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Sediment Characteristic Studies in the Surface Sediment from Kemaman Mangrove Forest, Terengganu, Malaysia

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ABSTRACT

43 surface sediment samples from Kemaman mangrove forest, Terengganu were analyzed for sediment characteristic (mean, sorting and skewness) off two seasons (dry season and wet season) by using the Particle Size Analyzer (PSA) after digest the sample with Hydrogen Peroxide (H_2O_2) and Hydrochloric Acid (HCl). There is a significant ($P<0.05$) relationship between sediment characteristic with the seasonal changes with the increasing mean particle size occurring during the wet season. Finer sediments dominate the mangrove sediment during monsoon season while coarser sediments dominate during the dry season. Meanwhile, sediment mean size for each transect tends to be coarser towards the back mangrove.

Key words: Kemaman mangrove, Sediment characteristic, PSA, Seasonal, Mean size.

INTRODUCTION

Grain size distribution has widely been used by sedimentologists to infer transport and depositional processes (Mason and Folk, 1958; Folk and Ward, 1957; Friedman, 1961; Visher 1969; Nyandwi, 1995). It is commonly believed that grain size distributions are generally related to two main factors; the availability of sediment (sources) to the depositional environments; and the hydrodynamic conditions during transport and deposition of the sediments (Mason and Folk, 1958; Folk and Robbles, 1964; Friedman, 1961; Taira and Scholle, 1979). Grain size distribution has been used to discriminate different depositional environments (Mason and Folk, 1958; Friedman, 1961). Others (McLaren and Bowles, 1985; Dyer, 1986) noted that the grain size distributions change predictably along the direction of transport. Similarly, the grain size distribution at the beach in conjunction with beach slope parameters, have been used globally to characterise areas that are under the impact of beach erosion or accretion (Bascom, 1951; Anwar *et al.,* 1979).

Mangroves are often associated with fine–grained sediment, but they are able to grow on a wide range of substrate types (Saloman, 1978). Sediments accumulating beneath a mangrove forest may be two types. The first type is allochthonous sediment, which are derived from outside the forest itself and are brought into the forest either from landward or from seaward. In deltaic areas, much terigenous may be imported by the river system; in estuaries of shallow – water carbonate banks. Mangrove may grow on intertidal calcareous flats in which the sediment is marine in origin.

Particle size is an important textual parameter to determine the transportation, sorting and deposition processes of bed sediment. Consequently, estuarine sediments are considered important sinks for nutrient, organic matter, trace substances and contaminants derived from inland sources. The dry method and wet method is the most widely to determine the grain size. Wentworth (1922) proposed that sediment could be referred to as size grade. Mod, mean, median, standard deviation is the statistical data obtained after the particle size analysis. However, Krumbein (1934) suggested that a logarithmic transformation of the Udden–Wentworth grade scale which characterize grain size in phi (Æ) by using this formula; Æ = –$\log_2$ D where D is the sediment diameter in mm unit.

Methodology

Sampling site

The Kemaman–Chukai mangrove forest is located in the Kemaman district, inside one of the most extensive mangrove area (298.2 ha) on the east coast of Peninsular Malaysia. In this study, three transect line (K1, K2 and K3) were set up inside the mangrove forest, where 43 sampling station points were fixed. The transect line with no physical signs of active bioturbation were selected, thus avoiding the complication of biological disturbance. K1 and K2 were set up near the estuary while K3 were set up near the upstream (Fig. 1). Surface sediment for sediment characteristic at all sampling points along each transect were collected by gently scraping the sediment surface.

Sediment characteristic analysis

1.5g sample were diluted with distilled water into a 100mL glass beaker. Then the sample was heat on the hot plate at the constant temperature of 60°C. Some distilled water and a few drops of Hydrogen Peroxide (H_2O_2) into the solution slowly and stir it with glass rod. This process will be continuing until all organic matter in the reaction stops (no formation of bubbles). Then 10% of calgon solution will be added into the solution to break down the sediment particle, which bond together. Finally the solution will be analyzed using PSA, model MALVERN Master Sizer. All data collected will be subjected for statistical analysis by using the Moment method suggested by McBride (1971) and Folk (1974). By using this method, the value of mean, were calculated. The formulas are as below:

$$\text{Mean, X} = \frac{\Sigma \text{fm}}{n}$$

$$\text{sorting, } \sigma = \frac{\Sigma \text{f (m-X)}^2}{100}$$

Where,

f = percentage weight of each grade of particle size

m = median of each particle size (Ø)

n = total number of the particle samples in 100 where f is in percentage (%)

Ø = diameter of the particle in mm

RESULT AND DISCUSSION

Mean value of particle size of each transect during dry season and wet season shown in Figure 2. In general, mean size value during wet season is higher than dry season. Finer particle can be found during wet season compare with dry season which it have a coarsest sediment. During dry season, particle mean size is at the range of 6.12 Ø to 7.02 Ø with the average of 6.75±0.26 Ø. Meanwhile the averages mean size during wet season is 7.18±0.34 Ø, range of 6.89 Øto 7.42Ø. There is a significant relationship ($P < 0.05$) between sediment characteristic with the seasonal changes where coarser sediment dominate the mangrove sediment during dry season.

