Tectonics, volcanism and sedimentation in the Atlantic Ocean and deep Mediterranean Sea

THE ALMERIA CHANNEL AND SURROUNDING AREAS FROM MAK-1 IMAGES AND 5 KHZ SEISMIC PROFILES: RECENT SEDIMENTARY EVOLUTION

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Introduction

The Almeria Channel is one of the most important architectural elements of the Almeria Turbidite System (ATS) developed on the Almeria margin and the Alboran Trough (Eastern Alboran Basin) (Fig. 1). This sedimentary system is Late Pliocene-Quaternary in age (Alonso and Maldonado, 1992) and it shifted progressively eastwards and retrograded till the present-day position (Estrada et al., 1997). It is fed by the Andarax River, a relatively long submarine canyon (55 km) and several gullies that erode the slope deposits. The ATS is surrounded by several morphologic highs and affected by two main fault systems (NE-SW and NW-SE). In fact, the Almeria Canyon appears faulted and a rejuvenation of its profile and related canyon-wall slumps occur (Estrada, 1994). During the TTR-12 cruise (Leg 3) on board of R/V *Professor Logachev* seven MAK-1 sonar lines (30 kHz) and 5 kHz seismic profiles were obtained in the distal reaches of the Almeria Channel and surrounding areas (Fig. 1). The studied area extends from base of slope to the Alboran Trough (1,400 to 1,900 m water depth).

Results and discussions

The MAK-1 mosaic shows a generalised medium backscatter locally affected by features of high and low backscatter. The most significant backscatter contrasts comprise the following morpho-sedimentary features: channel-like features with sinuous and meandriform paths, erosive features (spoon-shaped scours and rectilinear lineations), scarps and irregular reflective patches.

The sub-surficial sedimentary record (50 m thick) indicates a succession of five seismic units (s.u. 1 to 5, from older to younger) characterised by the following seismic facies (Fig. 2): s.u. 1, stratified divergent related with the development of levees; s.u. 2, opaque and semi-stratified both of high reflectivity which form lens-shaped bodies; s.u. 3, transparent to semitransparent which appear forming an extensive sheet-drape; s.u. 4, stratified divergent related with the development of levees, parallel stratified, semitransparent and opaque forming lens-shaped bodies; and s.u. 5, transparent, which appears forming an extensive sheet-drape and chaotic forming irregular bodies of debris-flow deposits.

The succession of these five s.u. reflects the recentmost sedimentary evolution of the Almeria Channel and surrounding areas. High-energy processes (turbidity currents, debris flows, etc.) alternate and/or coexist with phases of channel inactivity in which slow deposition from low-density currents or hemipelagic suspension prevailed. We interpret five evolutive phases (1st to 5th) corresponding to each s.u. (1 to 5) (Fig. 2). The first phase would be related with the activity of an older branch of the Almeria Channel, westward located from the present day channel and whose smoothed topography is still observed as meandriform loops in the MAK-1 mosaic. The second phase develops a succession of at least three channelized lobes. Their vertical stacking indicates an eastward shifting of the sedimentary bodies and points out an eastward migration of the Almeria Channel probably related with avulsion processes. The third phase is characterized by an extensive layer formed by semitransparent to transparent facies with an homogeneous thickness that suggests a generalized decrease in the channel sedimentary activity. During the fourth phase the sedimentary activity increases moderately as it is suggested by: the development of several small lens-shaped bodies of high reflectivity; the succession of high to low amplitude

