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Determination of texture characteristics of coastal sediments in East of Bandar Abbas

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Abstract

The studying area is a part of the coastal strip of Bandar Abbas with an approximate length of 8 Km which covers an area between Haghani Port to Ghadirpark (Bandar Abbas). To study the texture properties and characteristics of sediment's particle size, twenty three samples of coastal sediments were gathered in the area of tidal flat which were determined as sediments containing granule, sands and mud after statistical analysis and sedimentology. In terms of size, these particles are grain size which reduces as we move towards the sea. Sorting increases as you move towards the sea. Generally, these deposits have a negative to asymmetrical skewness. And from the point of view of textural maturity, they are mature to super mature.

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Introduction

Beaches as potential areas of human activity, have an important role for the people of the coastal region and so also in the country's economy. Management and optimum utilization of the coast requires the identification and evaluation of natural factors that can be evaluated from the perspective of different sciences.

In geological terms beach is an intermediate space between land and sea. In this range, processes such as wind, rivers, tides, waves and maritime currents leave their imprints alongside tectonics and climate (Reading, 2009). Complex coastal processes which were functioned in the past also leave their traces in sediments. In this regard, the coastal-sedimentology has a vital role in recording of the history of sedimentation in a region (Angusamy & Rajamanickam, 2007). Sedimentary loads of coastal environments are supplied from various sources (Perry & Taylor, 2007).

A functioning way to characterize the sediments provides the texture analysis. Characteristics of the sediment's texture are median, sorting, skewness and kurtosis which are widely used for the identification of sedimentary environments and sediments (Angusamy & Rajamanickam, 2006). When considering these texture characteristics, conditions at the Seduimentation can be presented. The purpose of this study was determination of texture characteristics of coastal sediments in East of Bandar Abbas.

This study attempts to identify the coastal sediments and checking their textual specifications in tidal flat and changes of sediments from the beach to the sea. The studying area is a part of northern coast in Persian Gulf located in the East of Bandar Abbas city.

Material and methods

Geographical Position

The studying area is located between latitudes 27° 11′ 16/8″& 27° 10′ 43/4″ in the north and longitude lengths 56° 20′ 15/53″& 56° 17′ 6/78″ in the east. This area is a part of east coast of Bandar Abbas with an approximate length of 8 Km, from Haghani port to Ghadirpark.

From left to right: Haghani Port, Ghadir Park

Fig. 1. Geographical location of the area under study.

Geological Position

Geologically, Bandar Abbas is a part of the folded Zagros which is under the area of hinterlandofBandar Abbas (Aghanabati, 2004). Several deposits has exposed in the coastal area which are from late Precambrian to the present deposits the form of anticlines of folded Zagros to the coastal sediments. Geological sedimentary and rock units of the studying area are series of Hormoz, Mishan formation, Aghajari formation and quaternary sediments by order.

Sampling method

Basis of this study is library research, field and laboratory studies. Sampling was done by Grub sampler from the tidal flat in form of the sections perpendicular to the coast and in any of the three sections, (upper tidal flat, tidal flat and lower tidal

flat) (Fig. 2). Samples were taken with an average 1 Kg from the 30 cm depth.

Fig. 2. Location of sampling stations.

Result and discussion

Analysis of the distribution of sedimentary grains for comparison of different samples is of special importance, because in this way we can understand the characteristics of different sediments and processes that can lead to their formation (Sahu, 1963).

In this study, after the formation of sediments with screening methods and determining the weight percentage of each category of particle size, particle size distribution curves are drawn and according to these charts, statistical parameters will be obtained. From the statistical parameters that can be derived from the graphical approach that includes mean, median and average particle size, we can note sorting, tilting and elongation.

Particle Size

Characteristics of sediments and their distribution pattern in coastal region are controlled by environmental factors, oceanography and climate (Mcmanus, 1975). Particle size distribution in sediments of coastal of east of Bandar Abbas is mainly consisted of sand, clay, and small amount of granules. Particles in size of granules are mainly organic components including fragments of shells, gastropod, foraminifera and crabs' skeleton. In the tidal zone, average particle size is reduced from the beach to the sea. Increasing the energy of waves causes sediments to be smaller (Angusamy & Raja Manickam, 2006). Table 1 shows the results of analyzing the particle size of 23 samples of sediments taken from the tidal zone. The average particle size of the most samples is reduced from station C (coast) to station A (sea) which represents the increase of wave's energy while reaching the beach and make fine-grained particles far away from the zone and reducing the energy of waves while returning to the sea and settling of particles of finer grains.

Table 1. The results of coastal sediment grain size analysis of the study area.

