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The impact of winter monsoon on changes of sediments grain size in the sub-tidal zone on northern coasts of Makoran Sea

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ABSTRACT

The northern coast of Makoran (Oman) Sea is a habitat for aquatic species; it suffers changes in environmental factors like particle sizing, influenced by the monsoon phenomenon. Therefore, sampling was carried out in 3 time procedures: winter pre-monsoon, winter monsoon, and winter post-monsoon in 3 areas named Ramin, Beris and Pasabandar from the month of October (2015) all the way through March(2016), using a Van-Veen Grab Sampler ($0.025m^2$). The results indicated that in the pre-monsoon month, gradation range was 0.04 (sand) to 97.76 (Mud=silt-clay), 0.24 to 96.48 in monsoon month, and 0.04 to 95.76 percent in the post-monsoon period. Overall, 55% of the sediments were composed of silt-clay (0.063 mm). Pasabandar Harbor had the highest amount throughout all seasons, with an average of 66.25± 18.56. Based on the one-way ANOVA, there was no significant difference within the months of sampling in various stations for measuring out the sediments. (P>0.05).According to the Duncan test, the weight of sediments sampled with a sieve below 0.063 mm was remarkably higher than other sieves. Based on the results, the bed texture was

of silt-clay in all seasons but in the month of March, or post-monsoon, these particles were smaller than in the earlier months; this was probably because of pacification of flows and deposit of fine aggregate sediments after the severe regional storms in earlier months, changing the texture of the area. On the other hand, spatial and temporal differences in the bed material can be attributed to various factors such as environmental ones.

Key Words: Makoran Sea, Particle Sizing, Sediments, Monsoon

1. INTRODUCTION

Oman is the only open sea in Iran affected by a hot tropical climate (11). Chabahar Bay, located in the southeast of the country and near the Gulf of Oman, is influenced by seasonal monsoon phenomenon, which has an effect on the diversity and richness of plankton in the bay, considered the basis of the food chain in the bay (5).

Monsoon cycles cause short seasonal monsoon winds in summer and strong winds in winter (8). The monsoon phenomenon is among the factors affecting climate conditions in the Gulf of Oman Sea, which can make changes in the seabed texture, with its seasonal storms followed by seasonal floods (10). The effect of the winter monsoon is so strong in most years that it makes problems for fishing activities and imposes stagnation of the industry.

Physical stability of the bed and sedimentary texture are among the main factors determining the type of animals which can live in a special part of the seabed (1). By sedimentary texture and its composition, we first mean the size of its components and second the amount of its nutrients and organic materials (4). Therefore, one can say that the composition of the sediments and the stability of the bed are interrelated factors which affect the distribution and expansion of benthic organisms (12). Some of the benthic species might choose a special bed and ecosystem for themselves; in this case the seabed quality indicates their type. As a result, these species are used as indicator species to introduce types of benthic communities in the seabed (13). Therefore, one of the objectives of this study is to determine the effect of the winter monsoon on the changes in the seabed material in the sub-tidal zone in the northern coasts of the Makoran (Oman) sea.

Figure 1 Geographical location of the sampled areas in the north of Makoran (Oman) Sea

2. MATERIALS AND METHODS

Sampling Location

The laboratory-field research has been conducted in the areas under investigation: the northern coasts of Makoran Sea in the province of Sistan and Baluchestan off the coasts of Chabahar (Ramin, Beris and Pasabandar).

Sample Collecting Method

Sampling was carried out based on winter monsoon in early October 2015 (pre-monsoon), January 2015 (monsoon) and March 2016 (post-monsoon) in 3 areas named Ramin with 3 stations, Beris with 3 stations, and Pasabandar including 4 stations (figure 1), using Van Veen Grab sampler of 0.025 square meters 3 times.

Laboratory Test

Some of the sediments were dried at 70^{0}C for 24 hours to do particle sizing. Then 250 ml water and 10 ml Sodium Hexametaphosphate were added to 25 grams of the dried sediments. They were stirred for 15 minutes with a vibration shaker and left there to be settled overnight (Deposit was formed). The following January, the sediments were again stirred for 15 minutes and then were passed through a 63-micron sieve so that no sediments could penetrate the sieve. After that, the remaining materials in the sieve were dried in the oven at 70 degrees Celsius.

