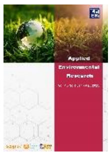
App. Envi. Res. 47(2) (2025): 017

Applied Environmental Research

- RESEARCH FOR SUSTAINABLE PLANET -



Research Article

Sediment Grain Size Analysis and Characteristics of Sedimentation Processes in the Bang Berd-Khao Tham Thong Beach, Chumphon Province

Rawadee Meeprasit, Sujaree Bureekul, Suriyan Saramul*

Department of Marine Science, Faculty of Science, Chulalongkorn University, Bangkok, Thailand

*Corresponding Email: suriyan.s@ chula.ac.th

Abstract

This study investigated the sedimentological characteristics of the Bang Berd-Khao Tham Thong beach system, which is located along the western shore of the central Gulf of Thailand, an area that is minimally disturbed by human activity and is ideal for studying natural coastal processes. Sediment samples were collected from both coastal and marine environments across four sampling periods (July 2022, September 2022, April 2023, and June 2023). The analysis focused on the grain size distribution, sorting, skewness, kurtosis, and sediment composition, revealing a predominance of medium sand in coastal sediments and increased silt and clay contents in marine sediments. The largest sediment particle size is 466.78 microns. Coastal sediments show a well-sorted size distribution, with a mesokurtic kurtosis. In contrast, sediment samples collected from the marine environment exhibit a poorly sorted size distribution, with leptokurtic kurtosis. Most sediment samples also have symmetrical skewness. Coastal sediments displayed characteristics of tidal influence, with some southern coastal areas exhibiting desert-like conditions due to wind action. The marine sediments were a mixture of shallow marine and fluvial depositional environments. Linear discriminant functions and the CM diagram were used to classify the sediment accumulation environments, identifying four main depositional modes: rolling, rolling and suspension, suspension and rolling and graded suspension. These findings contribute to a deeper understanding of sediment transport and accumulation processes in coastal and marine environments, with implications for coastal management and climate change adaptation strategies.

ARTICLE HISTORY

Received: 29 Nov. 2024
Accepted: 20 May 2025
Published: 21 May 2025

KEYWORDS

Sedimentology;
Coastal environments;
Grain size distribution;
Sediment accumulation;
Marine sediments

Introduction

Grain size is a fundamental property of sediments and is commonly used to describe sedimentary facies and classify sedimentary environments. The study of sedimentology involves understanding the character-ristics and dynamics of sediments, which provides valuable information about coastal environments and helps in understanding coastal behavior. Extensive research has been conducted on coastal sediments to enhance our understanding of these processes [1-5].

Statistical patterns of coastal sediment grain size have been widely applied to provide insights into sediment sources, transport history, and depositional conditions [6-9]. Coastal sediment size analysis also helps to identify key characteristics that determine energy flow in depositional environments [3-4, 9-10]. Sediment size serves as an indicator of the energy conditions within a sediment accumulation environment. Coarse sediments, such as sand and gravel, typically accumulate in high-energy environments, whereas finer sediments, including clay and fine sand, are deposited in low-energy environments. Skewness and kurtosis

https://doi.org/10.35762/AER.2025017

provide insights into sediment deposition dynamics. A skewness value of zero suggests stable energy conditions, whereas deviations from zero indicate irregular sediment transport. Fluvial sediments are generally characterized by poor to moderate sorting and positive skewness, whereas beach sediments tend to be well sorted with skewness values near zero. Shallow marine sediments exhibit a mixture of characteristics, whereas aeolian sediments are typically very well sorted, consisting of fine to medium sand. For example, a study on coastal sediments in India [9] analyzed grain size, sorting, skewness, and kurtosis to assess sediment transport processes and depositional environments in tidal regions. Liang, et al. [2] reported that variations in skewness in coastal sediments in China were linked to seasonal changes in sediment movement.

In coastal zones, sediment transport is influenced by wind over the upper part of the beach, whereas oceanographic conditions such as tides, currents, and waves cause continuous sediment transport in the swash zone, nearshore zone, and continental shelf. Understanding these oceanographic dynamics is essential for analyzing depositional processes in coastal plains, thereby improving our comprehension of sediment accumulation in both coastal and marine environments. This knowledge also plays a crucial role in informing coastal planning and management strategies, helping to mitigate potential impacts associated with future climate change scenarios [11-13].

A prominent example of these processes is the Bang Berd-Khao Tham Thong beach system (Figure 1), which is situated along the western shore of the central Gulf of Thailand and extends approximately 9 km in a north–south direction. It is distinguished by wind-blown sand dunes aligned parallel to the shoreline, a rare feature in Thailand [14]. Additionally, the area remains largely undisturbed by human activity, as it has been designated a conservation site under a royal initiative. These factors make the Bang Berd-Khao Tham Thong beach system an ideal location for studying sediment characteristics and natural coastal processes. An investigation of the sediment characteristics at Bang Berd, Chumphon, revealed that the sand dunes are oriented in a northwest–southeast direction. The sand grains are fine, well sorted, and slightly rounded, with dunes reaching a maximum height of approximately 20 m, shaped primarily by wind activity. The analysis indicates that narrow, steeply sloped beaches are prone to erosion, whereas wider, gently sloped beaches facilitate sediment accumulation. The prevailing wind direction is from east [15-17]. While most studies have concentrated on sand dunes, limited research has been conducted on the sediment characteristics of beach surfaces and marine sediments. This study aims to address this research gap.

Materials and methods

1) Sample preparation

In this study, sediment samples (Figure 1B) from both the shoreline (SL) and seabed (SS) were processed to remove salts, organic matter, and carbonates prior to particle size analysis to prevent interference with sediment property assessments. Salt removal was achieved by repeatedly washing the samples with distilled water until no residual salt was detected, as verified via a salinity refractometer. The removal of organic matter and carbonate followed the methods outlined by Dietze, et al. [18]. Approximately 30 g of wet sediment were placed in a container, with the exact quantity varying on the basis of the sediment size measurement method and the number of repetitions needed. The organic matter was removed by adding 20–50 mL of 35% hydrogen peroxide (H_2O_2) to the sediment and allowing the reaction to proceed overnight or until no further bubbling was observed, indicating complete decomposition. The samples were then heated to eliminate any residual H_2O_2. Once the majority of the H_2O_2 had evaporated, the carbonates were removed by treating the samples with 10 mL of 10% hydrochloric acid (HCl) until no further reactions occurred. The treated samples were subsequently rinsed with distilled water until a neutral pH was reached via litmus paper. Finally, the sediment samples were dried at 60°C until completely dry before being subjected to particle size analysis.

Analysis of the shoreline and seabed sediment samples revealed that the majority of shoreline sediments consisted primarily of quartz with minimal organic matter. To assess the impact of treatment on particle size, three shoreline sediment samples were randomly selected for processing, where salts, organic matter, and carbonates were removed before particle size measurement. These treated samples were then compared with untreated samples from the same locations, which had been washed with distilled water but not subjected to organic matter or carbonate removal. The observed difference in particle size between the treated and untreated samples ranged from 1.0 to 3.4 µm. Since the average particle size remained largely unchanged, future shoreline sediment samples require only salt removal followed by drying at 60°C before analysis.

For seabed sediments, which are characterized by a gray or grayish-green color, shell fragments, and high organic content, organic matter and carbonates were removed prior to particle size measurement via the previously described procedure.

2) Particle size measurement (grain size) via the laser scattering technique

The particle size distribution was determined via the laser scattering technique [19], in which a laser beam is directed onto a sample particle. The particles scatter the light in various directions, and the intensity of the scattered light is measured at fixed angles by detectors. Using mathematical models, the particle size and distribution are derived from the light scattering pattern. This method can measure both suspended particles in water (wet samples) and dry powdered samples, with particle sizes ranging from 10 nm to 5,000 μm. In this study, particle sizes were measured via a laser scattering particle size distribution analyzer (Model LA-960V2) with the dry method, and data analysis was performed via LA-960 software. Each sample was measured in triplicate, and the analyzer was calibrated using a standard particle size of 1.034 μm, with a deviation of 1.034 ± 0.020 μm.

