

PAPER • OPEN ACCESS

Grain size parameter of sediment in Leupung Beach, Aceh Province

To cite this article: S A Azis *et al* 2019 *IOP Conf. Ser.: Earth Environ. Sci.* **348** 012132

View the [article online](#) for updates and enhancements.

Grain size parameter of sediment in Leupung Beach, Aceh Province

S A Azis¹, R S Isman¹, S Agustina¹, S Antoni², I Setiawan¹, S Purnawan^{1*}

¹Department of Marine Sciences, Faculty of Marine and Fishery Sciences, Universitas Syiah Kuala, Banda Aceh 23111, Indonesia

²Faculty of Marine Science, Department of Marine Geology, King Abdulaziz University, Saudi Arabia

*Email: syahrulpurnawan@unsyiah.ac.id

Abstract. We investigated the sediment conditions on the Leupung Beach, located in Aceh Besar District, Aceh Province. Sampling was carried out in November 2018 at 3 stations along the coastline. Sediment sampling was carried out in the swash zone area by dividing each station into two zones, namely upper swash zone (USZ) and lower swash zone (LSZ). Sediment samples were taken vertically using a modified coring pipe to a depth of 15 cm. Sediment stratification was done by dividing the sample into 3 layers, where each layer has a thickness of 5 cm. The results obtained are sediment in the USZ area in the form of fine sand; moderately sorted to moderately well-sorted; symmetrical to coarse skewed; mesokurtic to very leptokurtic, while LSZ in the form of fine sand; moderately sorted to moderately well-sorted; symmetrical to coarse skewed; platykurtic to leptokurtic. The difference in position between LSZ and USZ, relative to the water level, gives a difference in the grain size distribution between the two.

1. Introduction

The coastal area is where the action took place. The type and condition of sediments on a coast are determined by rock sources, wave action, longshore and water transport [1]–[3]. Studies of sediments on the coast are also important in relation to beach erosion and morphodynamics [4], [5]. The size of the sediment grains is still one of the most important tools in predicting the dynamic processes and condition of a depositional environment, specifically in an aquatic area. The unevenness distribution pattern of sediment size fractions can be used as an indicator of sediment behavior, transport history and depositional process by transport agents [6]–[9].

Swash zone is a part of the coast where sediment conditions in this area are affected by the complexity of the water flow formed by the swash mechanism [10], [11]. Lower swash zone (LSZ), an area closer to the sea, is faced with conditions that are most often exposed to energy from the sea than the upper swash zone (USZ), as USZ received less energy from the sea.

Leupung is a village situated in Aceh-Besar Regency. Located at the end of Sumatra Island, the beach is facing the Indian Ocean on the west side. Periodically, Leupung beach has also certainly gotten the influence of the Indian monsoon. This study was carried to assess the condition of sandy sediment at



Leupung beach. The aim of this study was to deduce the sediment characteristic in Leupung Beach from analysis of quaternary sediment. Furthermore, this study is the initial stage of the study of temporal sediment behavior at Leupung beach.

2. Methods

The field survey was arranged during November 2018 along the Leupung coast (Fig. 1). A total of three stations were determined to represent the Leupung beach area and location coordinates were taken using GPS. Sediment collection was done twice at each station representing the LSZ and USZ regions.

The coring process was taken vertically using a modified PVC pipe to take sediment to a depth of 15 cm (fig. 2). Sediment samples were divided into three layers with a thickness of 5 cm, i.e. 0-5cm, 5-10cm, 10-15cm, which were measured from the surface. Standard sieves are used to sort the sediment samples based on the wet sieve method using seven grades of sieves: 2mm, 1mm, 0.5mm, 0.25mm, 0.125mm, 0.063mm, and 0.038mm. Each sample of sediment was dried to remove the moisture and calculated the weight of the remaining sediment from each sieve. Statistical parameters were calculated using the Gradistat Software [12] following original Folk and Ward formula [13].

