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A Global Synthesis with implications
for management of future coastal change

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Quaternary coastal morphology and sea level changes

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Tordera River delta relict lobes and Holocene Sea level rise (Maresme Coast, Spain, NW Mediterranean)

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Abstract

The **Tordera river delta** is at the origin of the Maresme coast 60 km sedimentary cell (NE Spain). Tordera sediment comes from the drainage of the granitic coastal ranges, forming at its end an alluvial coarse grain delta (Gilbert type). The fluvial regimen is pluvio-torrential type with periodical avenues, two or three annual, that contributes with an average volume of coarse sand carried to the coastal system between 100 and 200 000 m^3/y. These contributions feed delta plain braided main channel during low and medium regimen of the river, and the delta front and the set of the sedimentary Maresme cell due to higher avenues and the dominant drift transport towards the SW.

Morphological, sedimentary and dynamical characteristics throughout the Maresme **sedimentary cell**, are similar all along. The continuous presence of siliciclastic coarse sands results on beaches of high gradient (reflective). Towards the medium and external shelf, a series of sedimentary sand bodies occurs at downwasting depth following the sea level rise, described previously as transgressive sand bodies (Serra, 1986; Sorribas, 1991).

Tordera delta had built up and prograded until his present situation from the maximum transgressive sea level rise. During that period, Tordera **sediment outputs** had been distributed between the beach system and delta front, following the main wave energy input. At the moment when the delta reached actual size and development it begins to construct a sand mouth bar that will be derived to a **submerged coastal spit** or ridge. This spit has been extending to the SW related to the dominant wave climate (E and NE) and to the associated transversal transport processes, both processes responsible of its characteristic mixed shape of spit and prograding sand body. Most of the present sediment reaching the river mouth feed this sand body or sinks towards the deltaic talus.

Spit extends parallel to the deltaic coast from lower depths (depth of the crest <5m), at the river mouth. When the spit reach the old prodelta of Sta. Susanna torrent, it adopt an oblique direction from the coast (seawards), acquiring greater depth up to 10m. The terminal part of the spit, about 6km from the origin, results in a large sand flat. A cross section of the spit shows a steep seawards lee limit. Foresets and gravity processes can be deduced from seismic and side scan sonar. This external steeped surface of the prograding spit intersects abruptly the previous transgressive sandy bottom surface, or older prodeltaic bodies (Serra and Montori, 2003).

The **delta front** is constituted completely by coarse sands, with a high angle slope and scars of mass slides, and other gravity or rip current transport and instability. The base of the prograding slope is located at depths up to 60m depth, where it intersects previous transgressive bottom or older prodeltaic bodies at depths up to 40 m. From a high resolution bathimetry we can distinguish two main prodeltaic bodies (DI and DII) with its apex at depths of 50 and 35 m respectively. The Aloïsi (1986) eustatic curve can be applied to correlate and date the different relict delta formations. Between 11 and 9 ky the first distinguished deltaic body (DI) was build-up, and the second (DII) between 9 and 7.5 ky. Possible younger deltas from DII period up to the present sea level had been overlapped by the actually prograding Tordera river delta (Fig. 1). During low sea-level stages Tordera River discharged directly in the Blanes Canyon head at -100 m (Serra, 1975). Last postglacial sea-level rise displaced the coast and associated sedimentary bodies to the present situation. NW Mediterranean transgressive evolution have been described through sedimentary and morphologic marine formations as the transgressive sand bodies (Diaz and Maldonado, 1990), terraces (Verdaguer, 1983), or beachrocks (Serra, 2002).

Due to present depth of the delta front base (>60m) compared to previous one over the relict lobes (<40m), delta progradation needs much more volume of sediment. This important difference between present delta evolution and that of few centuries ago, can explain the drastic reduction of sediment input, changes in the coastal sedimentary cell transport and the present general erosive situation.

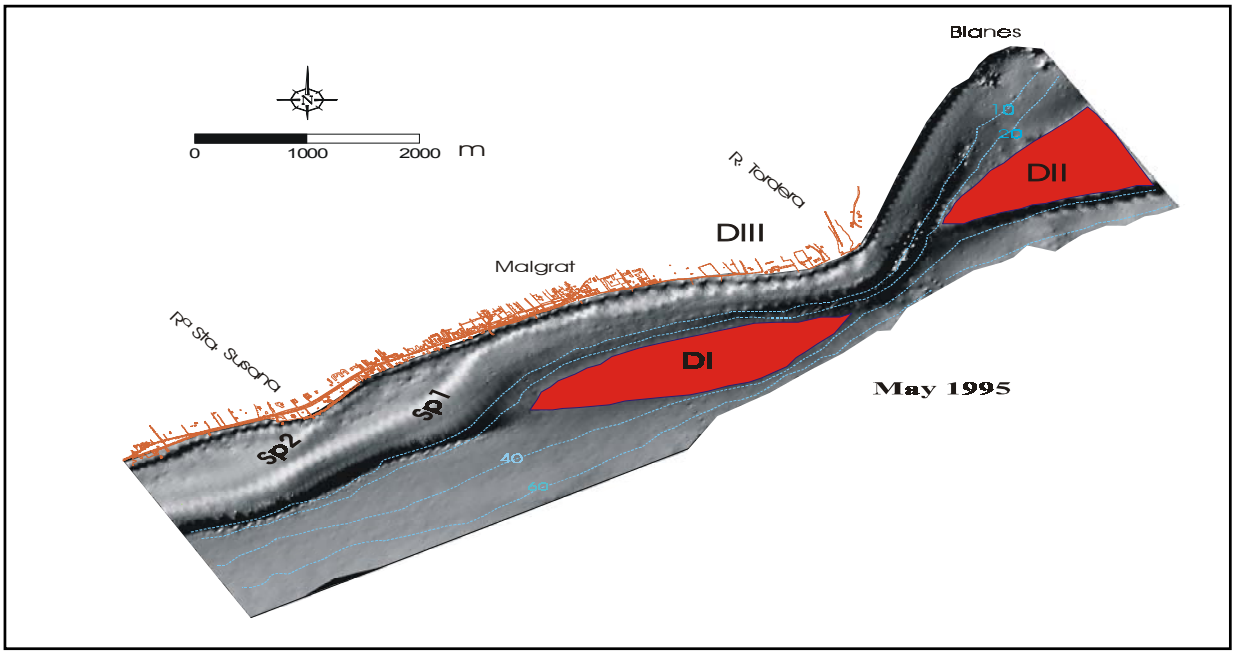

Figure 1. Bathymetric map and gradient image (increasing from white to dark) of Tordera delta front system. Relict deltas (DI & DII) and spits (Sp) can be distinguished.

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