Finally, they were carefully passed through a series of sieves with openings of 0.063, 0.125, 0.5, 1, and 2 mm. The amount of the sediments remaining in each sieve was carefully extracted and accurately weighed. This way, the weight of each particle was determined. Then, their weight percentage was computed and eventually, their distribution frequency was obtained (2). The sedimentary particles were classified based on the Wentworth Table.

3. RESULTS

Changes in average sedimentary grain sizing in various seasons are illustrated in Fig2. In the pre-monsoon month gradation range was 0.04 to 97.76, in monsoon month 0.24 to 96.48 and in the post-monsoon 0.04 to 95.76 percent between stations. Pre-monsoon (4.45±0.37) was ranked the highest in amount of sediments, followed by monsoon month (4.14±0.02) and post-monsoon (4.09±0.10) respectively. But according to the one-way ANOVA test, no significant difference was noticed within the months when sediments were sampled ($F_{(2,9)}$ 0.471and $P>0.05$).

Overall, 55 percent of the sediments contained silt-clay particles (0.063 mm) and Pasabandar Harbor was ranked the highest in all seasons with an average percentage of 66.25±18.56. Here Pasabandar is ranked high due to its sediments.

The highest amounts of coarse aggregate were acquired in Ramin, station 3, and the lowest in Beris and Pasabandar, stations 2 and 3. Furthermore, according to the one-way ANOVA test, there was no significant difference among various sampling stations in terms of the size of sediments ($F_{(9,29)}$ 37,79 and $P>0.05$).

The average weight of sediments (g) is demonstrated based on the applied sieve in Table 1. The highest percentage in sediment weights (g) was calculated 55/74% in a sieve with openings below 0/063 mm and the lowest, 0/4 %, in 1 mm sieve. On the other hand, based on the one-way ANOVA, a significant difference was observed among different sampling sieves in terms of sediments weight ($F_{(5,545)}$ 2.412 and $P>0.05$).In addition, according to the Duncan test, the significance of the sieve with openings under 0/063 mm was substantially greater than other groups.

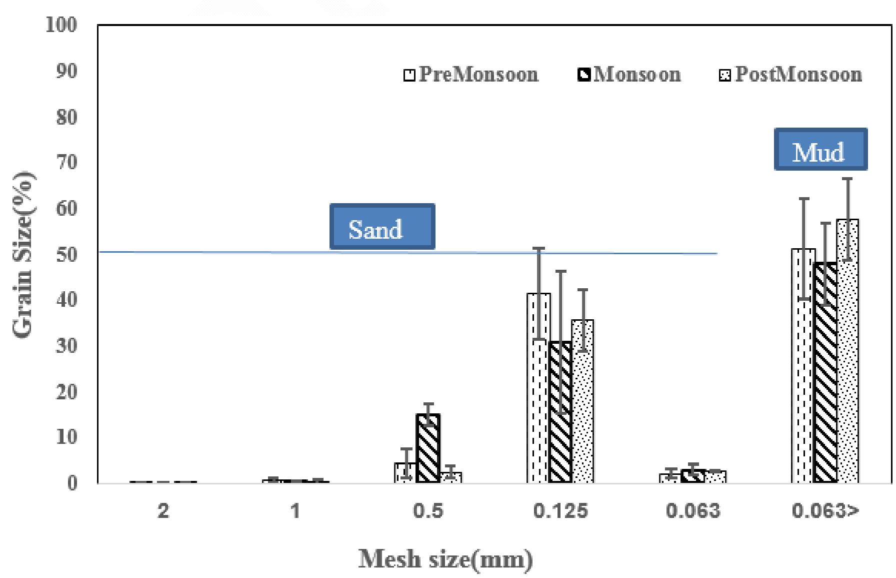

Figure 2 Average percentage in grain sizing (Mean±SD) in different seasons by sieve size (mm).

