EL CAMBIO DE LA COSTA: LOS SISTEMAS DE RÍAS

ORGANIZACIÓN:

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HOLOCENE CHANGING COASTLINES IN THE GUADALETE ESTUARY (BAY OF CADIZ, SOUTHERN SPAIN)

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Introduction

After the transgressive maximum reached ca. 6,900 years BP estuary/delta-plain and spit-bar/tidal-flat systems in the Gulf of Cadiz evolved in geological settings related to the neotectonic behaviour of each particular coastal segment, the morphology of the basin receiving sediments, and the balance of the interchange of Superficial Atlantic Waters (SAW) and Mediterranean Waters which, in its turn, is controlled by regional climatic conditions.

The systems of spit bars are usually located on the down thrown block of faults active during the recent Quaternary, with uplifted blocks serving as root for the spits. Spit systems usually enclose large tidal flats (*marismas*) in the Atlantic zone (Fig. 1).

Several phases of coastal evolution have been distinguished and placed into a temporal scale using detailed geomorphological mapping, analysis of sedimentary facies, ^{14}C measurements of samples from spit bars and cores drilled in deltaic marshes, and historical data (more information is given in Zazo *et al.*, 1994, Lario *et al.*, in press). This evolution is a result of changes in sediment input, climate, and man-induced actions.

The most complete spit system includes four spit-bars (named H_1 to H_4 in ZAZO *et al.*, 1994) that can be grouped into two episodes of enhanced progradation. Episode 1 (ca. 6,900 yr. BP to ca. 2,700 yr. BP) includes the spits H_1 and H_2, and it is particularly well represented in Valdelagrana. Episode 2 (ca. 2,400 yr. BP to Present) includes the spits named H_3 and H_4, and it is particularly well exposed in Doñana. These phases are separated by a gap extending from ca. 2,700 to 2,400 yr. BP. A younger, smaller gap extends from ca. 900 to 800 yr. BP inside the major prograding phase. Historical data confirm the increase of coastal progradation during the sedimentation of the most recent set.

The Bay of Guadalete and the Valdelagrana Spit System

The bay of Puerto de Santa María underwent active tectonic subsidence during the Holocene related to the Puerto de Santa María and Cádiz faults, favouring the generation of an estuary open to the west. The Guadalete river debouched in the bay during the Holocene transgressive maximum, forming a delta at the innermost, northeastern extremity of the estuary. The two afore-mentioned phases of progradation are recorded in the area, with spits attached both to the south and north extremities of the Puerto de Santa María Bay (Fig. 1).

After reaching the maximum transgression, spit bars (H_1) grew from the north as a consequence of the progradation of the delta front. In the southern side, littoral drift

flowing to the north induced the development of spits attached to the Puerto Real headland. These spits did not completely close the bay, allowing the wave action to shape the delta in a lobate morphology.

Spits belonging to the H_2 generation grew from both the north and south sides of the bay but, apparently, they did not connect and the central part of the bay remained open to the sea. It is interesting to stress the influence of the San Pedro River, a former distributary of the Guadalete River but a mere tidal channel nowadays. The river channel repeatedly shifted across the barrier island and lagoon complex that partly closed the bay. Such a migration eroded deeply into the older coastal units. The more recent shift of the river course created space for the deposition of the H_4 episode that form the present-day Valdelagrana spit bar.

The Filling of the Guadalete Estuary

During public works in the tidal flats of Puerto de Santa María (PSM) Bay several wells were drilled and cored along a line trending north-south across the bay (Fig. 1). Only one of the cores (PSM 104) has been measured from a sedimentological point of view. The other were analysed for rheological properties with only a rather schematic visual description. Besides, the investigation includes two hand-drills with continuous coring in the Marismas de Chiclana (7 m deep) and Puerto Real (5 m deep) and reconnaissance of a 6 m deep trench near the site of PSM 104. Sampling of Valdelagrana Spit was greatly impeded by human impacts

Core PSM 104 in the central part of the Marismas (tidal flats) reached 35 m. It was sampled for diatoms, magnetic susceptibility, palaeontology (macro and micro), sedimentology, and ^{14}C. All these studies are at present under way, with no time to be incorporated in this report; only two ^{14}C data at the lower part of the core are available. Six other cores and logs are under study for environmental reconstruction and reconstructions must be considered preliminary.

Present Interpretation of the Sequence PSM 104 (Fig. 2)

The lower gravels (-35 to -28.50) are interpreted as lowstand deposits laid down by the Guadalete braided river. The overlaying sand interval (-28.50 to -25 m) represents the marine retreating coast during a rapid sea-level rise. Thin gravely layers are interpreted as partial erosion and reworking of foreshore facies from coastal units during the transgressive event.

