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Architecture and depositional pattern of the Rhône Neofan and recent gravity activity in the Gulf of Lions (western Mediterranean)

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Abstract

The Rhône Deep Sea Fan is the largest sedimentary body in the western Mediterranean Sea. We present here the results of a detailed geophysical and sedimentological analysis of the most recent gravity deposits situated on the western flank of this large sedimentary body. These results are based on the interpretation of seismic profiles as well as acoustic and coring data acquired during the MARION cruise conducted in 2000 onboard R/V *Le Suroît* and Images V cruise on board of the R/V *Marion Dufresne* (1999). We found that (1) a new channel-levee unit developed during the last stage of the Rhône Neofan evolution and (2) the last phase of up-building of this channel/levee system dates back to 15.1 ka BP (^{14}C). This implies that the last lobe of the Rhône deep-sea fan was built during the last low sea-level and the ensuing sea-level rise. We also identified (3) 10 recent sandy deposits, previously interpreted as related to the Neofan activity. In fact, their origin is probably linked to the Sète canyon that collect sandy shelf-edge deposits remobilised at the head of the Pyreneo-Languedocian canyons. We also characterised (4) the morphology and discuss the origin of the scours previously identified in the study area. These results contrast with previous interpretation which assigned a much younger age to the Neofan (Méar and Gensous, 1993; Torres et al., 1997).

Keywords: Deep-sea fan; Turbidites; Debris flow; Sand; HARP; Sea-level; Erosional scours

1. Introduction

The timing of formation of gravity deposits with respect to sea-level changes, their architecture and the processes at their origin remain a matter of discussion. The Rhône deep sea fan is a rewarding area for addressing these questions because a large data set is available, including morpho-bathymetry, geophysics, chronostratigraphy and sedimentology.

In this paper, we present the results of a detailed geophysical and sedimentological investigation covering a surface of approximately 2000 km^2 situated on the western flank of the Rhône Deep Sea Fan and more precisely close to the last avulsion point of the turbidite channel. These new data allow understanding the timing of deposition and architecture of the Rhône Neofan, which is interpreted as the result of the last avulsion of the Rhône Deep-Sea Fan channel (Droz and Bellaiche, 1985), and the recent most gravity processes that took place during the sea-level rise in this part of the Gulf of Lions.

2. General framework and previous work

The study area is located on the Gulf of Lions continental rise at 2000–2500 m water depth. This zone is delimited to the North by the Rhône Deep-Sea Fan (RDSF) and to the West by the Pyreneo-Languedocian Sedimentary Ridge (PLSR) (Fig. 1). The Rhône Deep-Sea Fan is the largest turbidite system in the western Mediterranean and was fed by inputs mainly originating from the Rhône River. Its watershed covers 97,800 km^2 (Pont et al., 2002), corresponding mainly to the main part of the Alps, which were strongly affected by glaciations during the late Pliocene and the Quaternary. The deep-sea fan has an elongate shape with

