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Large-scale depositional bodies on the shelf around the Guadalfeo River, northern margin of the Alboran Sea, and their relationship with conduits of sediment transport into deeper domains

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Inner prodeltas and prograding bodies and outer relict morphologies constitute the main recent morpho-sedimentary bodies on the continental shelf of the northern margin of the Alboran Sea, western Mediterranean Basin (Ercilla et al., 1992; Fernández-Salas et al., 2003). Shallow-water prodeltaic wedges are linked with the main fluvial streams of the southern Iberian Peninsula supplying sediments to the Alboran Sea. Those river-prodelta systems display significant differences with relation to major river deltas, because of their hydrological regime and the abrupt margin physiography. Thus, the northern Alboran Sea shelf is fed by numerous seasonal and ephemeral streams, with drainage basins of several hundreds of km^2 and low water discharges. The main rivers from W to E are Guadiaro, Fuengirola, Guadalhorce, Guadalmedina, Vélez, Torrox, Verde, Guadalfeo, Andra and Andarax Rivers. The continental shelf is narrow, as shelf width ranges between 4 and more than 20 km (Alonso and Maldonado, 1992). Sea-floor gradients are relatively high, ranging between 0.06º and 0.08º (Ercilla and Alonso, 1996), and increasing to 0.1º towards the outer shelf (Ercilla et al., 1994). The slope is indented by several submarine canyons, generally related to inland river sources (Ercilla et al., 1994). This margin is dominated by low-energy waves with weak tidal currents (Flos, 1985).

A comprehensive study focused in a sector of the northern margin of the Alboran Sea covering the river mouths and related deposits of the Guadalfeo and Verde Rivers was undertaken in order to analyse the influence of Guadalfeo River on shelf sedimentation processes, and in a more general sense, to define depositional patterns on a typical Mediterrean shelf characterised by an abrupt morphology and a Mediterranean climate which influences fluvial water discharge and sediment supply. Two main rivers supply sediments to the study area, the Guadalfeo and the Verde River. Average values of annual water discharge show that water discharge of Guadalfeo River (maximum values below 12 m^3/s) is one order of magnitude higher than water discharge of Verde River (maximum values above 1.2 m^3/s). In the study area, the continental shelf is narrow, with a minimum width of less than 3 km in the vecinity of Sacratif Cape (eastern boundary), where the shelf break is affected by several submarine canyon heads, to more than 5 km off Verde River.

A wide variety of data has been considered in the comprehensive study around the Guadalfeo River margin, including: a) fluvial water discharge data; b) wave regime data; c) EM3000D multibeam echosounder data; d) TOPAS parametric sounder profiles; e) high-resolution seismic profiles (3.5 kHz); f) low-resolution seismic profiles (Sparker); g) surficial sediment samples; h) short sediment cores obtained for geotechnical purposes. For the purposes of this communication, the analysis by using an ARCGIS software of available morphological data obtained with multibeam, TOPAS and high-resolution seismic systems was used to: a) define large-scale depositional patterns in the study area, in order to document the imprint left by regional climate and fluvial regimes, hydrodynamic setting and shelf physiography; b) to study the relationship between main depositional bodies and geomorphological features interpreted as conduits for basinward sediment transport into the slope.

In the study area, two contrastig sector can be distinghised according to the regional distribution of surficial major-scale morpho-sedimentary units:

a) The shelf off Guadalfeo River is dominated by the Guadalfeo River prodelta, which shows a lobate morphology and extends both eastward and westward from the river mouth. In the central part, its distal boundary reaches the shelf break, and laterally it covers about 2/3 of shelf surface. In cross sections the topset-foreset break marks an abrupt slope increase. The surface morphology of the Guadalfeo River prodelta is affected by ubiquitous bahtymetric undulations (Fernández-Salas et al., this volume). In some cases, those features exhibit very high lateral continuity. Besides, several relatively straight features crossing accross surface undulations are identified. In addition, numerous straight small-scale channels are identified on the outer shelf and upper slope. In some cases, the landward parts of those channels erode the Guadalfeo River prodelta.

b) The shelf off Verde River displays an accross-shelf zonation, as three main morphological configurations occur from proximal to distal. The Verde River prodelta occupies the shallowest domain. It shows an elongated morphology, extending offshore less than 2 km. The topset-foreset break is less pronounced than in the case of the Guadalfeo River prodelta. Besides, its upper boundary is also affected by wavy-like morphologies, although they are fairly less extensively distributed than on the Guadalfeo River prodelta. At least two 2-3 km wide irregular morphologies partially buried by a shelf sedimentary fill occur on the middle shelf. Those morphologies exhibit a very reflective acoustic response in seismic profiles. Finally, the outer shelf shows several large-scale bar-like deposits with ENE-WSW to NE-SW orientations and high lateral continuity (more than 2 km).

Thickness distribution of recent morpho-sedimentary units reveals that the Guadalfeo River prodelta displays a well-defined wedge external shape, as the maximum depocenter (around 70 ms in twtt) occurs proximally, whereas sediment thickness decreases towards the outer shelf. In contrast, the depocenter related to the Verde River prodelta is attached to the coastline, with local maximum thickness around 50 ms. Offshore, another depocenter is identified over the middle shelf, with thickness ranging between 10-20 ms.

The interpretation of surficial distribution patterns and thickness of recent morpho-sedimentary units in the study area enables the distinction of two contrasting patterns of prodeltaic deposition influencing sediment transport into deeper domains:

a) The shelf off Guadalfeo River, where outer shelf straight channels are interpreted as gullies. There is evidence that some of them are related to the recent prodeltaic wedge, supporting the idea that some sediment transport through low-density flows has taken place recently. Besides, laterally the prodelta distal termination is located close to submarine canyon heads, also supporting the idea of recent sediment transport into deeper water

b) The shelf off Verde River, where prodeltaic influence on deep-water sedimentation is minimal, by the following reasons: 1) the main prodeltaic body is restricted to the shallowest domain, and its seaward boundary is located farther landward from the shelf break; 2) some of the sediment bodies covering the mid to outer shelf show morphologic and seismic characteristics that point out to a relict origin; 3) the outer shelf and shelf break are not affected by gullies, canyons or other channel-like features.

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