Table 1 Mean and Standard Deviation of the size of sediment particles in all seasons among sampling stations and sieve size (mm).

		2	1	0.5	0.125	0.063	>0.063
Ramin	St1	0.00±0.00	1.10±0.77	17±12.95	22.67±49.55	0.76±2.53	**12±33.89**
	St 2	0.07±0.04	1.13±1.22	7.51±8.72	19.64±35.44	1.66±2.68	**18.47±47.52**
	St 3	20.56±10.22	0.89±0.26	12.84±17.68	27.42±74.68	1.56±0.67	**23.85±6.72**
Beris	St 1	0.04±0.01	0.45±0.26	12.84±8.49	4.48±23.68	0.69±1.44	**7.42±70.83**
	St 2	0.00±0.00	0.38±0.27	9.14±6.75	21.35±39.89	0.72±0.96	**22.51±52.10**
	St 3	0.00±0.00	0.32±0.05	8.21±6.75	25.43±62.10	6.06±13.13	**28.6±14.56**
Pasabandar	St 1	0.04±0.02	0.34±0.23	2.01±4.38	5.68±10.8	0.17±0.13	**7.44±84.4**
	St 2	0.04±0.02	0.26±0.10	0.069±2.19	0.069±5.49	0.069±0.18	**0.069±19.92**
	St 3	0.00±0.00	0.27±0.23	1.8±2.67	5.24±8.1	0.16±0.07	**20.19±88.74**
	St 4	0.05±0.07	0.47±0.57	2.24±4.56	8±21	1.15±2.42	**21±71.14**
Total Average		9.58±1	0.69±0.4	10±7.26	27±33.19	4±2.37	**17.3±55.74**
		Sand					**Mud**

4. DISCUSSION

The Gulf of Oman's climate is totally different than other southern areas in the country. Summer and winter monsoon winds blow along the coasts, causing the sea level to rise and form the phenomenon of upwelling (3). The composition of sediment particle sizing is a major factor which not only affects all environmental factors but also plays a significant role in dispersion and distribution of benthos (6), which is associated with the retention feature of organic matters in fine aggregate sediments. Coarse aggregate sediments retain a larger amount of water and organic matter. Here, the water flow is very slow through the particles and therefore, when factors like temperature and salinity are involved, they would change slowly.

Each type of macrobenthic groups lives in special sediments, so a change in benthos can result from a change in the type of sediments (13).

In this study, particles over 2 mm in size were not observed and most particles were placed at sand textures between 65 and 125 microns, i.e. fine and very fine sand. In general, the analysis of sediment particle sizing in the sampled areas during 3 periods showed that they are covered in sand-(fine sand); mud textures which are termed sand-mud bed type (Table1). The results were similar to those by Moghaddasi *et al*. (2009); their sedimentological studies showed that the sedimentary texture of the Gulf of Oman sediments mostly consists of sand, clay and silt.

Also, in another study by Gray *et al.,* (2002), he has reported that the materials of sediments in tropical and subtropical beds are often made of silt-clay followed by sand. The current study is consistent with his finding[15].The bed texture in the Gulf of Oman was of fine sand in all seasons, but in March (post-monsoon), the sand particles were smaller than earlier months; on the whole, the diameter of sedimentary particles in the post-monsoon period was the largest in all stations. In fact, the order is as follows: post-monsoon, monsoon, and pre-monsoon in Chabahar Bay, which is consistent with the results by Shakoori (2009) in the sub-tidal zone of the bay.

The above results are probably due to severe storms in the region during this month, which has led to a change in the texture. Hylberg et al. (1985) reported that the intensity and direction of monsoon winds have remarkable effects on the sedimentary texture as well as on the diversity and density of macrobentic fauna (7). On the other hand, spatial and temporal variations in the bed material can result from various factors including biological factors, primary production, competition, and consistency with the environment (9).