(A-to the sea, C-to the beach)

Number of sample	Granul %	Sand %	Mud %	Average (Φ)
1A	0.3	92.6	7.0	3.2
1B	1.7	97.4	0.8	2.9
1C	0.6	98.1	1.2	2.7
2A	0.01	87.6	12.4	3.1
2B	1.1	97.3	1.6	2.6
2C	4.4	95.5	0.04	1.6
3A	0.48	82.6	16.8	3.3
3B	0.49	99.2	0.2	2.9
4A	0.03	99.1	0.9	2.6
4B	0.9	98.86	0.23	2.4
4C	0.1	97.3	2.6	3.1
5A	1.2	93	5.8	2.8
5B	0.0	99.6	0.3	2.3
5C	0.16	99.5	0.2	2.3
6A	0.0	97.3	2.7	3.2
6B	1.17	98.7	0.1	2.5
6C	0.6	99.1	0.3	2.6
7A	0.1	96.7	3.1	2.6
7B	0.2	97.6	2.2	2.6
7C	0.7	95.4	3.7	2.7
8A	0.8	67.0	32.0	3.5
8B	0.07	95	4.9	3.2
8C	0.5	90.2	9.2	2.9

Sorting

Sorting means distribution of particle size (Cojan & Richards, 2002). Sorting is one of the most useful parameters because it offers effective sign of sedimentation on separation of different grains level. Sediments which are moved by wind (sandy

sediments of desert and coast for example) are sorted much better (Tucker, 2001). It should be mentioned that waves have essential role on sorting of coastal sediments (Griffiths, 1967). Evaluating the sorting values during the sampling periods (beach to the sea) indicates better sorting.

Skewness

Skewness is another parameter which is calculated from the particle size distribution curve and it indicates the sedimentary environment and transportation process. Change in the amount of sorting is indicator of the change in energy which Angusamy and Raja manickam (2006) mentioned it before. Most of the average size sands and big size sands are negatively sorted and small size sands have positive sorting (Raignapathi *et al*., 2012). According to Table 2, particles in the area of average and big sand are negatively sorted which are deposited in relatively energetic environment.

Table 2. Textural Characteristics of Coastal Sediments Numerically and Descriptively.

Number of sample	Sorting Numerically and descriptively		Skewness	kurtosis Numerically and descriptively	
1A	0.49	well sorted	-0.386	leptokurtic	11.23
1B	0.83	moderately sorted	-0.44	leptokurticvery	11.71
1C	0.71	moderately sorted	-0.14	leptokurtic	11.38
2A	0.69	well sorted	-0.04	leptokurtic	11.43
2B	1.03	poorly sorted	-0.23	leptokurticvery	11.56
2C	1.78	poorly sorted	-0.56	leptokurtic	11.3
3A	0.64	moderately well sorted	-0.12	leptokurtic	11.14
3B	0.60	moderately well sorted	-0.13	mesokurtic	00.98
4A	0.58	moderately well sorted	0.1	platykurtic	00.75
4B	0.79	moderately sorted	-0.10	leptokurticvery	11.56
4C	0.45	well sorted	-0.27	mesokurtic	11.05
5A	0.46	well sorted	0.07	leptokurtic	11.23
5B	0.45	well sorted	0.09	leptokurtic	11.19
5C	0.85	moderately sorted	-0.33	leptokurtic	11.33
6A	0.29	very well sorted	-0.33	platykurtic	00.86
6B	0.60	moderately sorted	0.1	mesokurtic	00.94
6C	0.61	moderately sorted	0.099	platykurtic	00.865
7A	0.63	moderately sorted	0.256	platykurtic	00.84
7B	0.61	moderately sorted	0.26	platykurtic	00.882
7C	0.88	poorly sorted	-0.22	leptokurtic	11.25
8A	0.6	moderately well sorted	0.1	leptokurtic	11.17
8B	0.47	well sorted	-0.31	leptokurtic	11.09
8C	0.87	moderately sorted	-0.84	leptokurtic	11.3

Kurtosis

Particle size distribution curve gives us much information about the sorting and grain size (Musavi Herami, 2010). According to the Folk classification (Folk, 1966), in the present study, most of the sediment samples are leptokurtic and mesokurtic. Roman and Achab (1999) declared that sediments with leptycortic distributions are of precipitates with high textural maturity which are displaced again.

Fig. 3. represents the connection between sorting, skewness and kurtosis with median in coastal sediments of east of Bandar Abbas. According to this fig., the trend change of stretching and sorting are corresponded with each other.