3) Data analysis

The particle size data obtained from the laser scattering particle size distribution analyzer were analyzed via GRADISTAT Version 8.0 by Blott and Pye [20]. By inputting the sediment volume distribution data (%) obtained from the sediment size analyzer into GRADISTAT, statistical data in phi units are generated. GRADISTAT can then calculate the mean sediment size, sorting, skewness, and kurtosis values on the basis of the logarithmic graphical measurement method of Folk and Ward [21]. GRADISTAT is a freely available, user-friendly software that allows for detailed and accurate analysis of particle size distribution data and is widely utilized in numerous studies [1, 9, 22-25].

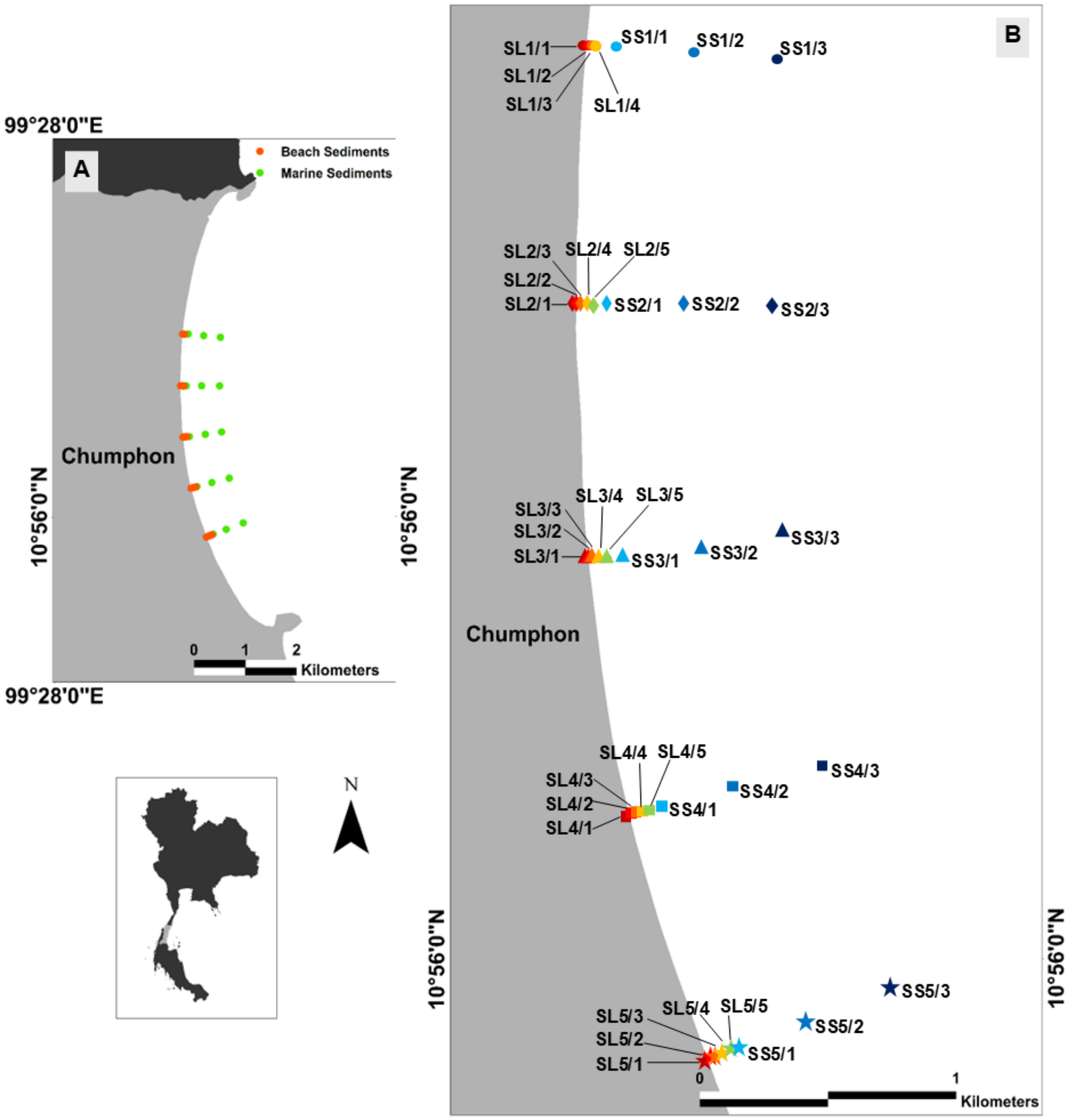


Figure 1 The Bang Berd-Khao Tham Thong beach cell system including A) transect lines 1–5 (from north to south) are presented, and each transect is composed of beach sediment (red dots) and marine sediment (green dots) and B) beach sediment (SL) and marine sediment (SS) sample points for each transect are defined.

Results and discussion

1) Mean sediment size

The mean sediment size in the study area (Figure 2) was categorized into four classes, from largest to smallest: medium sand, fine sand, very fine sand, and coarse silt. The majority of the sediments consisted of medium sand, followed by fine sand and very fine sand. Coarse silt was identified in only two samples, SS2/3 and SS3/3 (marine sediments from Lines 2 and 3), which were collected during the fourth sampling in June 2023 (Figure 2D), with mean sediment sizes of 4.1 phi and 4.2 phi, respectively. The largest sediment size, classified as medium sand with a mean size of 1.1 phi, was observed in sample SS1/3 (marine sediment from Line 1), which was collected during the second sampling in September 2022 (Figure 2B). The sediment sizes observed in this study reflect the energy levels of the depositional environment, with medium-sand particles found in relatively high-energy environments, whereas fine and very fine sands, which are characteristic of low-energy environments, were more prevalent.

2) Sediment sorting

The sediments in the study area exhibited four levels of sorting: poorly sorted, moderately sorted, moderately well sorted, and well sorted. The majority of the sediments were classified as well sorted. Coastal sediment samples were predominantly well sorted, followed by moderately well sorted samples, with no coastal samples categorized as poorly or moderately sorted. The sediments from the innermost coastal areas (dark red in Figure 2) were uniformly well sorted, with some samples approaching the very well-sorted classification.

Sediments from transitional zones, such as those at the coast–sea interface (light green in Figure 2) or from shallow nearshore waters (light blue in Figure 2), were predominantly moderately well sorted.

In contrast, the marine sediment samples were predominantly poorly sorted. The samples collected from the most distant offshore locations (dark blue) were almost entirely classified as poorly sorted (Figure 2). Well-sorted sediments indicate uniform particle sizes, with most particles being similar in size, suggesting a stable energy environment. Conversely, poorly sorted sediments exhibit a broad range of particle sizes, from coarse to fine, reflecting variable energy conditions and the mixing of sediments from different sources.

The well-sorted sediments from the shoreline likely indicate a relatively uniform sediment accumulation process driven by consistent energy. In contrast, the poorly and moderately sorted sediments from the seabed, located further from the shore, may suggest a more diverse and irregular sediment accumulation process influenced by varying energy conditions.