According to the findings, the highest amount of coarse aggregate sediments belonged to station 3 of Ramin and the lowest was calculated in station 2 of Ramin. Perhaps station 2 contained the finest sedimentary particles as a result of being immune from the sea waves that occur in stations 1 and 3.

5. CONCLUSION

According to the results, although there was no significant difference within the months of sampling in various stations in terms of sediment size, the sedimentation pace was lower due to the roughness and turbulence of the sea in the monsoon period; and the closer to the end of the monsoon, the lower the size of bed sediments.

REFERENCE

1. Amar, Y., A. Kandouci, S. Lebid, B. Djahed, T. Zahzeh and M. Anani., 2007. Description of the macrobenthic population in the gulf of arzew in Northwestern Algeria. *Pak. J. Biol. J. Biol. Sci*., 10: 2676-2681.
2. Buchanan,J.B., 1984.Sediment analysis-in: Method for the study of marine benthos. A.Holm & A.D.Macintyre (eds). Blackwell.Oxford.41-64.
3. Barratt, L., Ormond, R.F.G., Campbell, A., Hiscock, S., Hogarth, P., Taylor, J. 1984. Ecological Study of Rocky Shores on the South Coast of Oman. R*eport of the International Union for the Conservation of Nature and Natural Resources to the United Nations Environmental Programme*, Geneva. 102 p.
4. Chien, Y.H., 1992. Water quality requirements and management for marine shrimp culture. In: Wyban, J.Proceedings of the special session on shrimp farming. *World Aquaculture Society*, Baton Rouge. Los Angles, USA.pp.30-41.
5. Fazeli, N., Zare, R. 2011. Effect of seasonal monsoons on calanoid copepod in Chabahar bay, Gulf of Oman. *Jordan Journal of Biological Sciences*. 4(1): 55-62.
6. Gray, J.S, 1981. The ecology of marine sediments. *Cambridge University press*. Cambridge. pp 187.
7. Hylleberg, J., Nateewathana, A., Chatananthawei, B. 1985. Temporal changes in sediment characteristics on the west coast of Phuket Island. *Phuket Marine Biological Center Research Bulletin*, 37. 16 p.
8. Reynolds, R.M., 1993. Physical oceanography of the Gulf, Strait of Hormuz, and the Gulf of Oman: results from the Mitchell Expedition. *Mar. Pollut. Bull*. 27: 35-60.
9. Simpson, S.L., Batley, G.E., Chariton, A.A., Stauber, J.L., King, C.K., Chapman, J.C., Hyne, R.V., Gale, S.A., Roach, A.C., Maher, A. 2005. *Handbook for sediment quality assessment*. CSIRO, Bangor, NSW. 218 p.
10. Visvanthan, C., Trankler, J., Kuruparan, P., Xiaoning, Q., 2003. Effects of the monsoon conditions on generation and composition of the landfill leachate-lysimeter experiments with various input and design features. *CISA, Environmental Sanitary Engineering Centre*, Italy. 10p.
11. Eetmadi, Alef., Savari, Alef., Vali Nasab, T., Sakhai, N.2012.Species Identification and Investigation of the Impact of monsoon Phenomenon on the Crabs of the Family of Decapoda: Brachura in Tidal Areas of Oman Sea, Hormozgan Province, The Marine Sciences and Techniques Journal,11 (1): 18-32.
12. Khezri,H. 2000. Study benthic invertebrate shrimp farms in pools of Hilla site, Bushehr, Persian Gulf Fisheries Research Center, Bushehr. 14pp.
13. Gholami, Z., Nabavi, M, B.2015. The Effect of Total Amount of Organic Matter and Sedimentary Particle Sizing in Distribution of Macrobenthic Community of West Haffar River in Khorramshahr, Sciences and Technology of Environment, 17(3):94-104.
14. Valizadeh, M and Moghaddam, M, 2002. Pilot Projects in Agriculture, Parivar Publication Center. P. 23.
15. Gray, S.G., Wu, R.S. and Or, Y.Y., 2002. Effects of hypoxia and organic enrichment on the coastal marine environment. Marine Ecology Progress *Series,* 238, 249–279.