Transactions on Science and Technology, **3**(2-2), 388 - 392, 2016
ISSN: 2289-8786

Surface Sediment Particle Structure of Marudu Bay, Sabah, Malaysia

Muhammad Rashid Abdul Rahim*, Ejria Saleh, Sujjat Al Azad, B. Mabel Manjaji-Matsumoto, Julian Ransangan

Borneo Marine Research Institute, Universiti Malaysia Sabah, 88400, Kota Kinabalu, Sabah, MALAYSIA.
*Corresponding author. E-Mail: rashidrahim923@gmail.com; Tel: +6088-322594; Fax: +6088-320261

Received: *27 April 2016*
Revised: *1 August 2016*
Accepted: *1 September 2016*
Online: *27 October 2016*

Keywords:
Surface sediment; sediment particle structure; sediment texture; Marudu Bay

ABSTRACT

Sediment can be classified into three major categories: sand, silt and clay, which has a crucial impact on bottom marine life. In other words, different marine organisms prefer different sediment particle structure and texture, reflecting energetics of transport and deposition processes in the water column. The aim of this study is to determine the surface sediment particle structure and its texture in Marudu Bay. Surface sediments were collected from 10 stations which covered the coastal (ST1, ST2, ST3, ST6 and ST10) and the middle (ST4, ST5, ST7, ST8 and ST9) areas of the bay by using the Ponar© (WILDCO®, 6 inch) grab sampler. Subsequently, the sediment samples were then analysed with LISST-Portable Laser Diffraction Particle Size Analyser (Sequoila, WA). The results show coastal areas near river mouths have a coarser particle structure with very slightly clayey silty sand texture compared to stations away from river mouth. The pattern is consistent with the resuspension of finer particles from the sand, silt and clay within shallow turbulent coastal water, and transport across the deeper area of the bay. This finding can contribute to baseline information, and suggests that further understanding of the sediment hydrodynamic across the bay is required for management of the system.

Introduction

The most fundamental physical aspect of benthic habitat is sediment particle structure. In other words, different particle structures can determine the diversity and abundance of macro benthic organism (Poppe *et al*, 2000). Marudu Bay, in the northern part of Sabah, is rich in biodiversity, such as molluscs, corals, crustacean, fishes, reptiles, mangroves bird' and other mammals (Hanum *et al*., 2012). The diversity enables the community of Marudu Bay to earn their living by exploiting the resources. Therefore, knowledge of sediment particle structure across Marudu Bay is important to establish baseline information and to understanding the sediment dynamics for sustainable management of those resources. The aim of this study is to determine on surface sediment particle structure and its texture in Marudu Bay.

TRANSACTIONS ON SCIENCE AND TECHNOLOGY

Materials and Methods

The study area is covered from Kudat (6° 52’ 58.80” N, 116° 51’ 18.00” E) to Berungus (6° 57’ 03.96” N, 117° 02’ 01.90” E) located near the open sea entrance, to the inner part of Marudu Bay toward Kota Marudu (Figure 1). Ten stations (ST1-ST10) were selected to represent the surface sediment particle structure across Marudu Bay (Figure 1). Five stations including ST1, ST2, ST3, ST6 and ST10 were located near the coastal area and other five (ST4, ST5, ST7, ST8 and ST9) covered the deeper part (middle) of the bay. The sediment samples were collected from each station by using the Ponar© grab sampler (WILDCO®, 6 inches). The sediment samples were stored in airtight polyethylene bags (16.5 cm x 17.2 cm) and transported to laboratory in cold condition. In the laboratory, the sediments were soaked overnight in 10% of sodium hexametaphosphate (UNEP, 2006). One gram of the soaked sample was analysed for grain size by the use of laser diffraction particle size analyser (Sequoila, WA) according to Agrawal and Pottsmith (2000). The grain size scales of sediment samples were determined according to Wenthworth (1922). The grain sizes were categorised as fine sand (250 µm -125 µm), very fine sand (125 µm -63 µm), coarse silt (63 µm -31 µm), medium silt (31 µm -15.6 µm), fine silt (15.6 µm -7.8 µm), very fine silt (7.8 µm -3.9 µm) and clay (3.9 µm -0.06 µm). The relevant categories of the surface sediments textures were then determined by following Blott and Pye (2012).