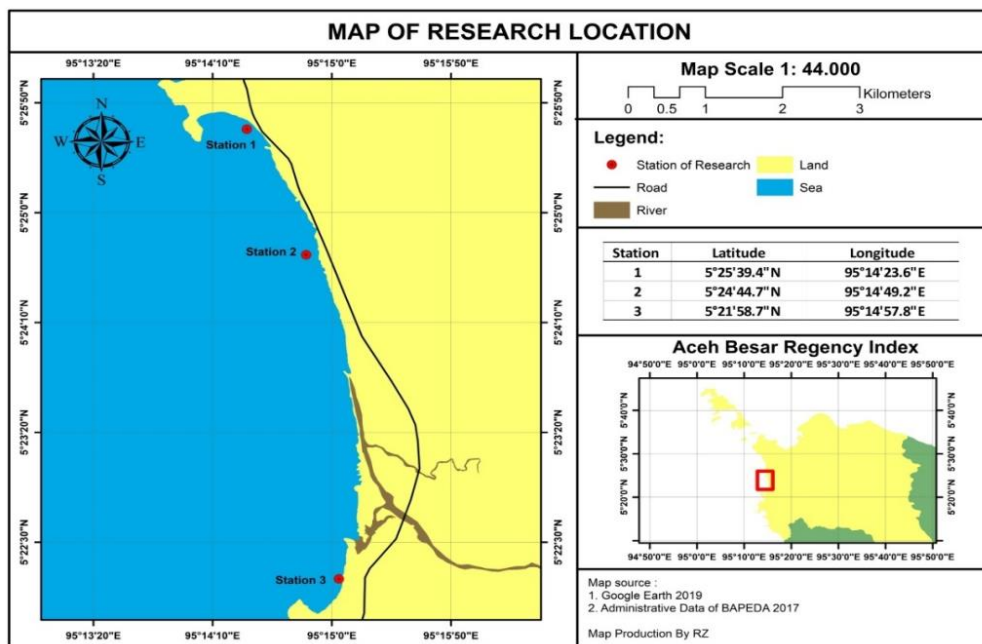


Figure 1. The sediment sampling station at Leupung village, Aceh Besar district.



Figure 2. Field data collection process (a); GPS was used to obtain the precise coordinate (b); seven level of sediment sieves (c).

3. Result and discussion

All samples were found to be unimodal and dominated by fine sand fractions. While the occurrence of the gravel fraction is only found at station 3, so that induce sediments with the type Slightly Gravelly Sand to Gravelly Sand (Table 1).

Table 1. Sediment weight distribution (%) per fraction at USZ and LSZ

St.	layer (cm)	Size (mm)							Total	Type	
		2	1	0.5	0.25	0.125	0.063	0.038			
USZ	1	0-5	0.00%	0.00%	0.05%	0.01%	85.85%	13.77%	0.31%	100%	Sand
		5-10	0.00%	0.00%	0.41%	0.03%	87.87%	11.49%	0.20%	100%	Sand
		10-15	0.00%	0.00%	0.01%	0.08%	94.26%	5.62%	0.04%	100%	Sand
	2	0-5	0.00%	0.54%	0.19%	31.44%	64.44%	3.37%	0.01%	100%	Sand
		5-10	0.00%	0.00%	0.14%	27.64%	67.42%	4.75%	0.04%	100%	Sand
		10-15	0.00%	0.00%	0.29%	33.10%	62.70%	3.88%	0.03%	100%	Sand
	3	0-5	4.32%	5.40%	4.38%	3.24%	68.91%	13.63%	0.13%	100%	Slightly Gravelly Sand
		5-10	0.74%	0.51%	0.47%	0.93%	83.86%	13.42%	0.07%	100%	Slightly Gravelly Sand
		10-15	0.35%	0.62%	0.81%	0.71%	77.35%	20.02%	0.14%	100%	Slightly Gravelly Sand
LSZ	1	0-5	0.00%	0.00%	0.08%	0.10%	86.76%	12.99%	0.08%	100%	Sand
		5-10	0.00%	0.00%	0.02%	0.47%	87.50%	11.92%	0.09%	100%	Sand
		10-15	0.00%	0.00%	0.01%	1.81%	90.45%	7.72%	0.01%	100%	Sand
	2	0-5	0.00%	0.18%	10.94%	38.46%	47.64%	2.72%	0.05%	100%	Sand
		5-10	0.00%	0.11%	5.19%	20.57%	69.20%	4.91%	0.02%	100%	Sand
		10-15	0.00%	0.16%	6.18%	31.16%	58.47%	4.01%	0.02%	100%	Sand
	3	0-5	11.10%	0.12%	2.36%	25.43%	57.28%	3.70%	0.01%	100%	Gravelly Sand
		5-10	4.07%	0.11%	1.53%	24.23%	67.28%	2.79%	0.00%	100%	Slightly Gravelly Sand
		10-15	0.03%	0.28%	4.98%	57.76%	34.49%	2.44%	0.02%	100%	Slightly Gravelly Sand

Calculation of sediment statistical parameters such as mean, sorting, skewness, and kurtosis was obtained entirely using the Gradistat V.8 software (Figure 3). Based on the calculation of all parameters

from the three observation stations, the surface layer area (0-5 cm) has the most varied sediment conditions compared to the deeper layers, specifically showed by the standard error values obtained. In other words, the sediment properties became less varied as it comes to deeper layers.