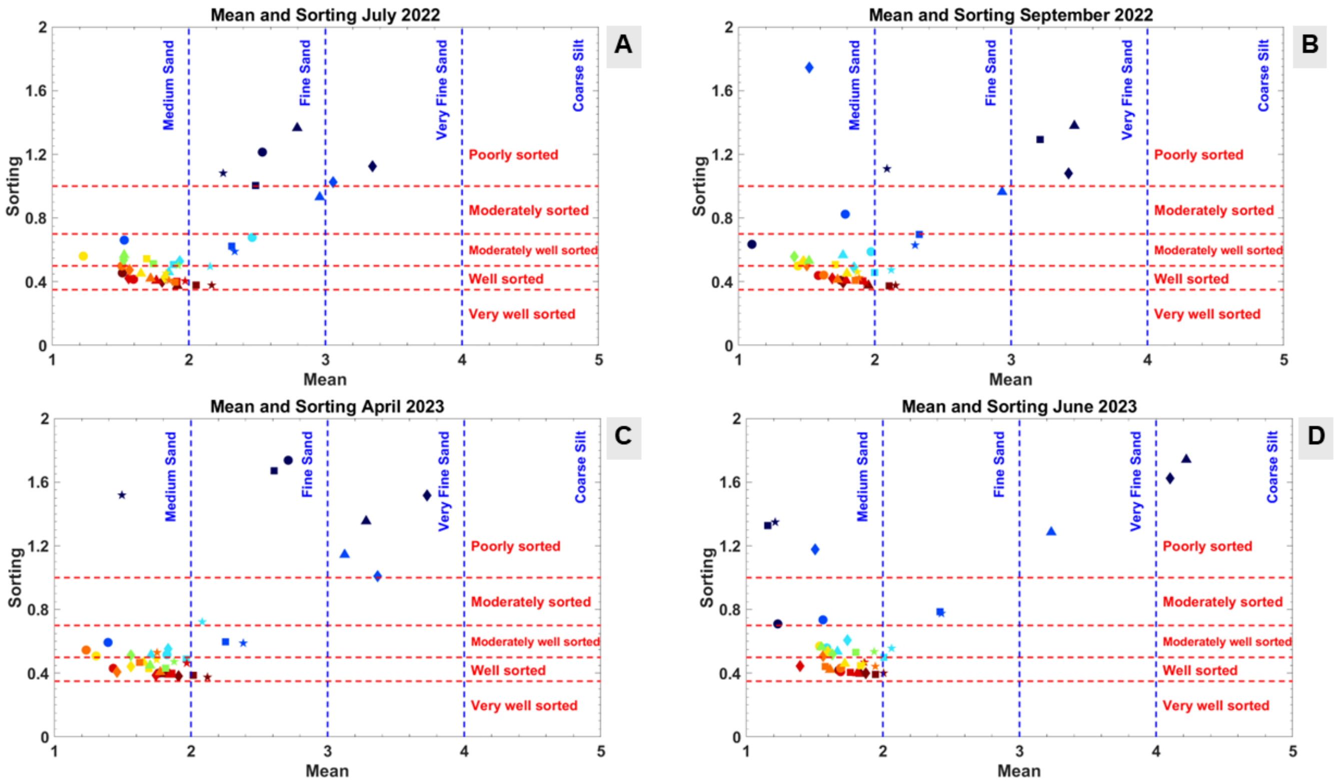


Figure 2 Mean and sorting types of sediment samples obtained during A) July 2022, B) September 2022, C) April 2023, and D) June 2023. The sample points for transect lines 1–5 (as shown in Figure 1A) are represented by circles, diamonds, triangles, squares, and stars, respectively. The colors indicate the transition from the coast to the sea, with the gradient progressing from dark red, red, orange, yellow, light green, light blue, and indigo to dark blue.

3) Skewness

The skewness of the sediment samples was categorized into four types: coarse-skewed, symmetrical, fine-skewed, and very fine-skewed. The majority of the sediments were symmetrical, followed by coarse-skewed, fine-skewed, and very fine-skewed. The coastal sediment samples were predominantly symmetrical, with coarse-skewed samples being the second most common type.

Marine sediments exhibited all four skewness types, with symmetrical sediments being the most prevalent, followed by fine-skewed, very fine-skewed, and coarse-skewed sediments. Coarse-skewed skewness was observed in only two instances: sample SS2/2 from July 2022 (Figure 3A) and sample SS2/1 from June 2023 (Figure 3D). The predominance of symmetrical skewness in most shoreline sediments suggests a normal distribution of particle sizes, with a balance between coarse and fine particles. This indicates stable energy conditions and efficient sorting processes, which are commonly found in stable beach environments or sandbars. In contrast, the seabed sediments displayed a wider range of skewness, reflecting more varied depositional environments. The presence of fine-skewed sediments suggests relatively low energy, which is typically associated with relatively fine sediment accumulation. Very fine-skewed sediments suggest even lower energy, with a higher proportion of fine particles. Coarsely skewed sediments are indicative of relatively high energy, with a relatively large proportion of coarse particles. The skewness values in the study area did not significantly differ across the sampling periods, which may be attributed to the fact that the sampling mostly occurred during the southwest monsoon, as noted by Liang et al. (2020), who reported that skewness values can vary seasonally.

4) Kurtosis

The sediment samples exhibit four types of kurtoses: platykurtic, mesokurtic, leptokurtic, and extremely leptokurtic. The majority of the sediments displayed mesokurtic kurtosis, followed by leptokurtic, extremely leptokurtic, and platykurtic kurtosis. Coastal sediments primarily exhibited mesokurtic kurtosis, whereas marine sediments included all four types, with leptokurtic kurtosis being the most common.

Platykurtic kurtosis was observed in only two marine samples, SS1/3 and SS3/3, both of which were collected in July 2022 (Figure 4A). During this sampling period, only three types—kurtosis platykurtic, mesokurtic, and leptokurtic—were identified. In September 2022 (Figure 4B), only leptokurtic and mesokurtic types were observed. In contrast, the samples from April and June 2023 presented three types of kurtoses: mesokurtic, leptokurtic, and extremely leptokurtic (Figure 4C and 4D).

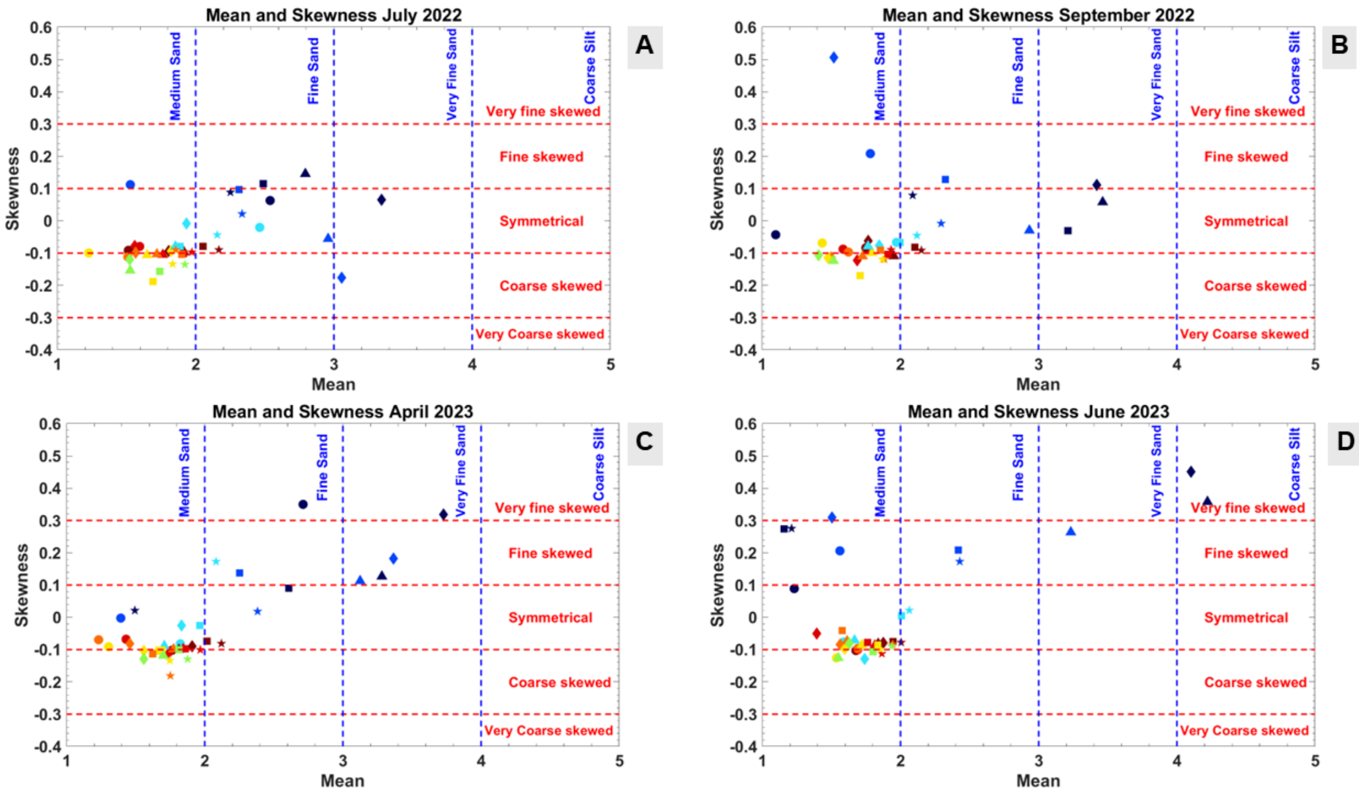


Figure 3 Mean and skewness types of sediment samples obtained during A) July 2022, B) September 2022, C) April 2023, and D) June 2023. The symbols and colors are similar to those described in Figure 2.

