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GEOMORPHOLOGICAL CHANGES OF THE SAND BARRIERS FROM MUSURA BAY DURING 2008 - 2017

Silică Petrișoaia, Răzvan Doru-Mateescu, Luminița Buga, Maria-Emanuela Mihailov, Dănuț Ilie Diaconeasa

National Institute for Marine Research and Development "Grigore Antipa", Constanța (NIMRD), 300 Mamaia Blvd.
E-mail: spetrisoaia@alpha.rmri.ro

ABSTRACT

In the Musura Bay of the Black Sea, the recent geomorphological marine deposits/barriers sand are developing. NIMRD has made, since 2005, the first geomorphological studies on this barrier sands in the Romanian area. This article analyzes the spatio-temporal changes of the barrier sands for 2008 and 2017, as well as the granulometric characteristics of the sediments in this area.
Key-Words: sand barrier, geomorphological changes, sediments, grain-size parameters

AIMS AND BACKGROUND

It is well known as of all types of coastal islands, the barrier sands are some of the most dynamic and fragile current reliefs. These are long, relatively short, geomorphological marine bodies of low altitude and essentially shore-parallel.

In the Musura Bay, which represents the NE area of the Romanian Black Sea coast, there are conditions where a series of barrier sands have formed, as a result of the sediments transported mainly to the branches of the secondary delta of Chilia, respectively to Oceakov, Bastroe and Old Stambul. The islands of the Musura Bay began to appear in the late of 1970 as a series of aligned islands and then merged and expanded to the south. At the beginning of the 1990's the islands crossed the Romanian - Ukrainian border (Giosan et al., 2005; Stanica et al., 2007; Vespremeanu-Stroe & Preoteasa., 2015) and then reached very close to the northern seaport of the Sulina waterway. It has a tendency to advance to the shore and to extend towards SW to the Sulina channel. The sediments in the Musura Bay are marine littoral deposits constituted from fossil and current sedimentary deposits. These are generally derived from two basic sources: deposits formed by the longshore drift from the North (from the mouths of rivers Southern Bug, Dniester and Dniper) and littoral deposits of Danubian origin (Panin, 1996).

EXPERIMENTAL

To study the spatio-temporal changes in the barrier sands in the Musura Bay, the position of shoreline and beach areas with GPS equipment (Leica VIVA Net-GS08 Plus for the 2017 measurements) was determined.

Sediment samples were analyzed by dry sieving techniques of the grains on the order of magnitude of between 6.3 - 0.04 mm, with a set of 23 meshes. For silt and clay (particles with diameters lesser than 0.063 mm), the laser-particle sizer (using ANALYSETTE 22 equipment) was employed to obtain the statistical value. The results were processed with the GRADISTAT program (Blott & Pie, 2001) to obtain sedimentological characteristics: mean (Mz), sorting (So), skewness (Sk) and kurtosis (Kg) and sediments class (Wentworth, 1922; Folk % Ward, 1957; Anastasiu & Jipa, 1983; Jipa, 1987).

RESULTS AND DISCUSSION

Sedimentary characteristics in the Musura Bay

A study was carried out around the lagoon, barrier sands and sea area until 10 m depth to determine the general characteristics and grain-size distribution of sediments. For this purpose, 11 samples of sediment (taken on September 13, 2017) from the Musura lagoon on the depth of -0.5m (S1), the shoreline of the lagoon and barrier sands (S2), the midpoint of the barrier sands (S3), the vegetation/backshore limit (S4), the median of backshore (S5), the sea shoreline of barrier sands (S6), depths sea of 1 m (S7), 3 m (S8), 5 m (S9), 7 m (S10) and 10 m (S11).