The sedimentary layer on the surface gained direct interaction from above, both ocean and wind interaction, depending on the various inputs and processes that have occurred. Although the distance between stations is not too far away, the specific conditions between stations, as well as coastal morphology, very likely produce different sedimentary properties.

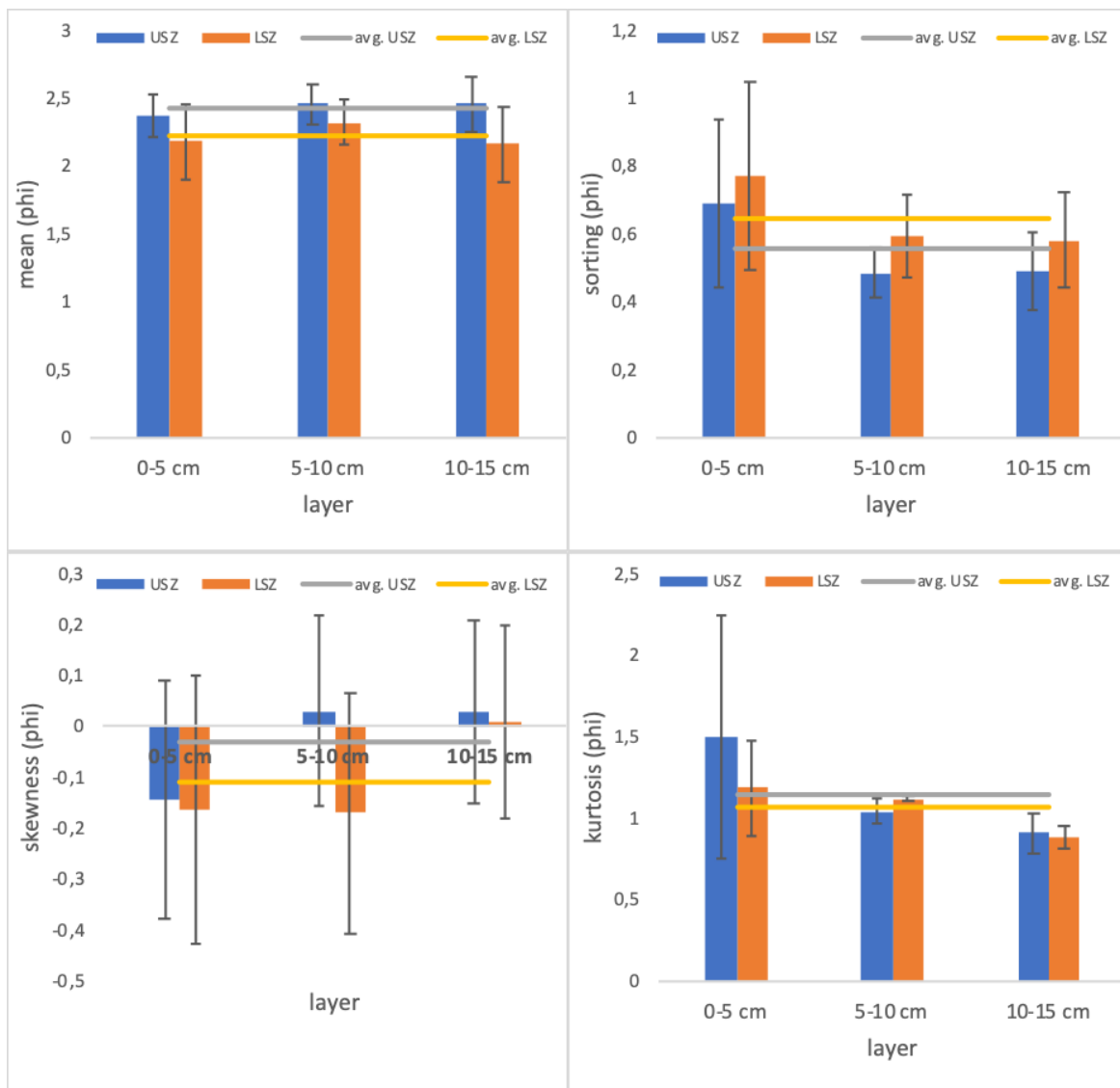


Figure 3. Sediment statistical parameters i.e. mean, sorting, skewness, and kurtosis in Leupung Beach

The mean value (phi) of Leupung beach sediment is dominantly in the size class of the fine sand (0.125mm to 0.250mm), with USZ has finer grains compared to LSZ by averaging the mean value (Fig.