Particle Shape

Particle shape is one of the basic features which provide important information about the history of sediment and consists of grain form, roundedness, sphericity and surface texture of the particle (Cheel, 2005). According to the morphometric studies performed, forms of the eastern coastal sediments of Bandar Abbas are often seen as blade and disc like, although, bar and cube grains are less frequently visible. Roundedness demonstrates the amount of weariness in the influenced grains (Douglas & Mc Conchie, 1994). Particles forming the coastal sediments of eastern Bandar Abbas are mostly semi-rounded to round with low to moderate sphericity (Fig. 4). Roundness and sphericity increases as we move away from the beach and being close to the sea. Morphoscopy studies show that the coastal processes (tides, waves, and ocean currents) have made the surface of sediment particals quite smooth and shiny.

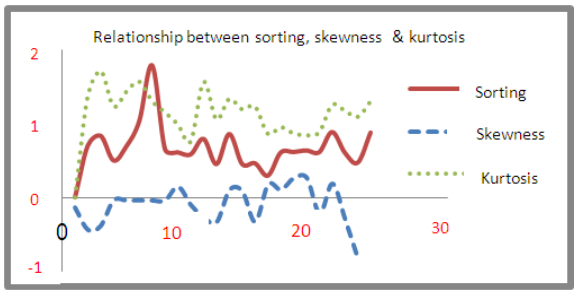

Fig. 3. Relationship between sorting, skewness and kurtosis with median in sediments of east of Bandar Abbas.

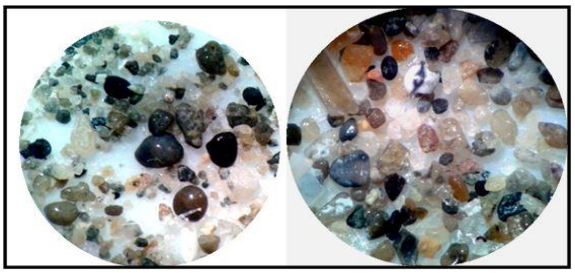

Fig. 4. Roundness and sphericity of the coastal sediments in the east of Bandar Abbas.

Textural Maturity

Diagnosis of the textural maturity depends on the mechanical energy in the environment in the final stage of deposition (Musavi Herami, 2010). With the increase of the environmental energy, mud is washed away from the sediments and become better rounded and sorted. Continuous stream causes the formation of very mature sediments (Tucker, 2001). More than 78% of the samples taken from coastal sediments are very mature sediments of the east of Bandar Abbas. The rest of the samples are less mature which are taken from the estuaries and seasonal rivers.

Naming the Sediments of Eastern Coast of Bandar Abbas

In sediment samples taken from the tidal zone, changes in weight percentage of different levels compliance with specific process and its value is 1% for granule, 94% sand and 5% mud.

Naming the coastal sediments of east of Bandar Abbas

In order to name sediments, Folk triangle (Folk, 1974) and Triplot software is used. According to the Fig. 5 Type of the coastal sediments deposits in the eastern of Bandar Abbas are sands and muddy sands.

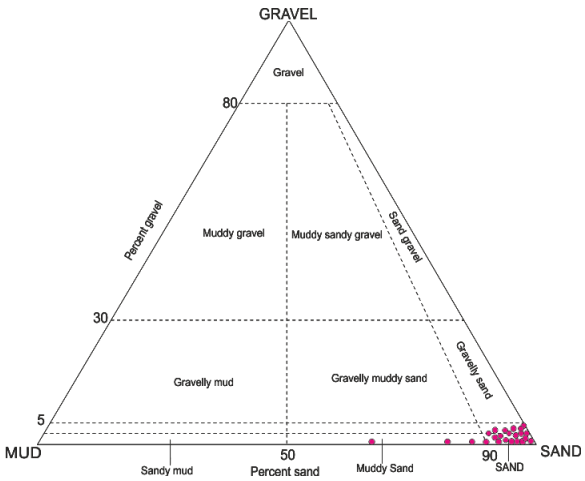

Fig. 5. Naming types of sediments according to Folk method.

Conclusion

Findings of the study show that: In samples taken from the tidal zone, changes in the weight percentage of different levels are complied with the specific process and its values are respectively 1% for granule, 94% sands, and 5% mud. By analysis of the grain size,

it is recognized that the overall change in the mean and median particle size from the beach to the sea is in the reduced form which is due to the intensity of flow and sediment transport, change in type of sediment and reduce the slope of topography. Studying the strains in different curves shows that in most cases, it is likely that curves are more stretched from the beach to the sea which is corresponded with sorting changes from the beach to the sea. By measuring the percentage of granule, sand and mud, it was found in 23 samples that these sediments are sand sediments or mud sediments. These sediments are in range of mature to super mature.

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