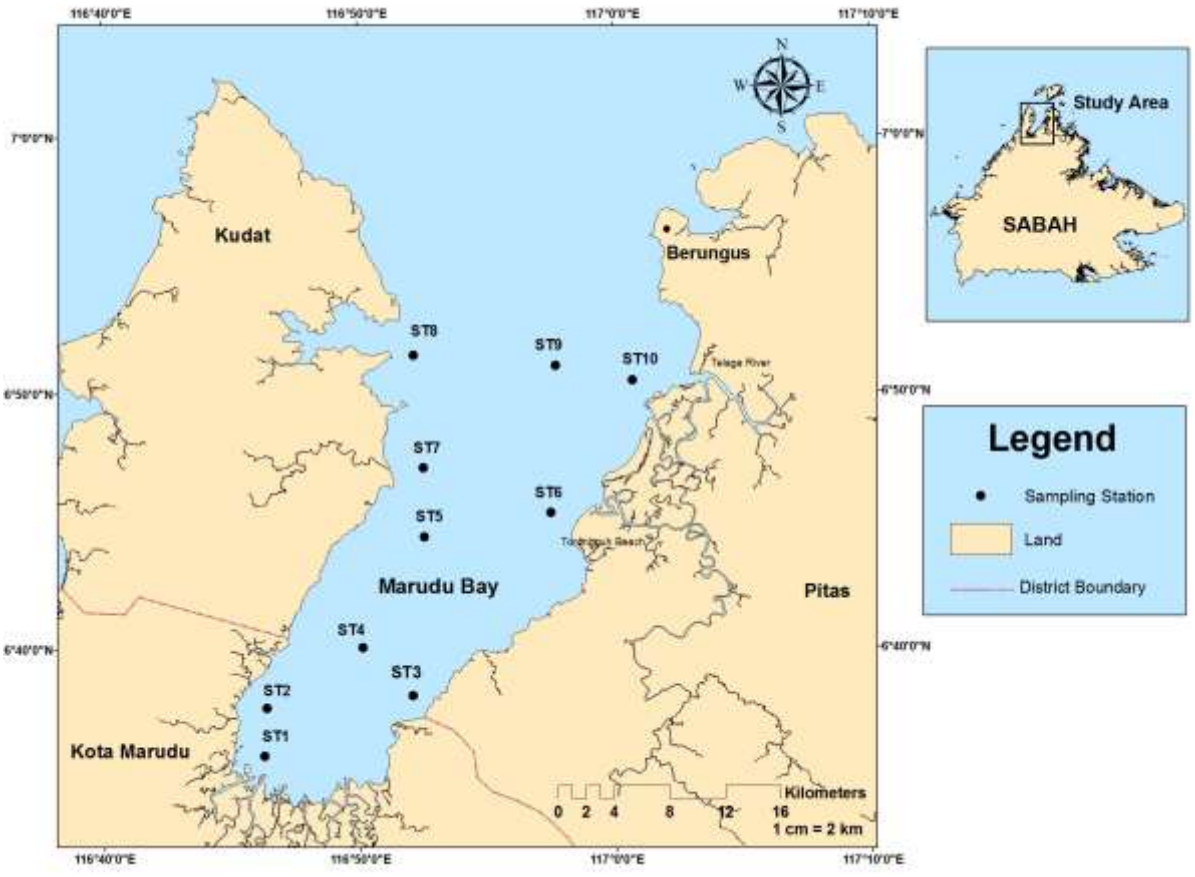

Figure 1. Location of sampling stations in Marudu Bay

Results and discussion

The surface sediment at coastal stations ST1, ST2, ST3, ST6 and ST10 was found to consist of 34% of very fine sand, 34% of very fine sand, 46% of fine silt, 96% of fine sand and 49% of very fine sand, respectively (Figure 2). Particle size in the sediment sampled at coastal stations ST1, ST2 and ST10 was fairly uniform and dominated by very fine sands. However, particle size at coastal station ST6 appeared exceptional in that it is dominated by fine sands (96%). In contrast, a different pattern in the grain size was observed at the stations located at middle of the Marudu bay, mostly uniform across all stations and dominated by fine silts that represent a mixture between medium (<31 µm) and fine silts (<15.6 µm) (Figure 3).