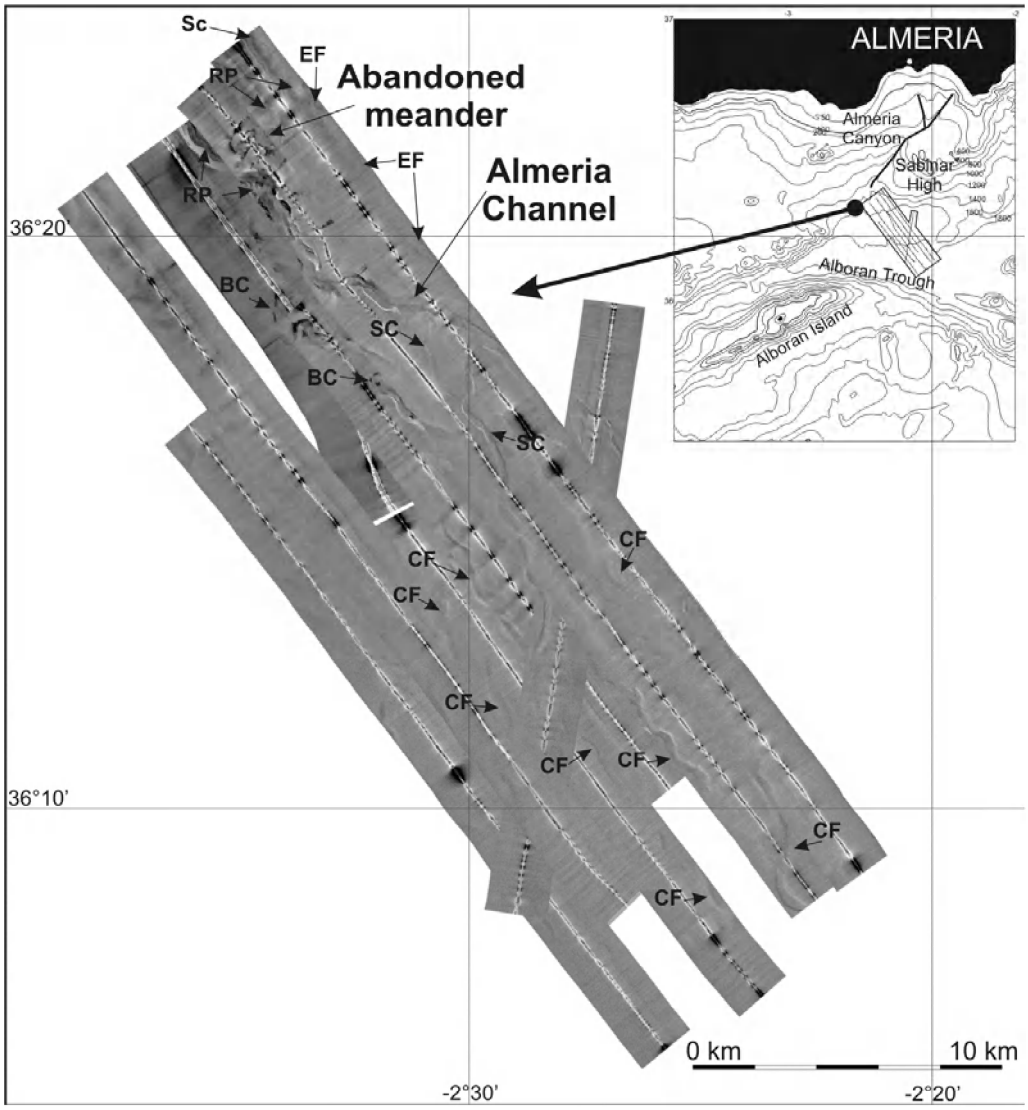

Fig. 1. MAK-1 mosaic and location of the study area. Legend: BC, buried channel; EF, erosive feature; CF, channel-like feature; RP, irregular reflective patches; SC, splay channel; Sc, scarp

reflectors on the channel-levee sediments; and the formation of splay channels (Cronin et al., 1995). The initiation of this channel reactivation is characterized by extensive discontinuous reflectors of high amplitude that in some places can form lens-shaped bodies. This could indicate instability events coming from the continental slope, probably triggered by earthquakes related with active faults. Similar high amplitude reflectors are also observed in the overlying sediments of the s.u. 4 suggesting a recurrent process. Towards the end of this phase a meander cut-off occurs in the uppermost reach of the Almeria Channel (1,525 m water depth) (Figs. 1 and 2). During the fifth phase the area is draped by a thin transparent layer (4 m average) attributed to an hemipelagic sedimentation, except in some places of the upper reaches of the Almeria Channel suggesting local erosive activity inside the channel. Coevally, debris-flows also occur in the upper reaches of the channel, closer to the Sabinar High. Its deposition results in the partial burying of the Almeria Channel.

