang terdiri daripada paip PVC plastik lutsinar sepanjang satu meter yang telah yang dimasukkan ke dalam sedimen yang jaraknya 2 m di bawah permukaan air. Teras sedimen yang diekstrak kemudian dipotong 5 cm, dilabel dan disimpan dalam sebuah bikar ditutp rapat. Sebanyak 24 sampel diperolehi dari 5 stesen persampelan. Ukuran aktiviti ^{210}Pb telah dibuat dengan menggunakan alat pengesan Germanium Hiper Tulen (HPGe). Jumlah keaktifan ^{210}Pb ditentukan dengan mengukur aras tenaga gamma 46.5 keV dan keaktifan ^{210}Pb lebihan yang turun dari udara boleh diukur pada aras tenaga 295, 351 dan 609 keV. Perbezaan jumlah keaktifan antara ^{210}Pb keseluruhan dan ^{210}Pb lebihan yang turun dari udara akan memberikan nilai sebenar keaktifan ^{210}Pb yang terhasil dalam tanah. Terdapat dua model yang telah digunakan dalam kajian ini, iaitu *Constant Initial Concentration* (CIC), dan *Advection-Diffusion Equation (ADE)*. Hasil kajian menunjukkan bahawa terdapat perbezaan dalam kadar pemendapan di setiap stesen bagi setiap jenis model. Nilai yang diperolehi bagi CIC berubah dari 0.08 ke 0.37 cm / thn dan ADE berbeza dari 0.43 kepada 0.93 cm / thn.

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CHAPTER 1

INTRODUCTION

1.1 Background Study

In tracing the history of the effect of mankind on the environment, it is evident that in many places, the period of the greatest impact has been within the last 150 years. Lake, ocean and lagoon can provide a basis for reconstructing the many aspects of this impact such as, for estimating rate of change, and for establishing a baseline in environmental monitoring program (Walling and He, 1993).

The establishment of accurate chronologies of sedimentation rates based on palynological or stratigraphy methods often provides only historical averages involving many meters of sediment. Furthermore, such measurements not only lack the necessary accuracy and details but may not adequately reflects the rates within the upper 20 cm or so of the sediment where significant sediment-water exchanges are occurring at the present time (Robbin and Edgington, 1975).

Nowadays, natural radionuclides have become powerful tracer that can provide basic insights into a variety of marine processes, such as processes in the water column and in biological and sedimentary system. Radioisotope ^{210}Pb (half-life 22.2 years) for instance has become the important tool for determining accumulation rates in sediments on about 100-year time scale. Shorter-lived natural radioisotopes such as ^{234}Th and ^{7}Be (half-life of 24 and 53 days) have proved useful in determining deposition and mixing rates on time scales of a few month (Dibb and Rice, 1989). Similarly the basis of using ^{137}Cs to derive chronologies for sediments during the past 30-40 years is based on the fact that weapon released atmospheric radio-cesium is washed away by precipitation and is rapidly and strongly bound to fine particulates of the land surface. Through run-off it gets washed away from land surface and settles on the lake or ocean bottom.

Since then, application of radiometric methods to sedimentary geochronology has enjoyed considerable success (Durham and Joshi, 1980). Krishnawami (1971) evaluated the use of ^{210}Pb as well as three other radionuclides (^{32}Si, ^{55}Fe, ^{137} Cs) for dating recent freshwater lake sediments and concluded that ^{210}Pb is ideal for dating lake sediments as old as a century. Subsequently, Koide (1972) further validated the utility of the method and determined sedimentation rates in a series of lakes. Edgington (1991) used the anthropogenic ^{137}Cs and natural radionuclide ^{210}Pb to estimate the recent sedimentation rates in Lake Baikal. Their results were used for the development of mass-balance models for sediments and contaminants.

1.2 Research Problem

Most studies on sedimentation rate such as Maria (2009) used ^{210}Po, an alpha emitter as proxy to ^{210}Pb radiotracer. This is due to the gamma decay energy that was released by ^{210}Pb (46.5 keV) lies in the low energy region. With high background, the detection of ^{210}Pb will be difficult. This study is to prove that ^{210}Pb can be use in studying sedimentation rate process without using ^{210}Po as proxy.

1.3 Objectives

The objectives of this research are;

1.3.1 To determine the efficiency of Hyper Purity Germanium (HPGe) for low energy gamma of less than 100 keV.

1.3.2 To determine the total activity of ^{210}Pb in sediment samples based on the 46.5 keV gamma energy.

1.3.3 To determine the supported ^{210}Pb activity based on the average of 295.2 keV (^{214}Pb), 351.6 keV (^{214}Pb) and 609.3 keV (^{214}Bi) gamma energies.

1.3.4 To estimate sedimentation rate at Setiu Lagoon, Terengganu by using two different mathematical models; Constant Initial Concentration (CIC) and Advection-Diffusion Equation (ADE) model.

1.4 Research Scope

This study will cover 22 km long of Setiu Lagoon, Terengganu (Setiu Mangroves forest) which is located on the East Coast of Peninsular Malaysia.

This study is based on the use of natural ^{210}Pb radioisotope gamma ray of 46.5 keV. Two mathematical models, Constant Initial Concentration (CIC) Advection-Diffusion Equation (ADE) will be used in this study.

1.5 Significance

This study will help in profiling the sedimentation process within the last 20 years. Apart from that, it can trace back the history of humankind. This method is more accurate, easy and time saving.

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