The sedimentological characteristic of the study areas in Terengganu region, like most other coastal environments, are very dependent upon the combination of physical forces such as freshwater runoffs, tidal currents and waves (Kamaruzzaman, 1994). The statistically test shows that the sediment texture and the grain size of the sediment in Terengganu mangrove varied significantly ($p < 0.05$) according to the seasonal changes with a decreasing grain size of sediment occurring during the wet season. Coarser sediments dominate during the dry season, while the finer sediments dominate during the dry season. The coarser sediment occurring during the wet season may be due to the heavy rainfall and higher energy of water movement from the up stream, where the finer sediments were transported out to the sea.

The sediment in Kemaman mangrove ranged from poorly sorted to very poorly sorted for the both dry season and wet season respectively (Figure 3). For the dry season, the sorting value ranged from 1.62 Ø to 2.08 Ø with an average value of 1.85±0.14 Ø. There is not much different for the wet season with an average sorting value of

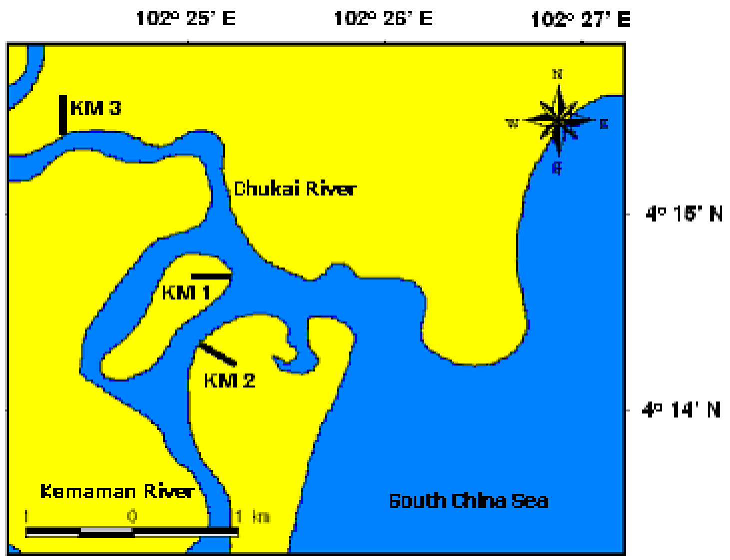

Fig. 1: Location of the study area

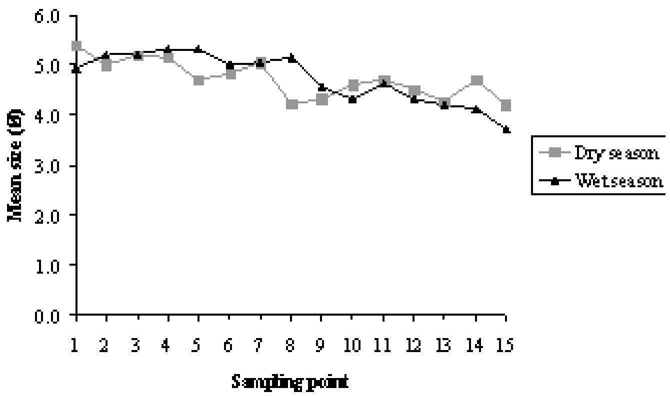

Fig. 2: Sediment mean size for both seasons at Kemaman-Chukai mangrove forest

2.01±0.21 Ø, ranging from 1.59 Ø to 2.41 Ø. From the statistical test, paired *t*–Test, shows that there are significant different in sediment sorting between the dry and wet season with the p = 0.02 ($p<0.05$). The sediments are more sorted during the wet season compared with the dry season.

The high values of sorting indicate the sediments are poorly sorted. Well-sorted sediments consists of single sized of particles, or in which a limited size range of particles occur, the other particle size have been removed, usually by mechanical means (Gross, 1977). Low sorting value indicates that the sediments are well sorted and have a high mean size value.

Figure 4 shows the relationship between sediment sorting and sediment mean size. It can be noted that the mangrove surface sediment of Terengganu region were not very well sorted. From the graph, the dry season sediment had relatively higher mean size indicating the finer grain size. Coarser grain size occurs during the wet season.

Figure 5 show the texture percentage of sand, silt and clay of all sampling point for the two different season. All samples for the both seasons show a high percentage of sand in content. In this study, the sand content during the dry season was higher compared with the wet season. The average percentage of sediment texture was 52.75% (sand), 39.73% (silt) and 7.35% (clay) during the dry season while in wet season, the average percentage of sediment texture was 45.80% (sand), 44.85% (silt) and 9.28% (clay).

