Morphological and hydraulic-sedimentological features of the Lignano tidal inlet (Northern Adriatic Sea)

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In the framework of a scientific program aimed at a systematic hydraulic sedimentological study of all the lagoon tidal inlets in the Northern Adriatic Sea, this paper presents the results of research carried out at the Lignano inlet, the largest of the six mouths of the Marano and Grado lagoons.

The Lignano channel provides the opportunity for an accurate analysis of the natural reaction of a lagoon mouth to the dynamic factors that determine the mobility and deposition of sediments in tidal environments characterized by practically unidirectional two-way current flows. Moreover, no dredging has ever been done because the inlet retains its shape in a natural way.

Morphological-bathymetrical and current measurements were carried out, coupled with a series of samplings within the channel.

The sea bottom configuration shows a clear asymmetry of the inlet with the axis oriented towards the east. This feature is a direct consequence of the stabilisation of the western side of the mouth (construction of the seawall in 1937-1940) as well as of the natural response to the changing equilibrium conditions (erosion of the eastern side), as partially observed by DORIGO (1965).

The local mean tidal range is approx. 65 cm; during spring tides, the excursion can reach 105 cm. Owing to exchanges between the lagoon and the sea through the Lignano mouth, up to 40-50 million m^3 water, both during flood and ebb-tide, can flow through a 4000 m^2 wide liquid section. Tidal currents are therefore considerable, with recorded peaks of 170 cm/s (DORIGO, 1965). The series of launchings of drift crosses that were done both during flood and ebb-tide highlighted that during ebb-tide currents move faster along the eastern part of the channel, while during flood-tide currents flow more towards the centre and more symmetrically about the axis of the channel. The sedimentological results confirm the morphological and current data : the median is perfectly correlated with the bathymetrical pattern of the inlet and with ebb-tide lines. Coarser sediments are located along the strip where maximum speeds was observed, which corresponds to the axis of the channel (greater depths).

This strip has well sorted, symmetric sediment while sorting and skewness tend to worsen near the edges of the channel, which are characterised by a sharp reduction of energy.

There are two main grain-size classes which account for over 90% of the analysed samples : the 150-210 μm class which prevails in the central section of the channel, and the 105-150 μm class which is predominantly at the sides of the channel.

The distribution of frequence percentages of the two main modes has led to a definition of the structure of the sediment masses by varying grain-size, thereby defining the transit axes.

The coarser sediments (150-210 μm) are almost entirely located at greater depth, along the axis of the channel. Here the sediment masses present modal values of 50-60% lined up along the flood lines, as highlighted by current-meter observations, which proves the greater strength of the currents rising along the axis of the channel. On the other hand, the finer sediments (105-150 μm) with modal values greater than 60% line up along the sides of the channel: on the eastern side of the channel, the lining-up corresponds to the ebb-tide linest while on the western sidet finer sand masses seem to be linked to the slower floodtide currents which characterize the lesser depth.

There is therefore a direct correlation between speed/direction of the currents and the distribution of sand masses with different grain-sizes: flood currents are more effective along the axis of the channel, where coarser sands than those located along the sides can be found; the latter are associated with the lower speeds which are characteristic of ebbtide currents on the eastern side and of flood tide currents on the western one.

From the point of view of applications, all types of investigations (bathymetry, current field and sedimentology) have clearly- shown that maximum sediment transport occurs mainly towards the western side of the channel, particularly during ebb- tide. This proves that the axis of the channel tends to shift eastwards and hence that erosion phenomena continue on this side of the channel, thereby highlighting the instability of the eastern side as compared to the western side.

REFERENCES

DORIGO L., 1965. - La laguna di Grado e le sue foci. Ricerche e rilievi idrografici. Uff. Tdr. *Mag. Acque*, Pbl. 155, 231 pp., Venezia.