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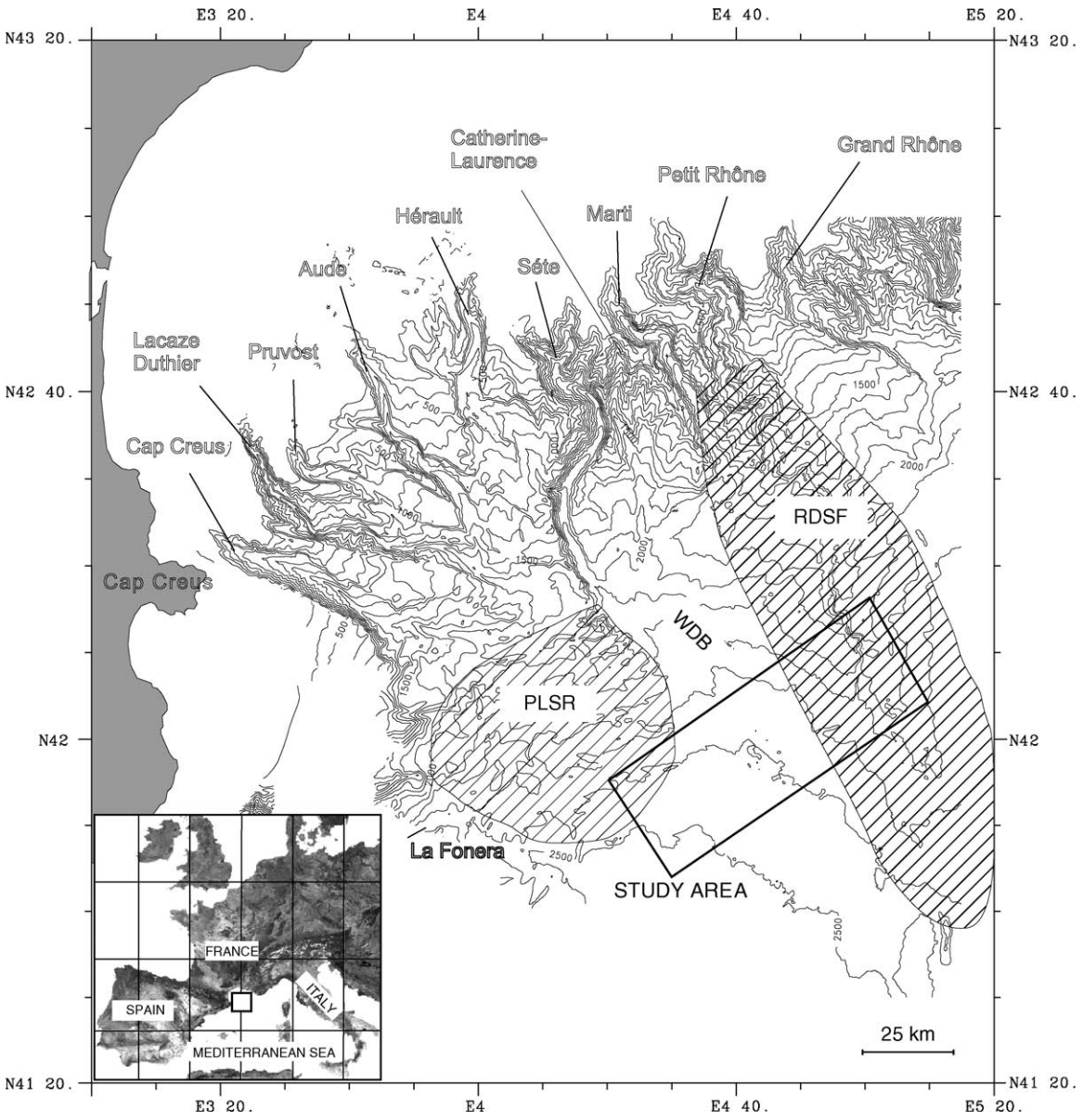

Fig. 1. Bathymetric map of the western Gulf of Lions showing the principal sedimentary features: the Rhône Deep Sea Fan (RDSF), the Pyreneo-Languedocian Ridge (PLSR) and the location of the Western Discordant body (WDB). Location of the study area.

a maximum width of 200 km and a total length of 300 km, and the maximum thickness of the sedimentary series deposited by the fan is about 3600 m (Droz and Bellaiche, 1985). The growth of the fan started during the Pliocene (5 Ma) and was strongly controlled by the Quaternary glacio-eustatic changes. It is connected to the shelf through a deeply incised canyon (the Petit Rhône canyon) with a meandering axial incision (Torres, 1995). Detailed maps of the shelf show that the retrogressive erosion of the Rhône during the deglacial sea-level rise has been preserved as a negative relief, visible from the shelf edge to a water depth of about 65 m (Berné et al., 2001), demonstrating the connection of the Petit Rhône canyon with a stream approximately located at the present position of the Petit Rhône river.

The Pyreneo-Languedocian Sedimentary Ridge (PLSR), initially identified as the 'Catalan Fan' by Got and Stanley (1974), or 'Pyrenean Canyon Deep Sedimentary Body' (PCDSCB) by Canals et al. (1985) and Alonso et al. (1991), is built up at the termination of the Sète canyon. The PLSR is a sediment body about 900 m thick (Berné et al., 1998), which developed since the Middle Pleistocene (~800 ka) (Dos Reis, 2001). The PLSR is a fine-grained turbiditic ridge exhibiting undulating morphologies probably corresponding to sediment waves (Jallet, 2002).

In-between the RDSF and the PLSR, several stacked units constitute the 'Western Discordant Body' (Droz, 1983) also called the 'Interlobe Unit' (Méar, 1984). Three major seismic units have been identified, the Lower Interlobe Unit (LIU) (Méar, 1984; Droz and Bellaiche,