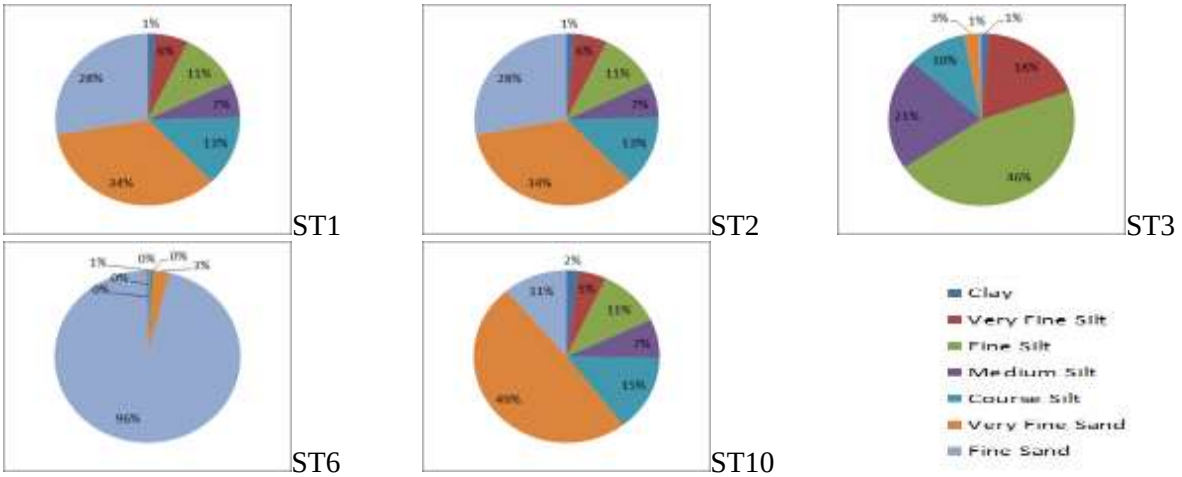

Figure 2. The particle size fraction (%) in stations located at the coastal area of Marudu Bay according to Wenthworth (1992).

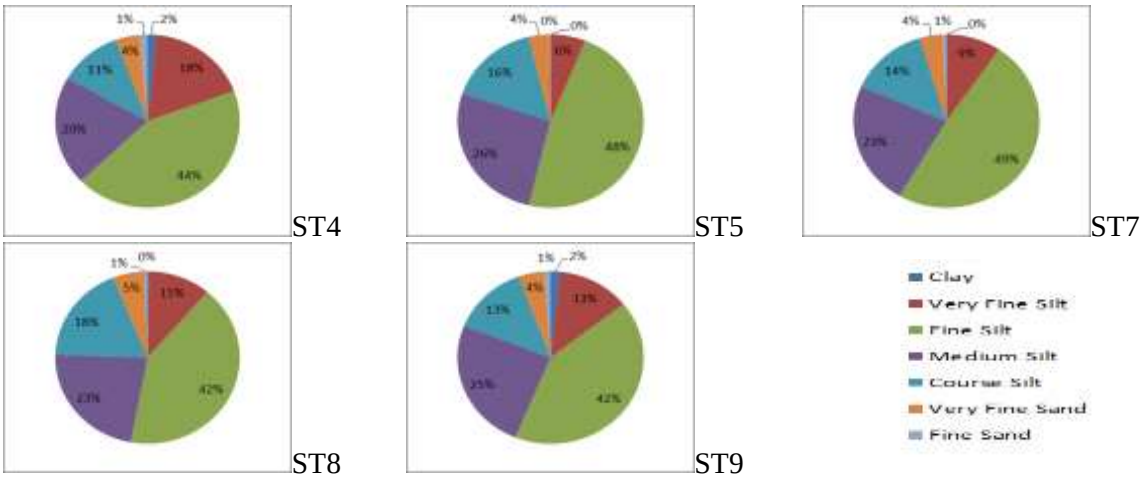

Figure 3. The particle size fraction (%) in stations located at the middle of Marudu Bay according to Wenthworth (1992).