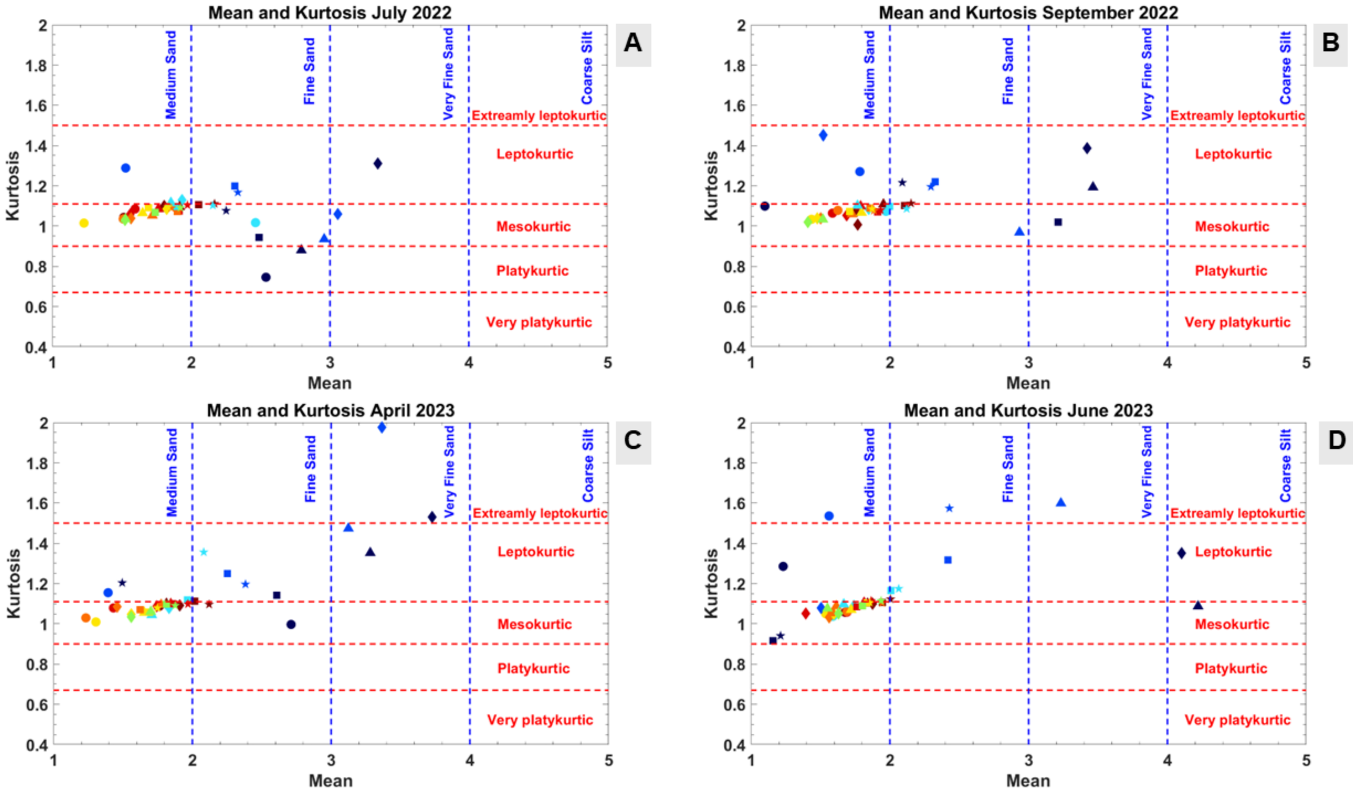


Figure 4 Mean and kurtosis types of sediment samples obtained during A) July 2022, B) September 2022, C) April 2023, and D) June 2023. The symbols and colors are similar to those described in Figure 2.

Shoreline sediments, which predominantly exhibited Mesokurtic kurtosis, displayed a normal distribution curve with a balanced particle size distribution, suggesting moderate sorting and relatively consistent energy levels. This indicates a stable accumulation process, typically found in environments such as stable beaches. In contrast, the seabed sediments presented more varied kurtosis values. Leptokurtic sediments, with a narrow distribution, indicate good sorting and relatively uniform energy, which are typical of environments with steady waves and sand dunes. Some samples exhibited platykurtic kurtosis, indicating a wider particle size distribution, poor sorting, and irregular energy conditions, which are often associated with sediments from multiple sources. Extremely leptokurtic kurtosis, marked by a very steep curve and narrow distribution, indicates excellent sorting and consistent energy and is frequently found in older sand dunes or beaches with long-standing, steady wave conditions. These varied distributions suggest diverse depositional environments in the seabed, in contrast to those found in the shoreline.

5) Linear discriminant analysis (LDA)

The linear discriminant function (LDF) was utilized to understand energy variations in sedimentary depositional environments. The results derived from fluidity factors demonstrated excellent correlations with sedimentary processes and depositional environments, with sediment grain size data serving as the foundation for the analysis [9-10].

This analysis employed multiple discriminant functions, as proposed by [10], focusing on the classification of depositional environments on the basis of sediment characteristics, which are mean sediment size (MZ), sorting (σ2), skewness (SK), and kurtosis (KG).

5.1) Classification of sediment accumulation environments in coastal areas influenced by tidal movement or desert-like environments dominated by wind:

The classification uses the following equation (Eq.1):

$$Y1 = 3.5688*MZ + 3.7016*\sigma 2 - 2.0766*SK + 3.1135*KG \quad \text{(Eq.1)}$$

A Y1 value greater than or equal to 2.7411 indicates a coastal sediment accumulation environment influenced by tidal movements, whereas a Y1 value less than 2.7411 suggests a sediment accumulation environment resembling desert conditions or influenced primarily by wind.

Sediments collected from coastal areas are characterized by deposition influenced by tidal movements. However, some samples from the southern part of the study area are dominated by desert-like conditions or wind influences. This region contains significant geomorphological features, including large sand dunes, the largest in Thailand. The sediment in this area is fine and subject to wind action, which results in the transportation and deposition of sand into these dunes.

The sediment characteristics in the study area are consistent with those of the Bang Berd sand dunes [15], where the dunes are formed primarily by the influence of wind.

In contrast, most marine sediments reflect a coastal sediment accumulation environment, although some samples exhibit characteristics of desert-like deposition or wind influences, more so than coastal samples do (Figure 5).

5.2) Classification of sediment accumulation environments in coastal areas and shallow marine areas:

This classification uses the following equation (Eq.2):

$$Y2 = 15.6534*MZ + 65.7091*\sigma 2 + 18.1071*SK + 18.5043*KG \quad \text{(Eq.2)}$$

A Y2 value greater than or equal to 63.3650 indicates a shallow marine sediment accumulation environment, whereas a Y2 value less than 63.3650 signifies a coastal sediment accumulation environment.

Sediment samples collected from the study area in July 2022 (Figure 5A), September 2022 (Figure 5B), April 2023 (Figure 5C), and June 2023 (Figure 5D) clearly distinguish between sediment accumulation environments in coastal areas. As samples were collected further from the shore, the sediment accumulation environment increasingly resembled that of shallow marine areas. The samples taken from the farthest offshore locations (light green) and those closest to the shore (light blue) represent the transitional zone between these two environments. In contrast, sediment samples from the sea (dark blue) clearly indicate a shallow marine sediment depositional environment (Figure 5).

