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Role of human actions on landscape changes since the Upper Holocene in the Bajo Segura Basin (SE Spain)

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ABSTRACT

The study area is the Bajo Segura Basin, located in the easternmost sector of the Betic Ranges. The existence of a wide coastal lagoon occupying the depressed spaces (at least since the Middle Pleistocene) has been inferred, in previous works, from the stratigraphic, micropaleontological and sedimentological analyses. Particularly during the Upper Holocene the environmental morphology was modified. This paper aims to correlate the geomorphological, sedimentological and micropaleontological data with archeological and geoarcheological information of the Upper Holocene. This will allow to hypothesize the recent environmental evolution and its relation to human settlement. The geomorphological approach consists in the analysis of six mechanical cores and geoarcheological studies in several sites. Archeological data is based on sites dating to the 2nd millennium B.C. (Bronze Age), 725–550 B.C., 8th–6th centuries B.C. (Early Iron Age), 550–206 B.C. (Iberian Age), 6th–3rd centuries B.C., 206–500 B.C. (Roman Age), 3rd century B.C.–5th century A.D. and 500–900 A.D., 5th–8th centuries A.D. (Early Middle Ages).
During the Bronze Age, the Bajo Segura Basin was occupied by a coastal lagoon with marine communication. The fossil assemblage indicates a greater marine influence near the coast and fresher conditions further away from it. At least since the subsequent period, and especially since the Iron Age, an activation of the alluvial processes is recorded establishing paleogeographical changes in the lagoons. During the roman period the southern landscape (Segura River) is dominated by the flood plain with associated lagoons and freshwater marshes, at least in the inner part. To the north, the Vinalopó alluvial fan progrades and reduces the dimensions of the lagoonal areas. The swampy conditions remained until the Modern Age. Agricultural expansion reached its maximum development in the 18th century A.D. and gave rise to the present landscape.

1. Introduction

The study area is located to the NE of the Bajo Segura Basin, in the south of the Valencian Community, Spain (Fig. 1), whose northern sub-basin (Elx Depression) evolved predominantly as a coastal lagoon system at least since the Middle Pleistocene (Blázquez, 2005). In the southern part of this area the environments have alternated with fluvial processes and forms. The micropaleontological (based on fossil foraminifera and ostracoda), sedimentological and chronostratigraphical analyses of more than twelve mechanical cores with an average depth of 30 m have allowed us to suggest a proposal of paleoenvironmental reconstruction of this coastal area during the last Marine Isotope Stage (MIS) 12 (Blázquez, 2005; Blázquez and Usera, 2010).

After the Holocene sea level maximum (Flandrian sea stabilization, MIS 1), a large lagoonal system is recorded. Its dimensions in the study area are more than 176 km^2 in size and at least 19 km in width from the coast landwards (Blázquez, 2005). The distal deposits of the Vinalopó alluvial fan and the Moncayo and Rojales Ranges would be respectively its northern and southern limits; the alluvial formations from the Crevillent Range would mark the NW boundary and the Segura River fluvial sediments would constitute their western edge.

The aim of this work is to relate the most recent landscape evolution with the human pattern of settlement and its distribution since the Upper Holocene, particularly from the Bronze Age to the Middle Age. A paleogeographical reconstruction, based on sedimentological and micropaleontological data together with the information derived from the archeological sites preserved in the area will be suggested.

2. Geomorphological setting of the study

Structurally, the study area is located in the Bajo Segura Basin, in the easternmost zone of the Betic Ranges. This basin is made up of a series of anticline and synclinal folds, characterized respectively by a rising and sinking trend. The tectonic behavior of the area is controlled by a recently active system of fractures, namely the Crevillent fault (ENE-WSW oriented), related to the fracture system of the Cádiz-Alicante accident, and the Bajo Segura fault (perpendicular to the coast, ENE-WSW oriented and utilized by the Segura River in its last stretch). These fractures act during the Quaternary including the Holocene (Alfaro,

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1995). The Vinalopó river flows along the Vinalopó fault (NW–SE oriented), with the Triassic diapiric phenomena having a smaller impact on the tectonic setting of this area. On a smaller scale, normal faults are developed along the northern and southern borders. The most remarkable anticlines are the Crevillent Range, with a maximal height of 835 m, and the Colmenar Range reaching 85 m in the northern limit. The southern boundary is represented by the Bajo Segura anticline or the Moncayo and Rojales Ranges (García-Mayordomo and Martínez-Díaz, 2006; Montenat and Ott D'Estevou, 1992); and within the depressed area, near the Mediterranean Sea, are the Santa Pola (144 m) and Molar (84 m) Ranges. Between these elevations hollows occur, which are partially occupied by littoral lakes.

The marine Mio-Pliocene substrate consists of sandstones, calcareous sandstones, marls, silts and clays which crop out in the neighboring ranges (Alfaro, 1995; Caracuel et al., 2004; Soria et al., 2005). During the Pleistocene and Holocene, marine Quaternary deposits are frequent next to the littoral side of the Molar and Santa Pola Ranges (Gaibar-Puertas and Cuerda, 1969; Goy and Zazo, 1988; Gozálvez and Rosselló, 1978; Mateu and Cuerda, 1978; Montenat, 1977). Goy et al. (1993) describe a Holocene level in the Santa Pola dated to 3290 B.P.