Coastal sediments, near river mouths, support very slightly clayey silty sand. Whereas coastal shallow areas and away from the river mouths is significantly less coarse with a very slightly sandy very slightly clayey silt texture (Figure 4). The sediment texture near the river mouths may be associated with the supply of fluvial sediment from catchment areas (Wright, 1977). This is consistent with the supply of a sand, silt and clay and subsequent resuspension of the finer fractions from these shallow and more turbulent environments.

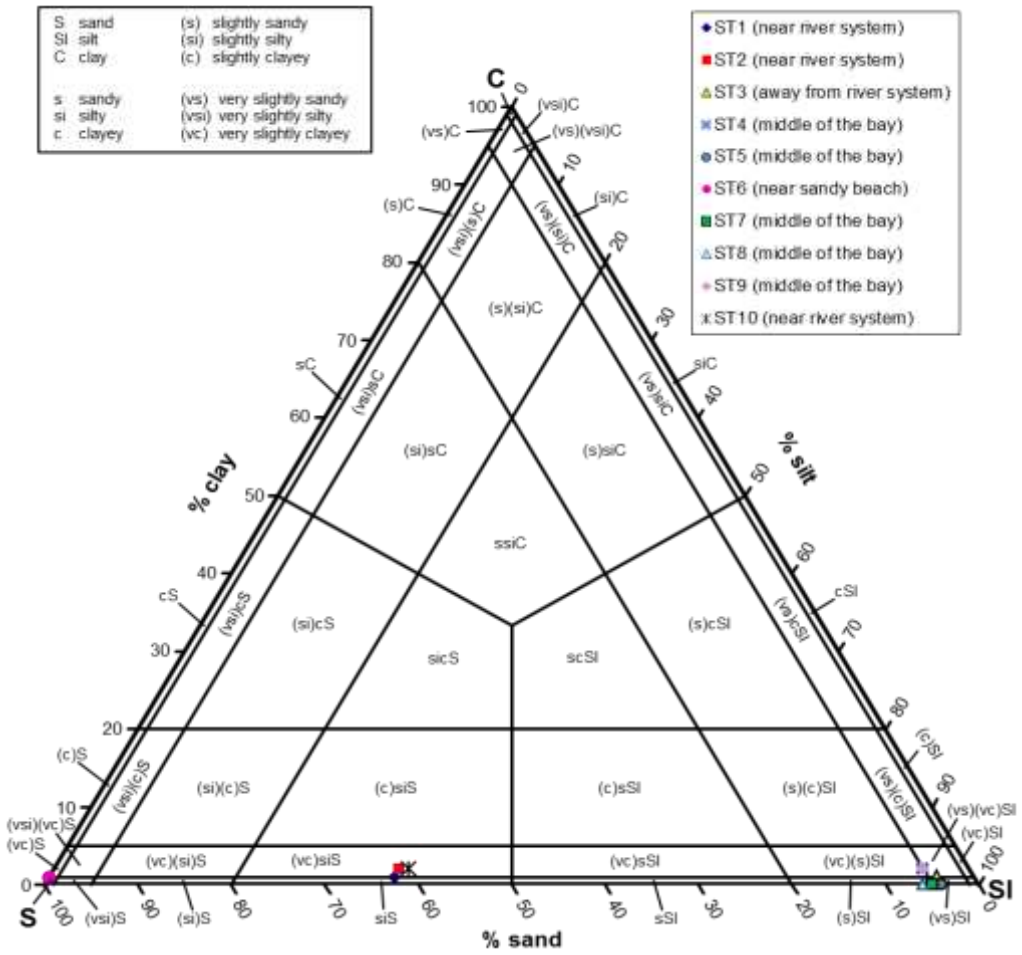

Figure 4. The sediment texture of each station (ST1-ST10) of Marudu Bay categorized according to Blott and Pye, 2012.

