CHAPTER 18

Ebro Fan, Mediterranean

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Abstract

The Ebro Fan System consists of en echelon channel–levee complexes, 50 × 20 km in area and 200-m thick. A few strong reflectors in a generally transparent seismic facies identify the sand-rich channel floors and levee crests. Numerous continuous acoustic reflectors characterize overbank turbidites and hemipelagites that blanket abandoned channel–levee complexes. The interlobe areas between channel complexes fill with homogeneous mud and sand from mass flow and overbank deposition; these exhibit a transparent seismic character. The steep continental rise and sediment “drainage” of Valencia Trough at the end of the channel–levee complexes prevent the development of distributary channels and midfan lobe deposits.

Introduction

The Ebro Deep-Sea Fan system lies in a restricted basin on the northwestern Mediterranean continental rise between the Ebro River and the Valencia Trough west of the Balearic Islands (Fig. 1). The fan is of particular interest because its morphology and development differ from typical systems. The Ebro system consists of several channel–levee complexes, each associated with a separate slope valley and terminating at Valencia Trough. This is in contrast to typical fan development, in which a main inner fan valley continues into distributaries within midfan or lower-fan depositional lobe areas.

In this study we correlate the near-surface (upper 100 m) seismic stratigraphy with detailed morphology and core stratigraphy. By defining the lobe history and morphological development, it is possible to formulate a growth pattern for the system.

Geologic Setting

The continental margin off the Ebro River is a young, passive margin initiated in Late Paleogene time as a result of the rifting and spreading of the western Mediterranean basins [1]. Listric normal faults striking northeast-southwest created deep-seated graben systems parallel to the margin that control basin configuration. The Pliocene through Quaternary stratigraphy and morphology of the continental margin reflect the seaward progradation of deltaic deposits [2]. On the continental slope these well-stratified deposits are cut by shallow slope canyons, some of which are filled with sediment.

The acoustic units on the continental rise (1200 to 1800-m water depth) are capped by a well-stratified Pleistocene sequence of deep-sea fan and base-of-slope deposits [3]. From the Ebro River and south for about 110 km, the continental rise is covered by channel–levee complexes. Each of these lenticular units is approximately 15-km wide, 40 to 50-km long, and 150 to 200-m thick [4].

The Ebro River, which feeds these deep-sea fan deposits, is one of the four major sediment sources of the Mediterranean Sea. It drains one-sixth of Spain (85,835 km²); its annual sediment discharge is 3 to 4 million t [5]. Fine-grained sand is trapped in the coastal environments of the delta while the prodelta is built by organic-rich silt and clay. Relict outer-shelf sand and gravel and the lack of turbidites in the Holocene sediment of the fan show that, at present, little Ebro sediment reaches the fan system.

In contrast, greater river discharge during low stands of sea level in the Pleistocene is suggested by coarse-grained,
polygenetic gravels both in the Ebro fluvial valley [5] and on the continental shelf [2]. The Ebro deep-sea fan system developed during the Pleistocene as a result of this abundant sediment supply and the concomitant displacement of the river depocenter to the outer shelf [3].

Methods

The *R.V. Cornide de Saavedra* was used in 1979 to take 1000 km of 3-kJ seismic profiles. In 1981, 60 piston cores were collected using this ship and the *R.V. Garcia del Cid*. Satellite and Loran A navigation systems with a precision of 1 to 2 km were used on both vessels. Our tracklines were adjusted to match unpublished seismic data collected with precision Shoran navigation. We surveyed the north half of the entire Ebro Fan system with a line spacing of 5 to 10 km over an area of 2000 km².

Morphology

The continental shelf off the Ebro River is wide (up to 70 km) in comparison with other shelf areas in the western Mediterranean (Fig. 1). The lobate Ebro Delta extends offshore, producing an arcuate prodelta bulge in the shelf. The con-

Figure 1. Ebro Fan system morphometry and generalized lithology. Gradients show that there are no generalized breaks in slope. Sand-rich cores have a sand/mud ratio greater than 1:1, sandy–silty cores have sand/mud ratios of 1:2–1:6, and mud-rich cores have sand/mud ratios of less than 1:10. Mud thickness is reduced to one-third for calculations so that these ratios for cores simulate sandstone/shale ratios.