5.3) Classification of sediment accumulation environments in shallow marine and river areas:

This classification uses the following equation (Eq.3):

$$Y3 = 0.2852*MZ - 8.7604*\sigma 2 - 4.8932*SK + 0.0428*KG \quad \text{(Eq.3)}$$

A Y3 value greater than or equal to -7.4190 indicates a shallow marine sediment accumulation environment, whereas a Y3 value less than -7.4190 suggests a fluvial environment or one influenced by river processes.

Analysis of sediment samples collected during all four data collection periods revealed that most samples from the study area presented characteristics consistent with sediment accumulation in shallow marine environments. All coastal sediment samples reflect a shallow marine depositional environment. In contrast, sediment samples from the sea present a combination of shallow marine and fluvial depositional environments (Figure 6).

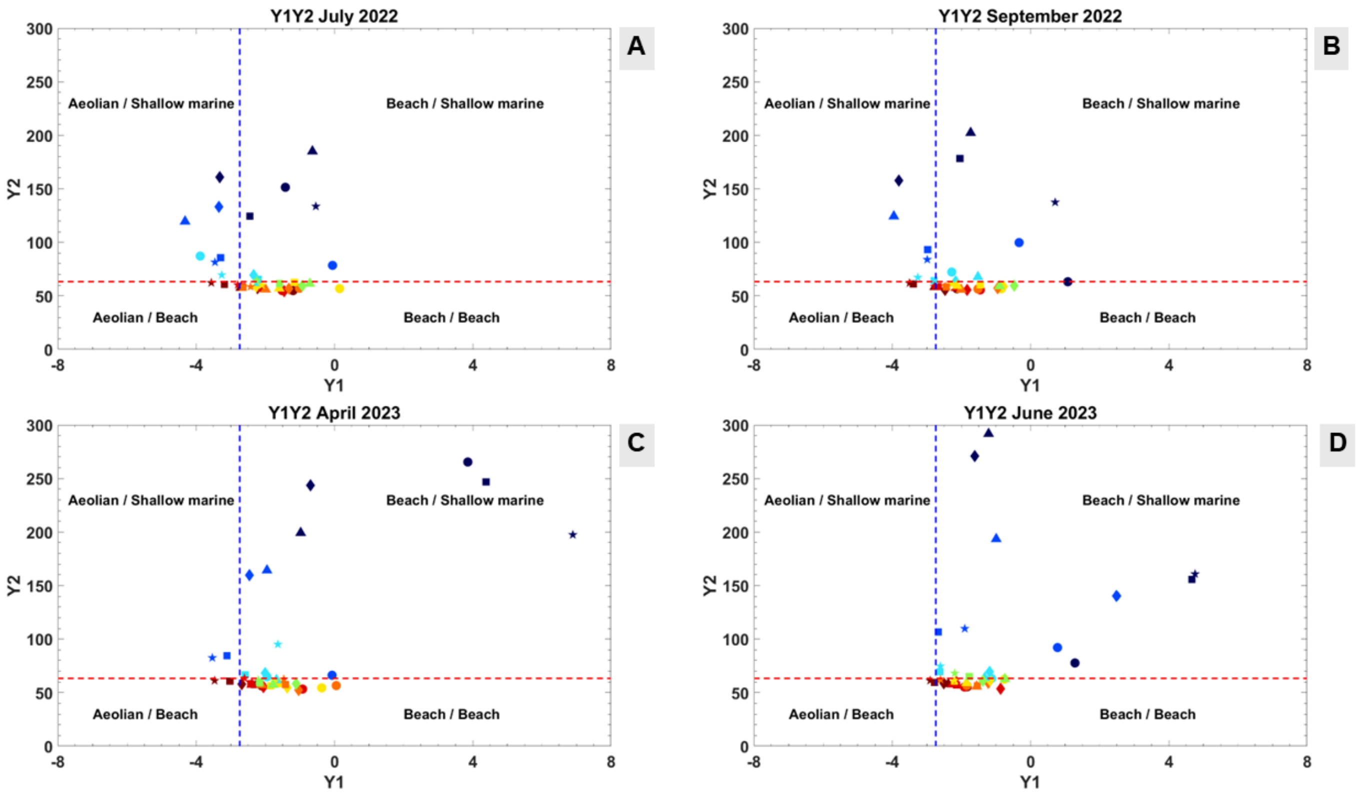


Figure 5 Classification of sediment accumulation environments Y1Y2 based on sediment samples obtained during A) July 2022, B) September 2022, C) April 2023, and D) June 2023. The symbols and colors are similar to those described in Figure 2.

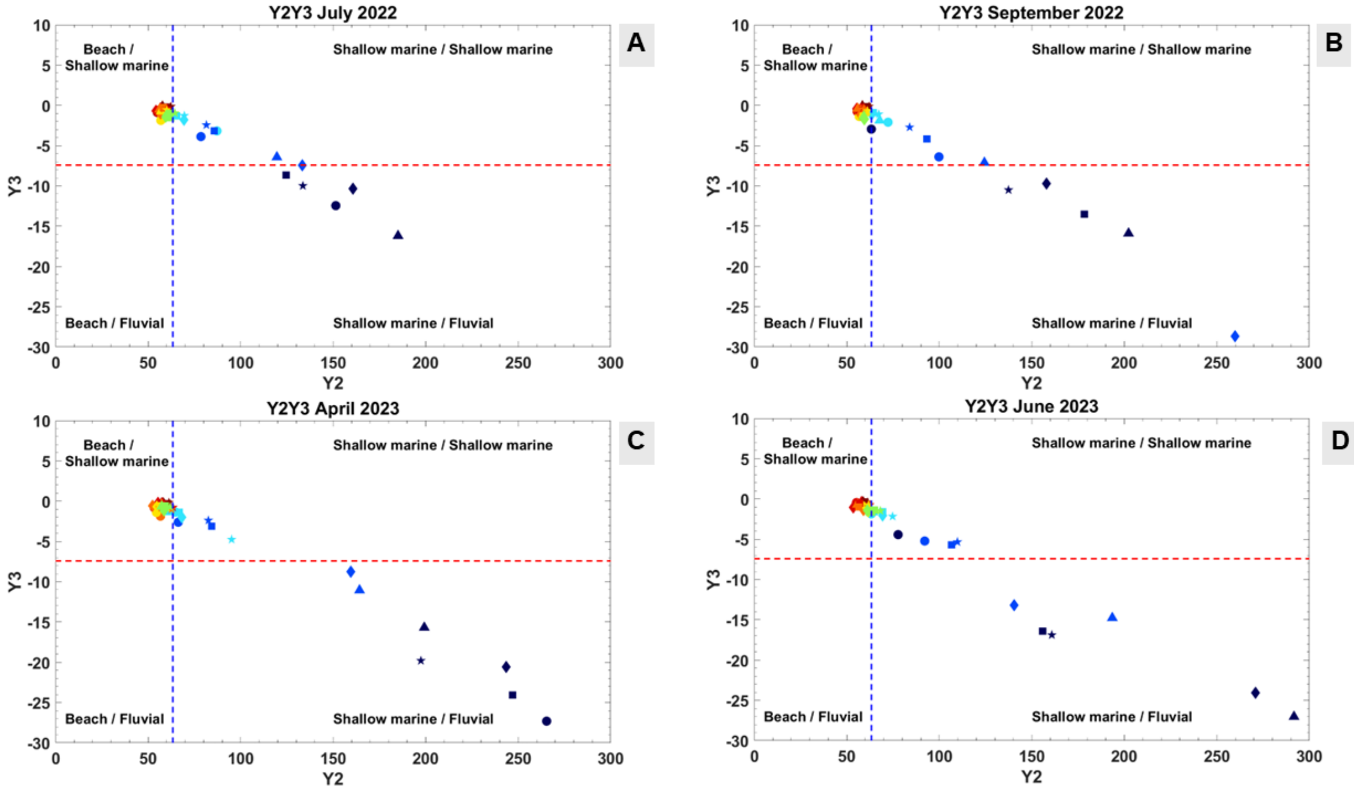


Figure 6 Classification of sediment accumulation environments Y2Y3 based on sediment samples obtained during A) July 2022, B) September 2022, C) April 2023, D) and June 2023. The symbols and colors are similar to those described in Figure 2.