The mean size value ranged between 0.13 mm-0.14 mm for sediments of lagoon, barrier sands and depth sea of 1m, with very good sorting (VWS), symmetrical skewness (S) distribution and mesocuric (M) kurtosis. The sediments are composed of fine sand (FS) and very fine sand (VFS) with an average percentage of over 95%, in which the fine sand participates with about 62%. Exceptions make the sediments of the depth sea of 1m (F7), where there is a balance between the two fine and very fine sand categories of about 49%. From the depth of 3 m to 10 m the mean sediment grain size decreases progressively by 0.11 mm (H-3m), 0.083 mm (H-7m), to 0.007 mm at the 10 depth. Sorting is well sorted, moderately sorted and poorly sorted with symmetric type distribution and positive asymmetry, and sharpness (Kg) of mesocurtic and leptocurtic type. The sediments are composed of fine sand (FS) and very fine (VFS), with an average percentage of over 95%, in which the very fine sand participates by over 70%. From the depth of 5 m the silt has percentages of over 10%, reaching 90% at 10m depth, where the clay holds 10%, (Table 1).

Table 1. Granulometric parameters of the sediments-the barrier sands of Musura Bay, 13.09.2017.

Sample/ grain size parameters	**Mz (mm)**	**So**	**Sk1**	**Kg**	**VCS %**	**CS %**	**MS %**	**FS %**	**VFS %**	**VCSt %**
S1	0.14	VWS	S	M	0	0.1	1.2	67.4	31.2	0.1
S2	0.13	VWS	S	M	0	1.1	0.6	55.8	42.8	0.1
S3	0.14	VWS	S	M	0	0.1	0.9	70.9	27.9	0.1
S4	0.14	VWS	S	M	0	0.1	1.7	63.1	37.3	0.2
S5	0.13	VWS	S	M	0.2	0.3	1.4	60.6	37.3	0.2
S6	0.13	VWS	S	M	0	0.1	0.7	56.6	42.1	0.5
S7	0.13	VWS	S	M	0.1	0.4	0.9	48.6	49.5	0.6
S8	0.11	WS	S	M	0.2	0.1	0.8	26.2	70.5	2.1
S9	0.091	MWS	FS	L	0.1	0.2	1.2	11.6	73.2	13.8
S10	0.083	WS	S	L	0	0	1.1	7.4	75.0	16.4
						CSt	**MSt**	**FSt**	**VFSt**	**CY**
S11	0.007	PS	VFS	P		20.8	34.6	18.7	15.3	10.6

Sorting-**So**: VWS=very well sorting; WS=well sorting; PS=poorly sorted
Skewness-**SK1**: FS=fine skewed; S=symmetrical; VFS=very fine skewed.
Kurtosis-**Kg**: P=platycurtic; M=mesokurtic; L=leptokurtic.
Sand: **VCS**=very coarse sand; **CS**=coarse sand, **MS**=medium sand; **FS**=fine sand; **VFS**=very fine sand.
Silt: **VCSt**=very coarse silt; **VCSt**=coarse silt; **MSt**=medium silt; **FSt**=fine silt; **VFSt**=very fine silt.
Clay-**Cy**

Based on the sedimentological analyzes, the sediments collected from the lagoon and in the barries sand are fine sand (over 50%) with an average diameter of 0.13-0.1 mm. From the depth of 1m, where there is a balance between the fine and very fine fractions (about 49% for each category), the transition to the very fine sand (over 70%) is made, and from the depth of 10m the silt prevails (over about 90%).

Morphological changes of barrier sands

On 18.08.2005, NIMRD "Grigore Antipa" (NIMRD, 2005) performed the first geomorphological measurements, on the recent barrier sands, which is formed in the Musura Bay, for which there were previously made and placed two landmarks (IRCM Ms/1 and IRCM/Ms2, Fig. 1).