The stations near the coastal line will generally dominated by coarser particles due to increasing transport capacity with river opening (Porrello *et al*., 2005). In contrast, the ST3 has a finer texture than other coastal stations adjacent to river mouth (ST1, ST2, ST6 and ST10). Such observation could be influenced by no supply of fluvial sediments and/or a lower level of turbulent due to the lower velocity depositional forces in the areas (Wright, 1977). This shows that Marudu Bay environment is characterized by high surface runoff, continuous sediment sources, less tidal scouring and the lack of stronger currents.

Fine sand which was dominant at ST6 may be originated from the *Torungguh* sandy beach located near to sampling station. Fine sands are indicatives of sites near to beach and coast line (Blott & Pye, 2012). The granular fractions are normally associated with the high velocity flow from the surrounding rivers. Normally, the lighter and finer sediments are suspended into water column, but coarser and heavier sandy sediments settled quickly on the bottom (Wood *et* al., 1997). Weak current velocity energy unable to flush out the sediment towards the open sea might make the bay become shallower when sediment continuously supply into the bay.

Conclusion

The surface sediment particles structure varies from each station. At relatively shallow coastal area near river mouth, the particles structure significantly coarser compared to stations away from the river mouth. While, less turbulent and deeper water in the middle of the bay are consistent with low rate percentage of resuspension and/or supply of finer particles resuspended from adjacent shallow coastal areas of the bay. It is postulated that as for future study, current patterns and water circulation may be responsible, a subject for future.

Acknowledgements

We thank John Barry Gallagher for his constructive comments to the manuscript. This study was financially supported by Pacific Rim Innovation and Management Exponents, Inc. via project no. (GL00132) and Ministry of Higher Education Malaysia via project no. (NRGS0003).

References

[1] Agrawal, Y. C. & Pottsmith, H. C. (2000). Instruments for Particle Size and Settling Velocity Observations in Sediment Transport. *Marine Geology*, **168**, 89-114.

[2] Blott, S. J. & Pye, K. (2012). Particle size scales and classification of sediment types based on particle size distributions: Review and recommended procedures. *Sedimentology*, **59**(7), 2071-2096.

[3] Hanum, F., Abd Kudus, K. & Saari, N. S. (2012). *Colours of Kota Marudu, Sabah, Malaysia*. Universiti Putra Malaysia (UPM) Press.

[4] Poppe, L. J., Eliason, A. H., Fredericks, J. J., Rendigs, R. R., Blackwood, D. & Polloni, C. F. (2000). *Chapter 1: Grain-size analysis of marine sediments: Methodology and data processing*. U. S. Geological Survey Open-File Report 00-358, 314p.

[5] Porrello, S., Tomassetti, P., Manzueto, L., Finoia, M. G., Persia, E., Mercatali, I. & Stipa, P. (2005). The influence of marine cages on the sediment chemistry in the Western Mediterranean Sea. *Aquaculture*, **249**, 145-158.

[6] UNEP (United Nations Environment Programme). (2006). Methods for sediment sampling and analysis. *Review Meeting of Mediterranean Action Plan MED POL – Phase III Monitoring Activities.* Plermo (Sicily), Italy. 12 – 15 December 2005.

[7] Wentworth, C. K. (1922). A scale of grade and class terms for clastic sediments. *Journal of Geology*, **30**, 377-392.

[8] Wood, A. K. H., Ahmad, Z., Shazili, N. A. M., Yaakob, R. & Carpenter, R. (1997). Geochemistry of sediments in Johor Strait between Malaysia and Singapore. *Continental Shelf Research*, **17**(10), 1207-1228.

[9] Wright, L. D. (1977). Sediment transport and deposition at river mouths: A synthesis. *Geological Society of America Bulletin*, **6**, 857-868.