Peat layers (-25 m), several centimetres thick are interpreted to represent the stabilisation or at least the decceleration of sea-level rise that took place around 9,495 ± 340 years BP (C-13 corrected) to 8,915 ± 100 years BP (C-13 corrected, determinations by Geochron Labs., USA).

Following upwards (-25 to -13.5 m), the grey silt and clay with fine intercalations of fine sands contain *Cardium edule*, *Plagiocardium cf. papillosum*, *Corbula gibba*, *Bittium reticulatum*, *Parvicardium* sp, *Nassarius*, Rissoaceae, Turridae and some other geni of gastropods still under study (by Dr. Angel González, University of Salamanca), and plant debris. Sand content, plant debris and sheil accumulations increase upwards. This is interpreted as the filling of an open estuary. It is very attractive to relate this episode to the first phase of spit progradation (episode 1), inmediately after the Flandrian transgressive maximum (ca. 6,900 years BP).

The fining upwards sequence up to the top of the core (-13.5 to 0 m) records the progradation of tidal flats related to delta progradation. Faunal content is similar as in the underlying units but *Ostrea* sp, *Turbonilla* sp, *Tellina cf. nitida*, *Lutraria* sp, Pectiniidae (probably a fragment of *Chlamys*) and *Rissoa* sp are also present.

Correlation

A preliminary correlation with the other well-logs (Fig. 3) indicates the dominance of fluvial-dominated deposits including yellowish gravels and sands, and brown-green clays with interbedded sandy or gravely thin layers, in the northern part of the Bay. This witness the closer location of these cores with respect to the river mouth and delta. Coarser-grained layers represent underwater river channels or major fluxes during large floods.

Units of grey sands in core 105 and 104 (centre and south of the Bay) can be interpreted as subtidal channels, followed upwards by one or two episodes of tidal flat progradation related to progradation of the Gualdalete River and partial infilling of the former estuary. These events may correspond to the episodes H_3 and H_4 recognized inside the prograding episode 2 of spit development. Pending radiocarbon age determinations will allow a refined correlation of events.

Acknowledgments

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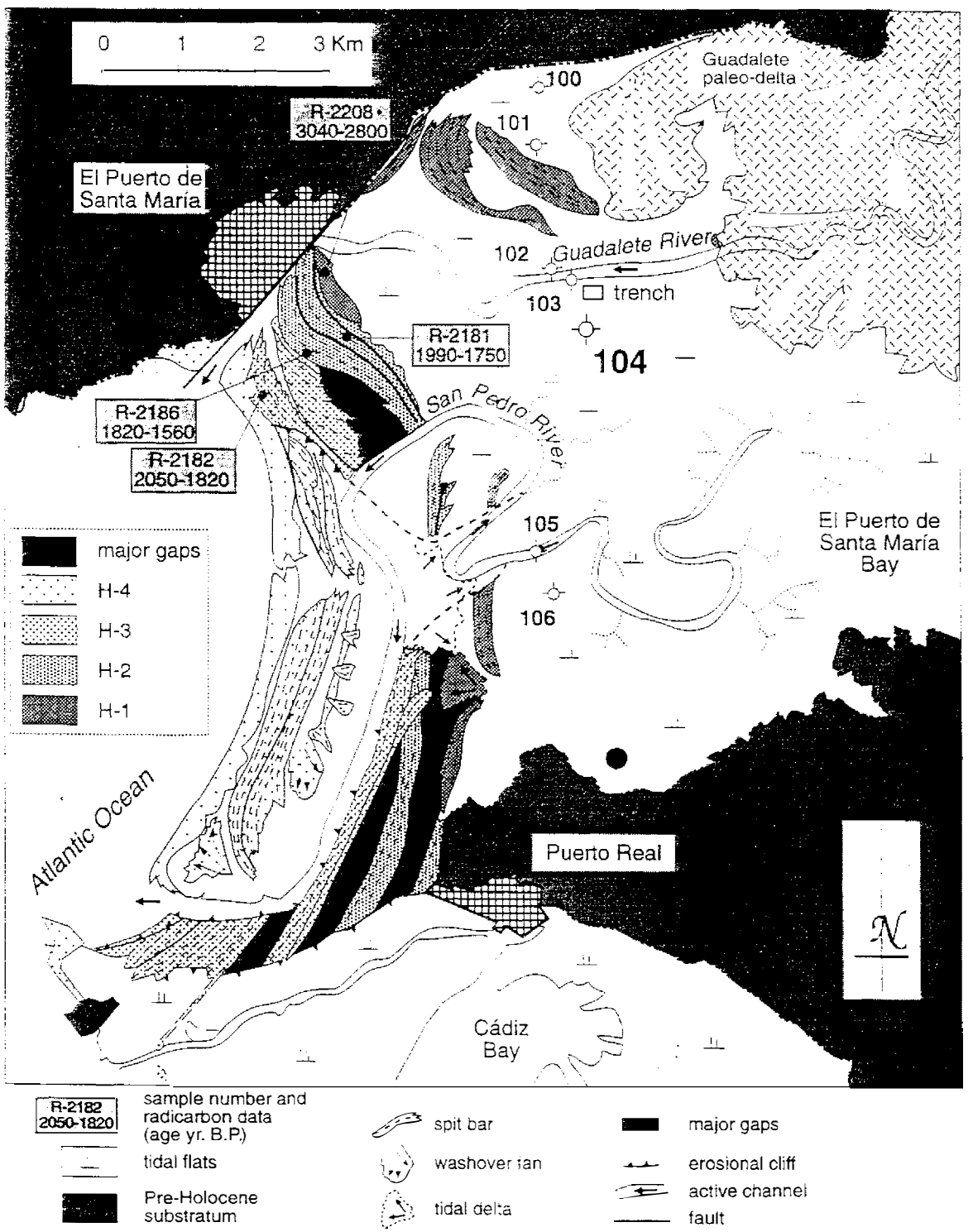