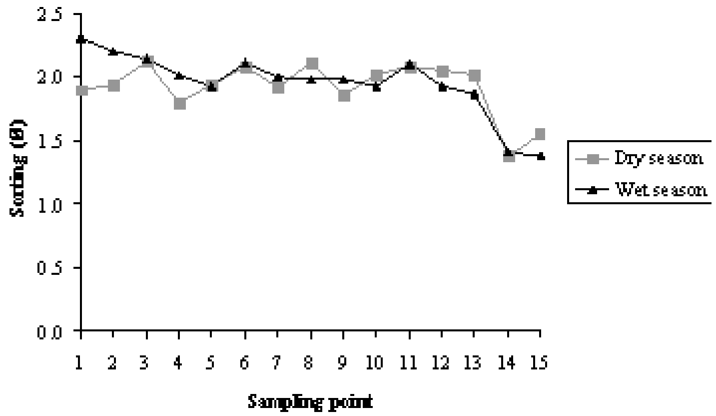

Fig. 3: Sediment sorting for both seasons at Kemaman-Chukai mangrove forest

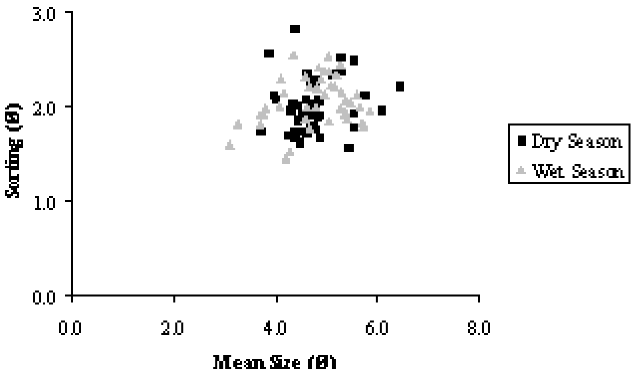

Fig. 4: Correlation between sediment mean size and sediment sorting at Kemaman-Chukai mangrove forest

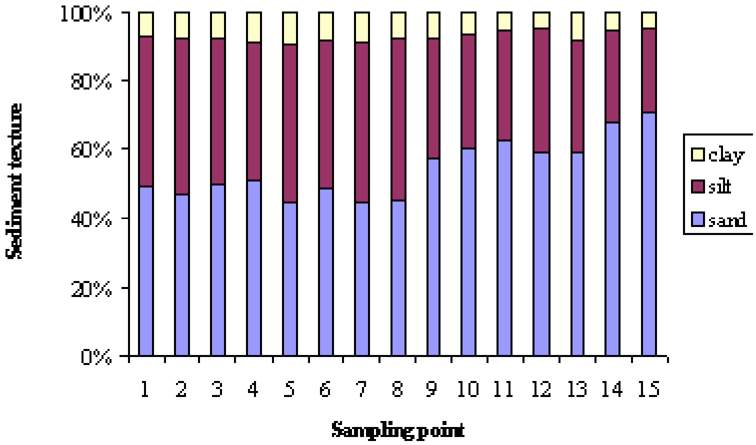

Fig. 5(a): Sediment texture for dry season at Kemaman-Chukai mangrove forest

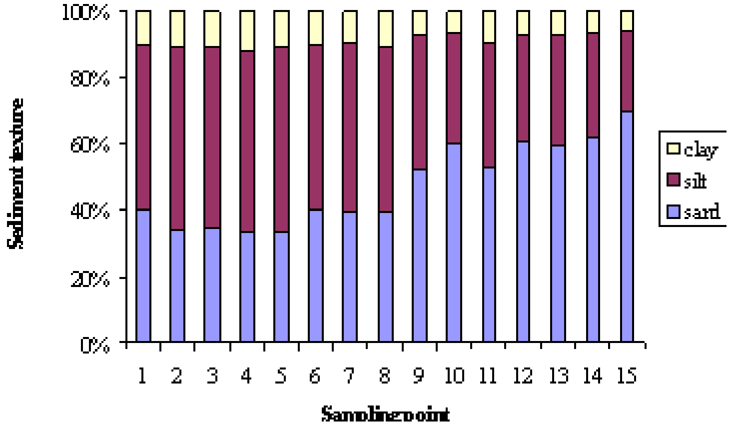

Fig. 5(b): Sediment texture for wet season at Kemaman-Chukai mangrove forest

CONCLUSION

The sediment characteristics in the study areas were influenced by the monsoon season. The mean particle sizes become a relatively smaller size during the wet season. Meanwhile the sand content during the dry season was higher compared to wet season. The characteristic of deposited sediments at the study area are probably dependent upon the combination of physical forces such as river water runoff, tidal currents and waves and even though those physical combinations were not discussed in this study.

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