6) CM diagram

The CM diagram in Passega [26] illustrates the relationship between sediment grain size, measured in microns at the first percentile, and the median value (D50), also in microns. This relationship is presented on a logarithmic scale and is used to describe the hydrodynamic forces influencing sediment accumulation.

The CM diagram is divided into six modes of sediment transport and deposition: N (rolling), P (rolling and suspension), Q (suspension and rolling), R (graded suspension), S (uniform suspension), and T (pelagic suspension). Analysis of the sediment samples collected during all four periods revealed that sediment accumulation in the study area occurred in only three modes: S (uniform suspension), R (graded suspension), and T (pelagic suspension).

Analysis of the four data collection periods revealed that the sediment movement mechanisms were consistent and could be categorized into four types: N (rolling), P (rolling and suspension), Q (suspension and rolling), and R (graded suspension). The CM diagram in Figure 7 displays distinctly different movement mechanisms between coastal and marine sediment samples. Coastal sediment samples primarily exhibited P (rolling and suspension) and Q (suspension and rolling) mechanisms, whereas marine sediments displayed a broader range of movement mechanisms.

For coastal sediments, the P (rolling and suspension) mechanism indicates that the sediment moves by both rolling and suspension, with medium to coarse grain sizes and moderate to high energy. The Q (suspension and rolling) mechanism indicates that sediment is primarily suspended, with some rolling motion, and typically involves medium-sized grains with moderate energy. Marine sediment samples also exhibited P (rolling and suspension) and Q (suspension and rolling) mechanisms, but some samples exhibited N (rolling), where sediment rolls along the seabed, indicating coarse grain sizes and high energy. Additionally, some marine samples display an R (graded suspension) mechanism, where sediment is sorted by size, with finer grains and lower energy over time. These variations in sediment movement mechanisms reflect the diversity of depositional environments involved in marine sedimentation. (Figure 7).

7) Sediment types

The percentages of sand, silt, and clay following the sediment size [27] were plotted on a ternary diagram based on Shepperd's classification [28], which categorizes sediments into 10 types: sand, silty sand, clayey sand, silt, sandy silt, clayey silt, clay, clay, sandy clay, silty clay and sandy clay (equal proportions of sand, silt, and clay).

Among the 154 sediment samples analyzed in the present study, only two sediment types were identified: sandy and silty sand. Among these samples, silty sand accounted for only 9 samples, accounting for 5.8% of the total. All the silty sand samples were collected exclusively from marine environments (Figure 8), while the coastal sediment samples were predominantly sandy, with nearly 100% of the sediment consisting of sand-sized particles. Both sandy and silty sands were present in the marine samples.

The exclusive presence of sand in coastal samples indicates a high-energy environment characterized by strong waves and currents capable of transporting finer particles away. In contrast, the presence of silty sand only in marine environments indicates a lower-energy environment, where finer particles can accumulate and settle.

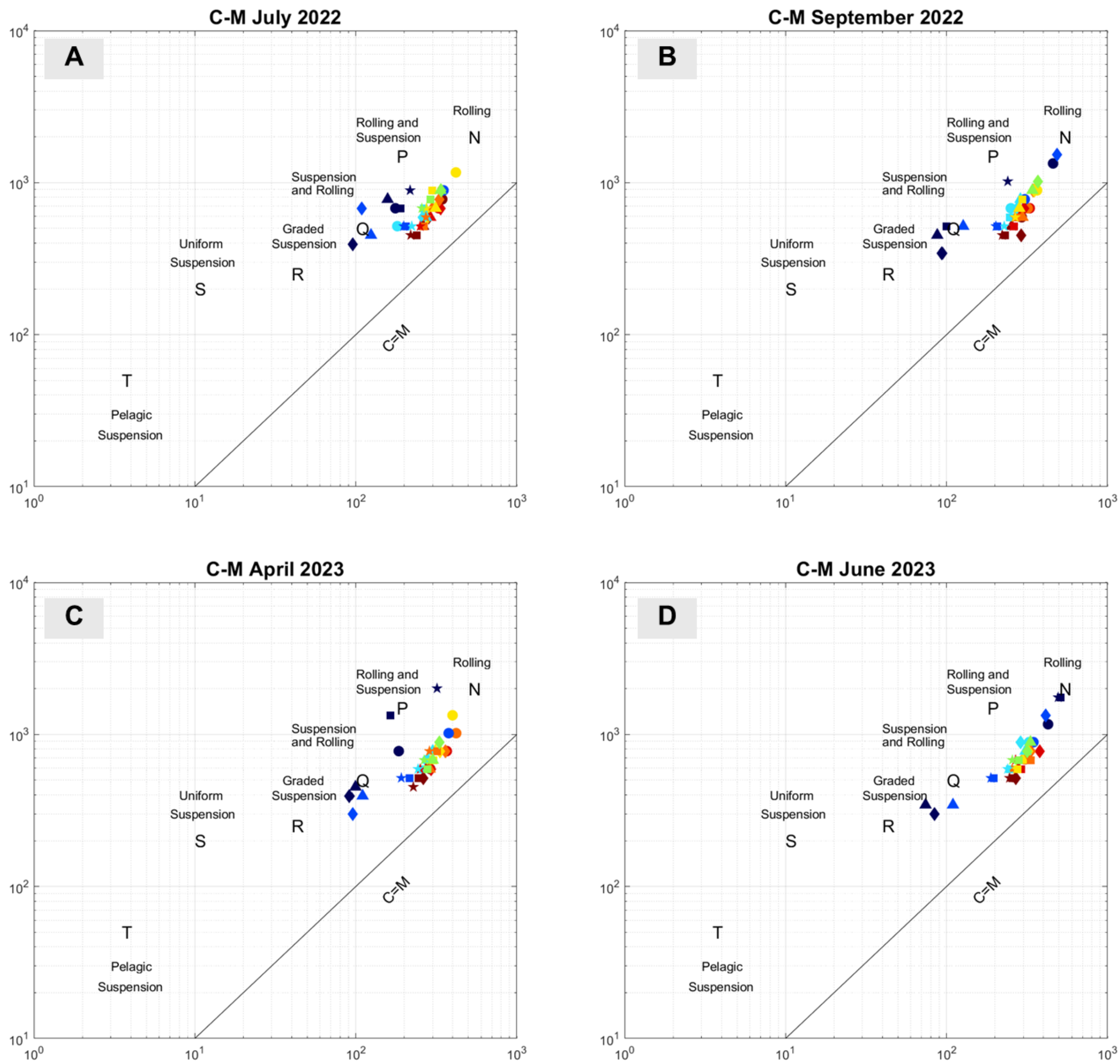


Figure 7 CM diagram based on sediment samples obtained during A) July 2022, B) September 2022, C) April 2023, and D) June 2023. The symbols and colors are similar to those described in Figure 2.

8) Quantity of sand, silt, and clay sediments

The sediment composition across all the samples ranged from 54.8% to 100.0% sand, 0.0% to 41.9% silt, and 0.0% to 3.2% clay. The highest proportion of sand was observed in July 2022, ranging from 71.7% to 100.0%, whereas in September 2022, the sand content ranged from 63.9% to 100.0%. In April 2023, the sand content ranged from 67.0% to 100.0%, and in June 2023, it ranged from 54.8% to 100.0%. The highest proportion of silt was found in June 2023, with silt contents ranging from 0.0% to 28.1% in July 2022, 0.0% to 35.6% in September 2022, 0.0% to 32.0% in April 2023, and 0.0% to 41.9% in June 2023. The highest proportion of clay was also observed in June 2023, similar to the silt distribution, with clay contents ranging from 0.0% to 0.2% in July 2022, 0.0% to 0.5% in September 2022, 0.0% to 1.5% in April 2023, and 0.0% to 3.2% in June 2023. Sample SS2/3 had the highest proportions of sand, silt, and clay in July and April, whereas sample SS3/3 had the highest proportions in September and June. Both samples were collected from most seaward locations in the central part of the study area. Furthermore, all coastal sediment samples collected in July 2022, September 2022, and April 2023 contained 100% sand, whereas the coastal sediment samples collected in June 2023 had sand contents ranging from 99.1% to 100.0%. Compared with coastal samples, seafloor samples had a lower proportion of sand but greater silt and clay contents. The sediments from the northern and southern parts of the study area had a greater proportion of sand than did those from the central part. This variation may be influenced by monsoon winds, currents, waves, and tidal forces, which affect the transport and deposition of sediments in the area (Figure 9).