The Vinalopó and Segura rivers are particularly relevant from a hydrogeomorphological point of view. The deposits form an alluvial fan to the north of the depression with a series of superimposed and growing sedimentary structures since the Middle Pleistocene. The oldest alluvial fan experienced intense neotectonic movements which gave rise to the subsidence of distal facies, disconnected from the proximal ones (Goy et al., 1990). The younger fans have grown towards the south since the Late Pleistocene, covering in their last stages the northern lagoonal environments. These systems alluvial fan follow the textural distribution described in McCraw (1968), with coarse sediments at the fanhead; fine sediments in old distributary channels and coarse soils on their levees on the middle fan. The Segura River goes into the depression from the southwest and flows close to the southern elevations as a result of neotectonic activity. It reaches the coast with a somewhat meandering channel and flows between natural and artificial walls some meters above the plain occupied by freshwater marshes.

At present the basin is occupied by agricultural fields which were transformed from old lagoons and salt marshes during the last centuries, and by artificially managed marginal lagoons. The transformation started in the 13th century A.D. reaching its maximum in the 18th century A.D., and was mainly implemented in low zones (below 10 m height). El Fondo d'Elx-Crevillent, which functions as an irrigation pond, and the Salinas de Santa Pola are the only humid zones preserved (Fig. 1).

3. Archeological setting of the study

Regarding the archeological occupation of the territory, during recent times, the settlement pattern has been organized around the lagoonal spaces that occupied most of the plain. Archeological data indicate that four areas were occupied during the 2nd millennium B.C. (Table 1): in the Crevillent Range distant from the humid zone; the Orihuela Range along the river in the southwest; in the Moncayo and Rojales Ranges next to the current bed of the Segura River; and in "Cabezos de Albatera" ("Cabezo Pardo" in Fig. 1) in a freshwater outcrop, situated by the inner sector of the humid zone. These sites are related to the control of the territory and thoroughfares and with the exploitation of the nearby plains (alluvial piedmont slope and piedmont of the surrounding ranges, Vinalopó alluvial fan and Segura fluvial deposits) and the lagoonal resources.

The above pattern changes in the 8th–6th centuries B.C.: a large population with a clearly indigenous substratum continues in the Crevillent Range, remarkable sites are "Penya Negra" (González Prats and Ruiz, 1990) and the "Saladares" settlement. These settlements are the first to be found on the coastline for this time ("La Fonteta", González Prats and Ruiz, 2000) to the south of the actual Segura mouth. This Phoenician foundation reflects a distinct occupation pattern geared to maritime trade and exchange. The possibly natural harbor was part of a protected environment, either inside a lagoon or in a sheltered marine inlet. This period is characterized by intense and complex contact between Phoenicians and indigenous groups (Vives-Ferrándiz, 2008) around or across the lagoonal area.

During the 8th to 6th centuries important changes occurred, the most dense settlement is recorded in the Vinalopó alluvial fan, in the "L'Alcúdia" site. Several littoral commercial settlements that follow the model described in the already disappeared settlement of "La Fonteta" depend on this site of Vinalopó. These are the Molar Range sites to the

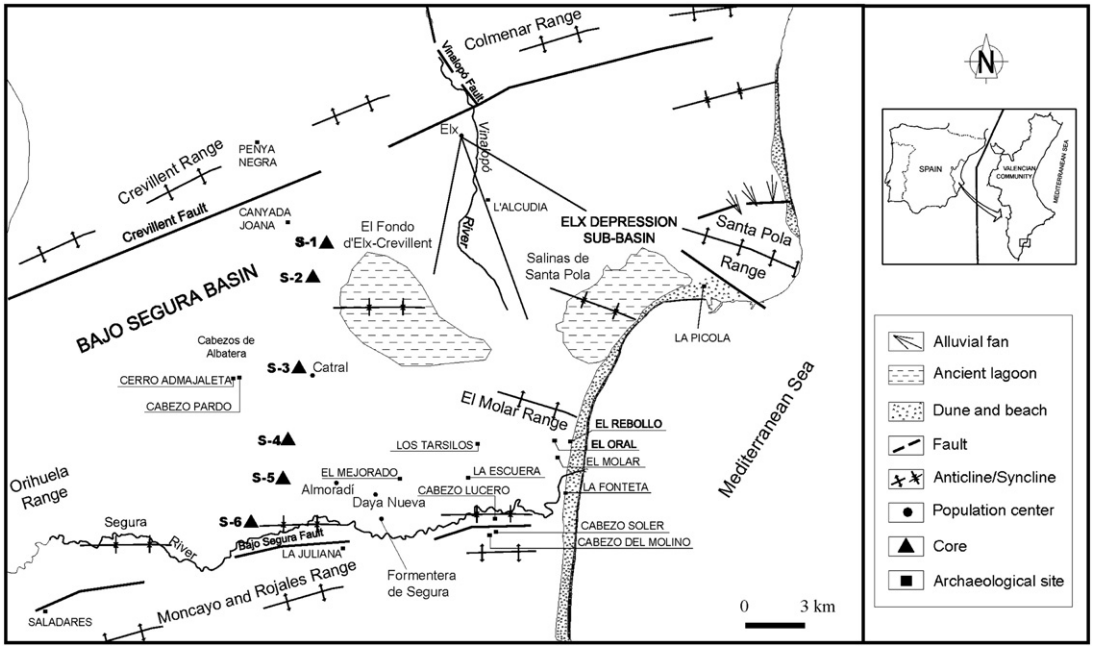

Fig. 1. Location of the study area, geomorphological scheme, situation of the mechanical cores and archeological occupation stages.