3). Both of USZ and LSZ were moderately well-sorted, although USZ had better sorting conditions than LSZ. The presence of the gravel fraction is thought to contribute to the poorer sorted sorting value of the LSZ. The location of the LSZ likely has diverse conditions, which differ at high tide conditions (more covered and closer to location of wave action) and at low tide (more exposed and only get less energy from swash). However, USZ had less variation produced by the swash mechanism only during high tide conditions, which brings finer grains to the USZ region. These states were also confirmed by skewness properties where the LSZ area negatively skewed while USZ has found as symmetrical. Though the value difference is insignificant, USZ has a leptokurtic curve, yet LSZ has a mesokurtic curve on average.

Vertically, USZ has a slight tendency of grain size becomes finer in the deeper layers. Furthermore, sorting value gets smaller as depth increases, which means better sorting conditions in deeper layers. Commonly well sorted sediments tend to have a leptokurtic, yet Leupung sediments showed a flatter curve in deep layers, which indicates something opposite of the existing sorting pattern. Skewness values indicate a slight pattern to be positively skewed on a deeper layer. The surface layer has been exposed to high energy, and the energy gets smaller downward, which also removes fine grains and leaves coarser grains, which will result in a negatively skewed surface area on Leupung Beach.

Though in general there was no noticeable pattern of vertically formed on Leupung beach, yet the vertical pattern is slightly seen in a number of parameters. The high standard error value of various parameters measured makes it rather difficult to present precise conclusions.

4. Conclusion

The high standard error value in the LSZ indicates that the area has a fairly varied sediment size distribution. By average, both USZ and LSZ moderately well sorted and grain sizes in the range of fine sand. Furthermore, the skewness value indicates LSZ is coarse skewed and USZ has symmetrical in average. There is no tendency obtained by grain size parameter values differ as depth layer increase.

Acknowledgements

Authors would like to thank LPPM Unsyiah for financial assistance under 'Penelitian Dasar Grants', with contract number: 63/UN11.2/PP/SP3/2019. We also thank to our Laboratory staff: Muchlis and Muntazir, which helped a lot along the data preparation and analysis.

References

- [1] Gopikrishna B, M C Deo 2018 *Geomorphology* **303** 243–255
- [2] Anderson J B, D J Wallace, A R Simms, A B Rodriguez, K T Milliken 2014 *Mar. Geol.* **352** 348–366
- [3] Ruggiero P, M Buijsman, G M Kaminsky, G Gelfenbaum 2010 *Mar. Geol.* **273**(1–4) 127–140
- [4] Hanley M E *et al.* 2014 *Coast. Eng.* **87** 136–146
- [5] Loureiro C, Ó Ferreira, J A G Cooper 2012 *Geomorphology* **139–140** 155–171
- [6] Purnawan S, H A Haridhi, I Setiawan, M Marwantim *J. Ilmu dan Teknol. Kelaut. Trop.* **7**(1) 15–22
- [7] Purnawan S, R Adidarma, Z Jalil, C Akmal, Y Ilhamsyah 2018 *Aceh Int. J. Sci. Technol.* **7**(1) 63–68
- [8] Jiang C, Z Wu, J Chen, B Deng, Y Long 2015 *Procedia Eng.* **116**(1) 771–777
- [9] Nottebaum V, F Lehmkuhl, G Stauch, H Lu, S Yi 2015 *Geomorphology* **250** 113–127
- [10] Chardón-Maldonado P, J C Pintado-Patiño, J A Puleo 2016 *Coast. Eng.* **115** 8–25
- [11] Alsina J M, I Cáceres 2011 *Coast. Eng.* **58**(8) 657–670
- [12] Blott S J, K Pye 2001 *Earth Surf. Process. Landforms* **26**(11) 1237–1248
- [13] Folk R L, W C Ward 1957 *J. Sediment. Petrol.* **27** 3–26