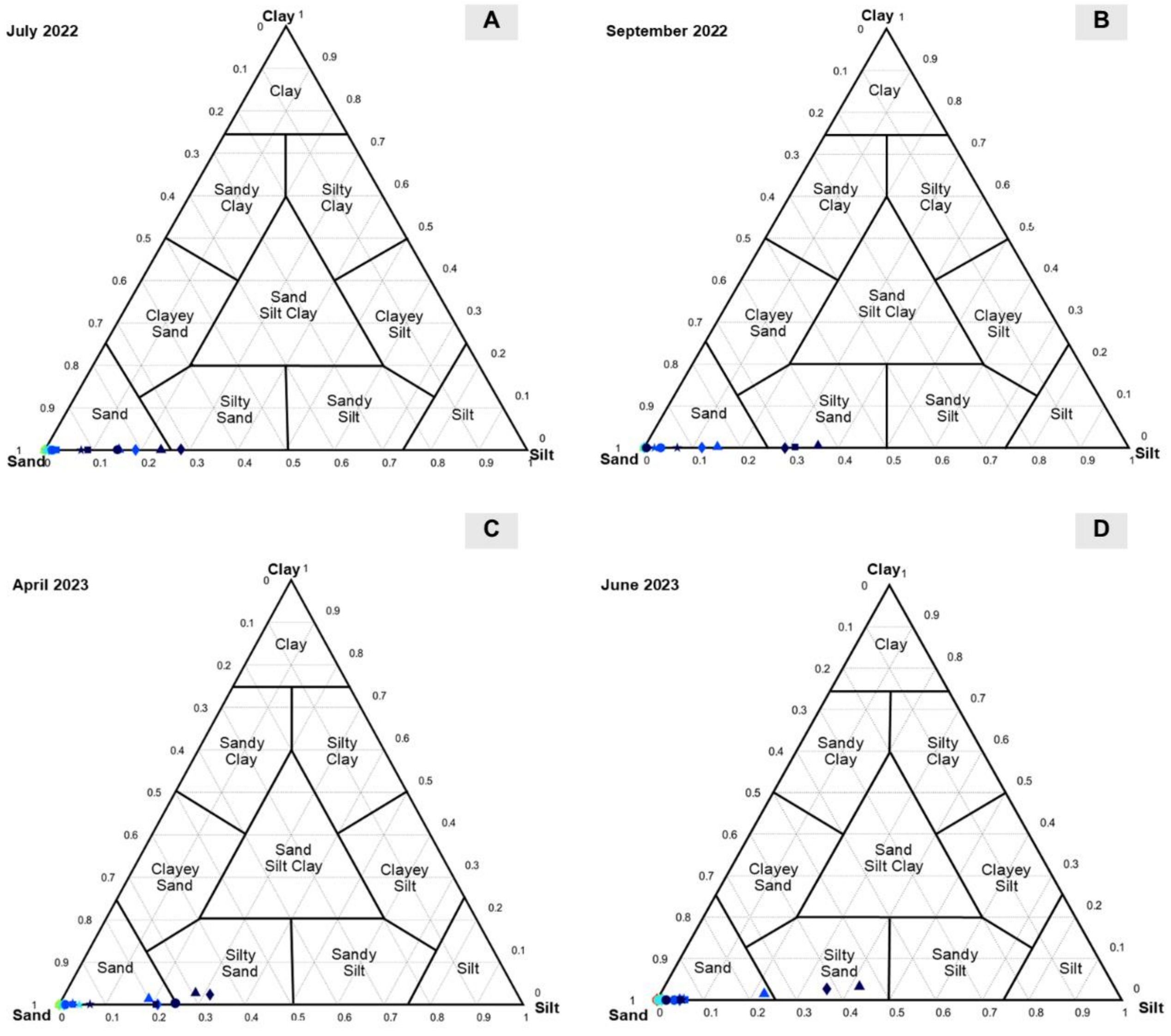


Figure 8 Sediment types obtained from sediment samples during A) July 2022, B) September 2022, C) April 2023, and D) June 2023. The symbols and colors are similar to those described in Figure 2.

Conclusions

In conclusion, this study provides valuable insights into the sediment characteristics of the Bang Berd-Khao Tham Thong beach system, a minimally disturbed coastal area in Thailand. A detailed analysis of sediment properties revealed that coastal sediments are influenced mainly by tidal movements, with some southern areas showing desert-like features driven by wind. Marine sediments are linked to shallow marine environments, with transitional features between coastal and fluvial deposition observed.

Statistical analyses, including the use of linear discriminant functions and the CM diagram, highlighted the hydrodynamic forces driving sediment transport and accumulation in the study area, revealing distinct depositional modes such as suspension and rolling, graded suspension, and pelagic suspension. Furthermore, the study revealed spatial variations in sediment composition, with coastal areas showing high sand contents, whereas marine samples presented increased silt and clay proportions.

