

Preliminary Evaluation of Sedimentation Rates in Philippine Mangrove Forests Using ^{210}Pb Dating Technique

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Abstract

Three 100-cm sediment cores from mangrove forests in Pangasinan, Zambales and Subic, Philippines were collected for the analysis of sedimentation rate using ^{210}Pb . ^{210}Pb is a natural radionuclide tracer used to create ca. 100-year geochronologies. Each of the 100-cm cores was divided into 1 cm layers. Representative layers were selected, dried, homogenized, and approximately 1 gram per layer was weighed for sample preparation. Each sample was spiked with 100 μL ^{209}Po as tracer to determine % efficiency of the ^{210}Pb analysis procedure. The solution matrices were plated on silver discs. The discs were then placed in an alpha spectrometer for ^{210}Pb measurement. ^{210}Pb was determined by measurement of ^{210}Po , the daughter nuclide of ^{210}Pb . The Constant Initial Concentration (CIC) model was used to estimate the sedimentation rate. Using the CIC model, sedimentation rates are estimated to fall within or near the global median range of 1.9- 3.9 mm y^{-1} . Globally, the ^{210}Pb dating method has been widely used for coastal sediment analysis for the past 40 years; however, this study is the first to apply the method on mangrove sediments in the Philippines. This method can be used as a historical dating tool, to determine the environmental impacts of natural and anthropogenic activities around mangrove forests, up to a century.

Introduction

^{210}Pb is a radionuclide naturally found in sediments from the radioactive decay series of ^{238}U . It has proven to be useful in determining accretion rates up to a century (Lynch, et al. 1989). The ^{210}Pb dating technique was first used by Golberg (1963) to measure glacier accumulation rates. It was then used by Krishnaswam et al. (1971) in dating lake sediments. In 1972, the technique was used by Koide et al. for marine sediments. ^{210}Pb analysis has been used to compute for sedimentation rates of mangrove forests since then, in different countries like the US and Australia (Lynch, et al. 1989; Sanders, et al. 2015). However, this analysis has never been used

on mangrove forests in the Philippines. This study aims to pioneer the use of the ^{210}Pb analysis in Philippine mangrove forests.

Materials and Methods

A 100-cm core was obtained from the study sites in mangrove forests of Bani, Pangasinan and Triboa, Subic Bay Freeport Zone. Each core was cut into one-centimeter layers, and each layer was dried and homogenized. One gram of dried and homogenized sediments from selected layers of each core was weighed and placed inside Teflon bombs. These samples were then spiked with the tracer ^{209}Po . Strong acids were added, and the bombs were placed inside a microwave oven for 90 seconds for acid digestion. The bombs were left overnight to cool, and the acid was dried off the next day. To further digest the sediments, more acid was added and dried off two more times. The remaining substrate was transferred into centrifuge tubes and diluted with 0.5 M HCl. The supernatants were transferred to glass beakers and placed on hot plates, with a constant temperature of 85°C . Silver discs on Teflon holders were placed inside the glass beakers containing the solutions, and plating of the solution on to the discs was done for six hours. After six hours, the discs were washed with distilled water and methanol, before it was placed in an alpha-spectrometer for ^{210}Po activity counting.

Summary and Implications

A sedimentation rate of $2.4 \pm 0.3 \text{ mm y}^{-1}$ was obtained from Bani, Pangasinan. This falls within the 95% confidence interval of the global average for mangrove sedimentation rates of 1.9 mmy^{-1} - 3.9 mm y^{-1} (Breithaupt, et al. 2012). This result validates the applicability of the ^{210}Pb method on Philippine mangrove forests. However, the sedimentation rate for Triboa, Subic was calculated to be $12 \pm 3 \text{ mm y}^{-1}$. This large value must be further analyzed, to account for natural occurrences that may have disturbed the sediments, such as a sediment washout by a typhoon. Other studies on the sediments such as the ^{137}Cs technique are suggested to be used for correlation with the ^{210}Pb data.

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