The present-day sea-floor features observed in the MAK-1 mosaic results of the stacking of the above mentioned sedimentary processes. The generalised medium backscatter reflects the hemipelagic drape that covers the whole area during the fifth phase (Fig. 1). Most of the sinuous

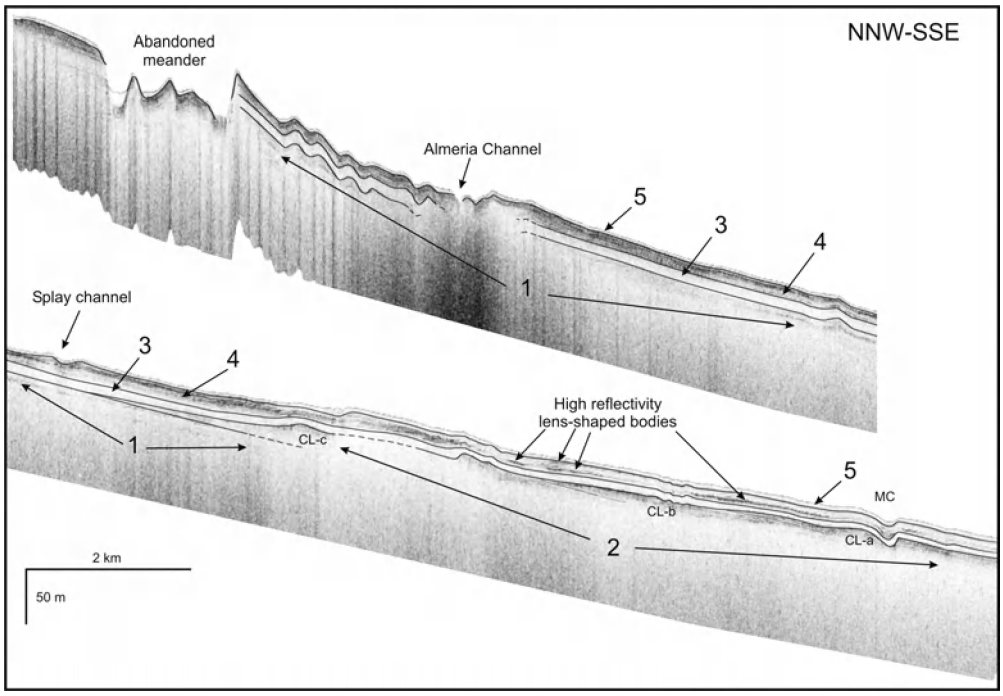

Fig. 2. Seismic profile (5 kHz) showing the main seismic units: 1, 2, 3, 4 and 5. Legend: CL, channelized lobes (a, b and c, from younger to older) and MC, mimetized channel

channel-like features correspond to those formed during second phase with more than 20 m of sedimentary cover that mimics the former channel topography (Figs. 1 and 2). On the other hand, some irregular patches and braided path features (Cronin, 1995) on the Almeria Channel floor suggest recent sedimentary activity probably related with the rejuvenation of the Almeria Canyon profile during the fourth phase. Reflective patches, scarps, erosive rectilinear lineations and spon-shaped scours are identified at the base of the Sabinar High affecting the upper reaches of the Almeria Channel (1,600 m water depth). They correspond to those gravitative processes occurred during the fifth phase. The orientation of these erosive features coincides with that of the recent splay channels, which depict an orthogonal angle respect to the Almeria Channel. These facts suggest that splay channels are more related with sediments coming from the Sabinar High than from the Almeria Channel.

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