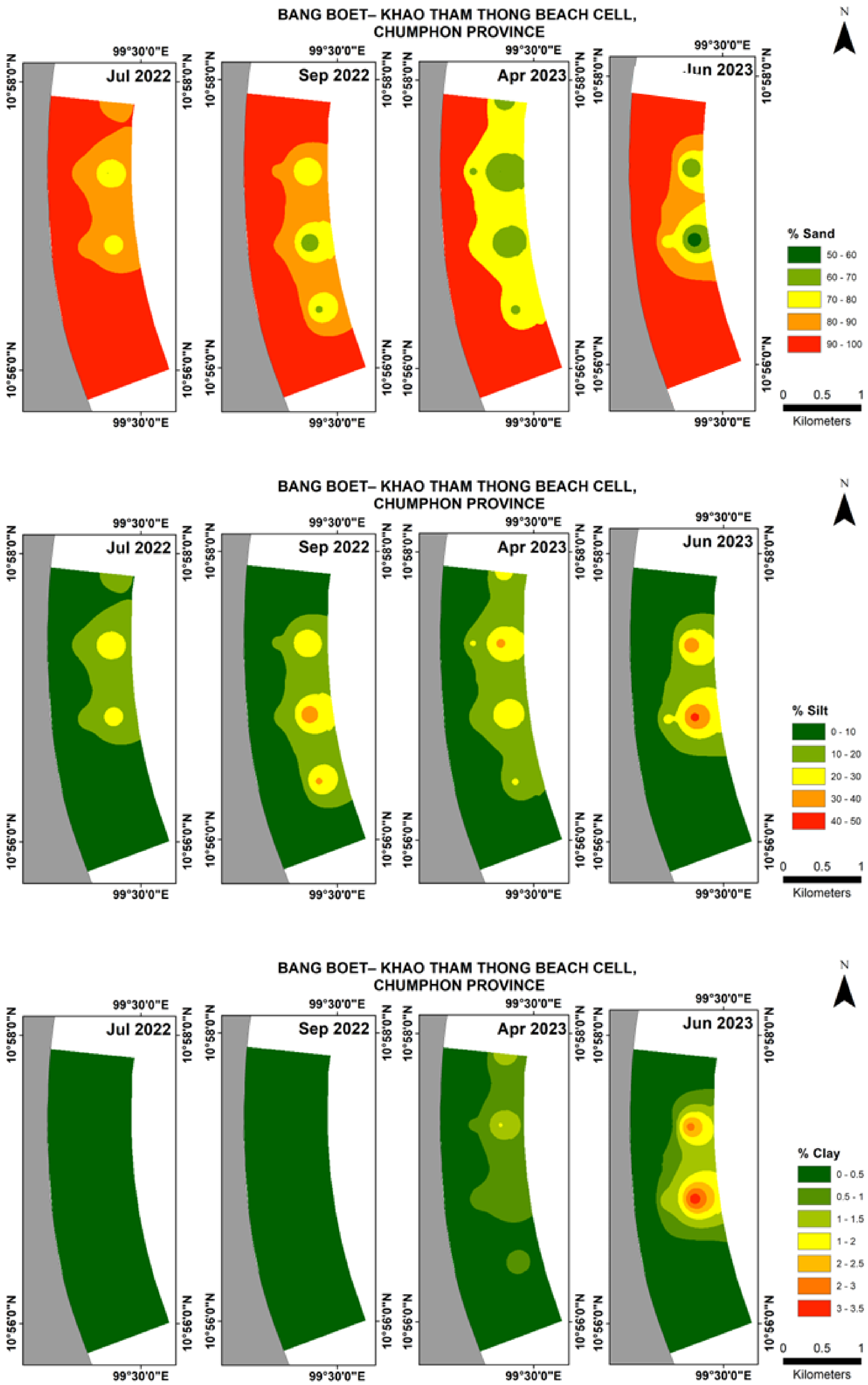


Figure 9 Distribution of the quantity of sand (upper panel), silt (middle panel), and clay (lower panel) sediments across different months.

This research contributes valuable knowledge to the field of sedimentology, providing critical data on sediment dynamics in coastal and marine environments. The results also have practical implications for coastal management, offering a better understanding of sedimentary processes that could inform strategies to address future challenges posed by climate change and coastal erosion.

Future studies will focus on collecting comprehensive data on sediment characteristics, including structure, surface features, and chemical composition across various areas and environmental conditions. Techniques such as SEM, EDS, and XRF can be used to improve accuracy and efficiency, helping to better understand sediment accumulation and movement in different environments.

Acknowledgement

This study was supported by a research grant from the Graduate Research Capacity Development Program 2022, Faculty of Science, Chulalongkorn University.

References

[1] Baiyegunhi, C., Liu, K., Gwavava, O. Grain size statistics and depositional pattern of the Ecca Group sandstones, Karoo Supergroup in the Eastern Cape Province, South Africa. Open Geosciences, 2017, 9(1), 554–576.

[2] Liang, J., Liu, J., Xu, G., Chen, B. Grain-size characteristics and net transport patterns of surficial sediments in the Zhejiang nearshore area, East China Sea. Oceanologia, 2020, 62(1), 12–22.

[3] Venkatesan, S., Singarasubramanian, S., Suganraj, K. Depositional mechanism of sediments through size analysis from the core of Arasalar river near Karaikkal, east coast of India. Indian Journal of Geo Marine Sciences, 2017, 46(10), 2122–2131.

[4] Wang, C., Chen, M., Qi, H., Intasen, W., Kanchanapant, A. Grain-size distribution of surface sediments in the chanthaburi coast, Thailand and implications for the sedimentary dynamic environment. Journal of Marine Science and Engineering, 2020, 8(4), 242.

[5] Román-Sierra, J., Muñoz-perez, J.J., Navarro-Pons, M. Influence of sieving time on the efficiency and accuracy of grain-size analysis of beach and dune sands. Sedimentology, 2013, 60(6), 1484–1497.

[6] Folk, R.L. The distinction between grain size and mineral composition in sedimentary-rock nomenclature. The Journal of Geology, 1954, 62(4), 344–359.

[7] Friedman, G.M. Distinction between dune, beach, and river sands from their textural characteristics. Journal of Sedimentary Research, 1961, 31(4), 514–529.

[8] Friedman, G.M. Dynamic processes and statistical parameters compared for size frequency distribution of beach and river sands. Journal of Sedimentary Research, 1967, 37(2), 327–354.

[9] Saha, K., Sinha, S. Grain size analysis and characterization of sedimentary process in tidal flat of Chandipur Region, East Coast of India. Marine Geodesy, 2021, 44(5), 485–503.

[10] Sahu, B.K. Depositional mechanisms from the size analysis of clastic sediments. Journal of Sedimentary Research, 1964, 34(1), 73–83.

[11] Barnard, P.L., Schoellhamer, D.H., Jaffe, B.E., McKee, L.J. Sediment transport in the San Francisco Bay coastal system: An overview. Marine Geology, 2013, 345, 3–17.

[12] Dickson, M.E., Walkden, M.J., Hall, J.W. Systemic impacts of climate change on an eroding coastal region over the twenty-first century. Climatic Change, 2007, 84(2), 141–166.

[13] Masselink, G., Russell, P. Impacts of climate change on coastal erosion. MCCIP Science Review, 2013, 71–86.

[14] Department of Mineral Resources (DMR). Resources: Beautiful sand dunes guide. Bangkok, Thailand, 2023.

[15] Prachantasen, N., Choowong, M., Pailoplee, S., Phantuwongraj, S. Sedimentary characteristics of sand dune from Bang Berd, Chumphon Province, southern Thailand. Bulletin of Earth Sciences of Thailand, 2008, 1(1&2), 28–34.

[16] Lertnok, W., Choowong, M., Thitimakorn, T. Geomorphology and ground penetrating radar profiles of Holocene coastal dune, western coastal plain of the Gulf of Thailand. Bulletin of Earth Sciences of Thailand, 2010, 3(1), 17–27.

[17] Wonphuk, P. Sediment budget analysis of Bangberd beach cell. The 26th National Convention on Civil Engineering, Online Conference, 23–25 June 2021.

[18] Dietze, E. Hartmann, K., Diekmann, B., Ilmker, J., Lehmkuhl, F., Opitz, S., … Borchers, A. An end-member algorithm for deciphering modern detrital processes from lake sediments of Lake Donggi Cona, NE Tibetan Plateau, China. Sedimentary Geology, 2012, 243, 169–180.

[19] López, G.I. Grain size analysis. Encyclopedia of geoarchaeology, 2017, 341–348.

[20] Blott, S.J., Pye, K. GRADISTAT: A grain size distribution and statistics package for the analysis of unconsolidated sediment. Earth Surface Processes and Landforms, 2001, 26(11), 1237–1248.

[21] Folk, R.L., Ward, W.C. Brazos River bar [Texas]; A study in the significance of grain size parameters. Journal of Sedimentary Research, 1957, 27(1), 3–26.
[22] Nhon, D.H., Thao, N.V., Thanh, T.D., Ve, N.D., Vuong, B.V., Thuy, L.T.B., …, Nghi, D.T. Characteristic and distribution of grain sizes and minerals in sediments from the Vietnamese Gulf of Tonkin. Vietnam Journal of Science, Technology and Engineering, 2023, 65(2), 88–96.
[23] Hairan, M.H., Jamil, N.R., Azmai, M.N.A., Looi, L.J., Aris, A.Z., Rosli, M.H. The analysis of large dam impacts on sediment grain size distribution in a tropical river system. Civil Engineering Journal, 2023, 9, 15–26.
[24] Ostrowski, A. The application of different methods for the investigation of glacial deposits in Donegal and grain size analysis of marine sediment cores. ResearchGate, 2018. [Online] Available from: https://www.researchgate.net/publication/378071758_The_application_of_different_methods_for_the_investigation_of_glacial_deposits_in_Donegal_and_grain_size_analysis_of_marine_sediment_cores
[25] Kasim, S.A., Ismail, M.S., Ahmed, N. Grain size statistics and morphometric analysis of Kluang-Niyor, Layang-Layang, and Kampung Durian Chondong tertiary sediments, onshore peninsular Malaysia: implications for paleoenvironment and depositional processes. Journal of King Saud University-Science, 2023, 35(2), 102481.
[26] Passega, R. Grain size representation by CM patterns as a geologic tool. Journal of Sedimentary Research, 1964, 34(4), 830–847.
[27] Wentworth, C. K. A scale of grade and class terms for clastic sediments. The Journal of Geology, 1922, 30(5), 377–392.
[28] Shepard, F.P. Nomenclature based on sand-silt-clay ratios. Journal of Sedimentary Research, 1954, 24(3), pp. 151–158.