Sedimentary dynamics (beach and aeolian) of the Essaouira littoral (Atlantic Morocco): preliminary characterization

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The coastal system of the Essaouira region (Atlantic coast of Morocco) has a particularly complex sedimentary dynamics resulting from interaction of sea, wind, vegetation and human occupation. Peculiar forms evolved very quickly at a century scale or even at a human lifetime scale.

Field observations and the comparison of cartographic and photographic documents from the Essaouira bay area since 1920 shows a net erosion of the beach, resulting in an important backward movement of the coastline (reaching an average of 3,5 m/year in the 1956 to 1986 period in front of the Mogador island pier). This huge sedimentary deficit recorded in the beaches adjacent to the village is a consequence, at least in part, of the intersection of the southward littoral sedimentary drift by the harbour constructions. On the contrary, south of the Ksob estuary (south of Essaouira) important net accumulation are recorded on the beach.

The Essaouira sandstone is a quaternary cemented beach/ /aeolianite parallel to the current shoreline and constitutes most of the shelf bottom (in the tidal, subtidal and outer shelf domains), as well as a longshore relief including, namely near the Essaouira village, the Jarf Barmil, Doukhana and Jarf Hmam islets and the Mogador Island. Such relief plays a determinant role in the longitudinal and transverse sedimentary transfer budget within the coastal system, both as feeder and as barrier, and consequently in the morphologic evolution of the Essaouira beaches.

Spring tides reach an average range around 3 m and the yearly significant wave is between 5 and 7 m. The coast orientation, coupled with the dominant wind direction at a regional and local level, imposes the oblique wave incidence in the coast that creates the southward littoral drift. This particular coastal dynamics generate sand bars parallel to the coast reach. Such bars, with variable dimension, acts in association with the cemented Essaouira sandstone relief to promote the energy dissipation of waves by premature break and friction.

The Essaouira region is under a dominant NNE wind regime (the Trade Winds system), with periods of NE origin. In detail, the wind record allowed the definition of: 1) a calm period (Autumn and Winter) of low intensity winds, never exceeding 5 m/s, with a dominant NNE trend persisting until October and then turning to NE; 2) a windy period (spring and summer) starting in March, with NNE winds increasing in speed until the maximum in April (6,7 m/s) and July (7,1 m/s).

The coastal reach has a mean direction parallel to the dominant wind and, thus, the sand are transported along the beaches, but some segments of the coast has a small angle to that dominant wind allowing the edification of dune fields like the Essauoira aeolian complex. Such situations created three main accumulation zones dominated by barkhan or barkhan-derivated dunes. The most important field is located in the northern border of the Essaouira village and is currently a huge local problem of urban management, because the dunes are invading the village infrastructures located in its line of progradation. Also the longitudinal beach dune ridge just north of the village is recently experiencing instability and the sand blown from the beach feeds this field, intensifying the problem. The successive attempts of fixation of all the referred dunes had little success. The second dune field is located just south of the village and is in fact a sector of remobilization of previous accumulations; it has a triangular shape with an angle located in Cap Sim. Here, parabolic dunes are concentrated in topographic deflection corridors under the action of the NNE winds and reach the coast south of the Cap. The third accumulation zone, of relatively minor importance, is close to Cap Hadid.

This study is a preliminary equation aiming to contribute to the management of a littoral area experiencing several problems created by the human impact on sediments transfer.