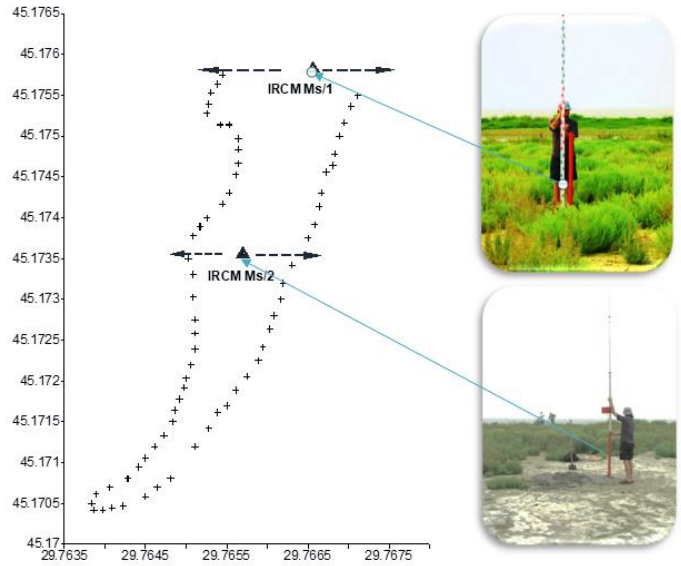

Fig. 1. Location of NIMRD's landmarks on the developing barries sands in the Musura Bay, 18.08.2005.

On the surface of the barrier sands a rich vegetation of psamobiont plants has been developed (Photo. 1).

Photo 1. Vegetation on the barrier sands, 05.08.2005 (NIMRD photo).

In a three year period, the barrier sands moved to the shore (from east to west) and its breadth diminished beyond the Ms2 landmark, from 128 m in 2005 to 116 m in 2006 and 109 m in 2007, in 2008 the landmark being found at the shoreline, then it subsequently disappeared (Photo 2).

Photo. 2. Ms2 landmark at the beachface, 2008 (NIMRD photo).

The study of the spatio-temporal morphological changes of the barrier sands in the Musura bay was carried out on the basis of GPS measurement sessions performed by NIMRD ”Grigore Antipa” on 07-08.08.2008 and 12-13.09.2017 (NIMRD, 2017).

The geomorphological situation of the barrier island in 2008

The length measured at the shoreline of the barrier sands was about 2,013 m with the area of 184,494 sq.m. The average width determined on 4 transects (Fig. 2) was 101 m, with variations from 75m (M1) to 139m (M4) (Table 2).

Table 2. The width of the barrier sands in the Musura Bay, 08.08.2008.

Transect	Length (m)
M1	75
M2	89
M3	102
M4	139

The geomorphological situation of the barrier island in 2017

The length of the island measured at the shoreline was about 2235m, with a surface of about 270,495 sq.m. The average width determined on 4 sections was 130 m, with variations from 111 m (M3) to 155 m (M2) (Table 3).

Table 3. The width of the barrier sands in the Musura Bay, 13.09.2017.

Transect	Lenght (m)
M1	115
M2	155
M3	111
M4	137

In the southern part of the barrier sands to the Sulina channel, more submerged barrier sands are developed with small heads at the surface of the sea (Photo. 3).

Photo. 3. Small heads of submerged barrier sands, Musura Bay, 13.09.2017 (NIMRD photo).

In the Musura Bay, alongside the main barrier sands, a series of barrier sands are formed in the lagoon area (Photo. 4).

Photo. 4. More barrier sands in the Musura Bay, 13.09. 2017 (NIMRD photo).

Based on the measurements made, it is observed that in 2008 and 2017, the barrier sands moved to the north direction about 1,070 m and to the eastern direction by 300 m (Fig. 2).

Fig. 2. Spatio-temporal changes of barrier sands, Musura Bay, 2008 and 2017.

CONCLUSIONS

The study of geomorphological changes in the Musura Bay carried out by NIMRD ”Grigore Antipa”, in 2008 and 2017, points out that the barrier sands moved in space, towards the northern direction with about 1,070 m and to the western direction by about 300 m.

The sediments collected on the lagoon and in the barrier sands are fine sand

(over 50%), with an average diameter of 0.13-0.14 mm. From the depth of 1 m, where there is a balance between fine and very fine fractions (about 49% for each category), the transition to very fine sand (over 70%) is made, and from the depth of 10 m the silt is prevalent (about 90%).

Aknowlegement

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