FIGURE 1.- *Simplified map of El Puerto de Santa María bay and Valdelagrana spit bar system with indication of samples and calibrated radiocarbon ages (after Zazo et al., 1994) and location of studied well cores.*

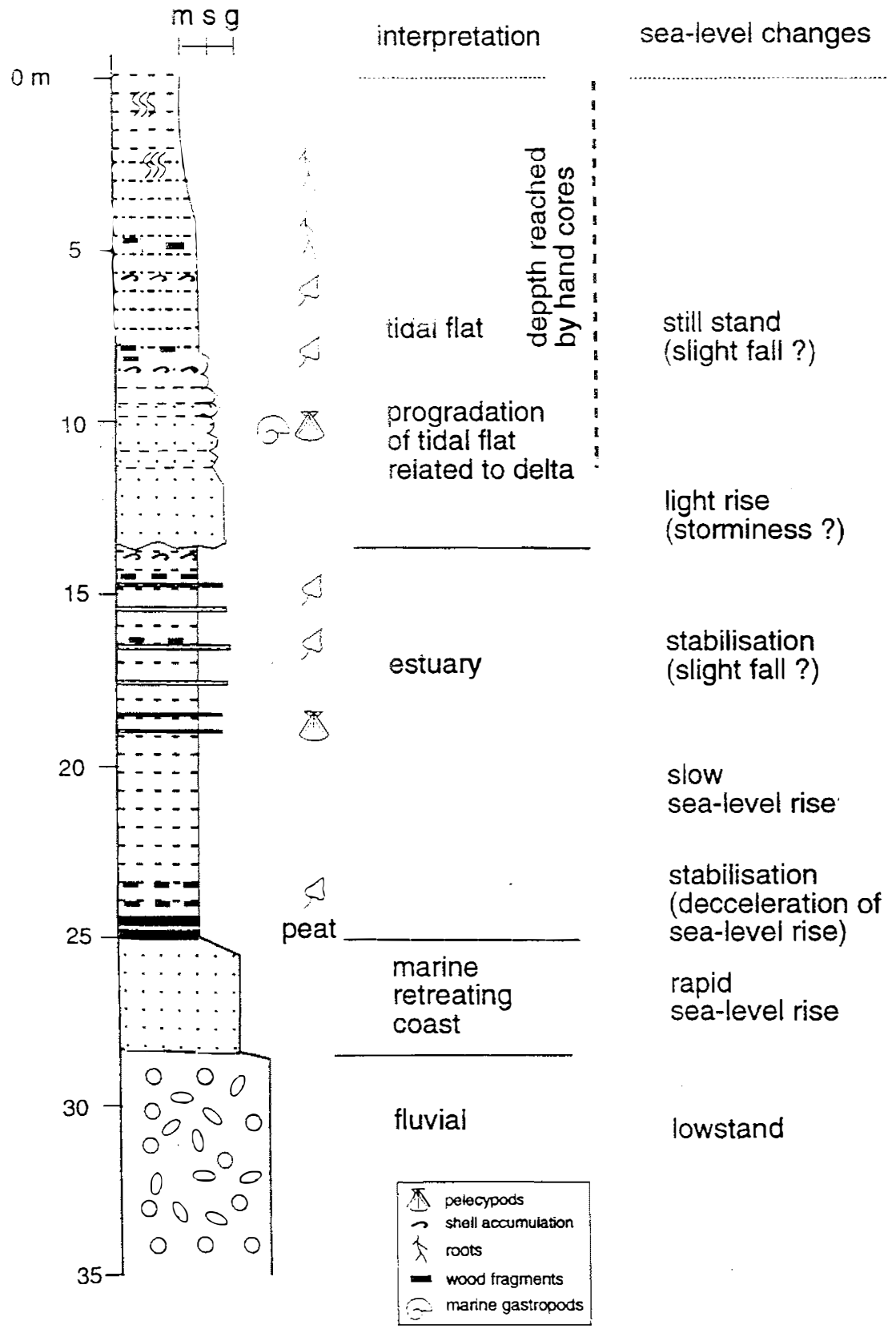

FIGURE 2.- *Schematic sequence of drill-core PSM 104.*

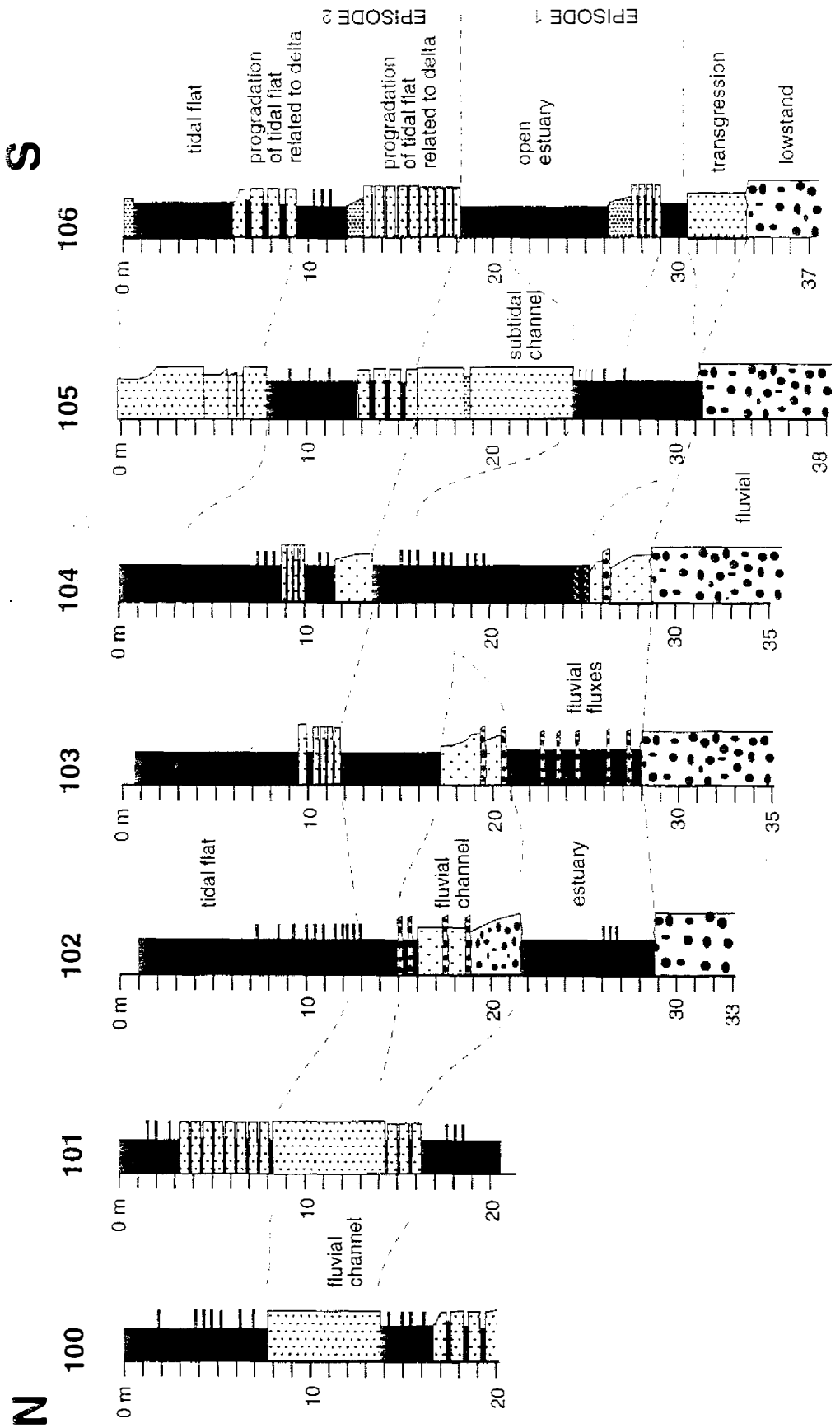

FIGURE 3.- *Preliminary correlation of drill cores across the Puerto de Santa María Bay.*