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Late Glacial to Preboreal sea-level rise recorded by the Rhône deltaic system (NW Mediterranean)

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Abstract

A unique late Glacial–Preboreal record of changes in sea-level and sediment fluxes originating from the Alps is recorded in the Rhône subaqueous delta in the Western Mediterranean Sea. The compilation of detailed bathymetric charts, together with high-resolution seismic profiles and long cores, reveals the detailed architecture of several sediment lobes, related to periods of decreased sea-level rise and/or increased sediment flux. They are situated along the retreat path of the Rhône distributaries, from the shelf edge and canyon heads up to the modern coastline. They form transgressive backstepping parasequences across the shelf, the late Holocene (highstand) deltas being confined to the inner shelf. The most prominent feature is an elongated paleo-shoreface/deltaic system, with an uppermost sandy fraction remolded into subaqueous dunes. A long piston core into the bottomsets of this prograding unit allows precise dating of this ancient deltaic system. In seismic data, it displays aggradation, starting at ~15 cal kyr BP, followed by progradation initiated during the first phase of the Younger Dryas, a period of reduced sea-level rise or stillstand. The delta kept pace with resumed sea-level rise during the Preboreal (which is estimated at about 1 cm/yr), as a result of increased sediment supply from the Alps (melting of glaciers and more humid climate "flushing" the sediment down to the sea). Abandonment of the delta occurred around 10,500 cal yr BP, that is to say about 1000 yr after the end of the Younger Dryas, probably because of decreased sediment flux.

Keywords: sea-level; deglacial; Younger Dryas; delta; Western Mediterranean Sea

1. Introduction and background

The direct record of sea-level rise for the last deglacial period has been mainly determined from the position of reef-crest *Acropora* corals living at less than 5 m of water depth (Fairbanks, 1989; Bard et al., 1996). Another way to explore this record is to study the retreat path of fluvial systems. Estuaries and deltas are depocenters that may leave on the shelf large quantities of sediments from their landward migration. The amount of preserved deposits is thought to be mainly a function of the energy of coastal and marine processes, of the amount of sediment supplied, and of the rate of relative sea-level rise. For instance, some authors have estimated the last deglacial sea-level rise by dating continental fragments of coastal sedimentary environments deposited along the retreat path of large rivers on

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the Sunda Shelf (Hannebuth et al., 2000). In areas where sediment supply is high, prograding transgressive deposits (parasequences in the sense of Van Wagoner et al. (1990)) formed during periods of deceleration of sea-level rise. First described in the stratigraphic record, they have also been identified in Quaternary sedimentary environments (Anderson and Thomas, 1991). However, autogenic processes (such as the change of sediment flux due to increased rainfall, or the avulsion of deltaic systems) may mimic parasequences induced by sea-level forcing, as discussed by Harris (1999).

In the Gulf of Lions (Fig. 1), Aloïsi et al. (1975) were the first who recognized the architecture of sediment bodies linked to the Rhône retreat during the last sea-level rise. Using seismic and core data, they demonstrated that an elongated sediment body, roughly parallel to the bathymetric contour lines, was situated at a water depth of about 50 m. They suggested that this sediment body was Younger Dryas in age, and formed during a sea-level stillstand followed by a slight fall in sea-level. Further investigations more precisely defined the morphology of the subaqueous delta (Tesson et al., 1998) and the shape of some of its constituting sediment bodies (Gensous et al., 1993; Marsset and Bellec, 2002). The compilation of a large set of seismic data allowed Labaune et al. (2005) to propose a synthesis of the architecture of various seismic units composing the transgressive subaqueous Rhône delta, but details of the morphology and chronostratigraphic framework were not available until now.

2. Terminology

2.1. Subaqueous deltas

The term of subaqueous delta employed in this study corresponds to the sediment bulge which formed by accumulation of sediments during the retreat of the Rhône river during the last deglacial sea-level rise and subsequent highstand. It includes remains of various

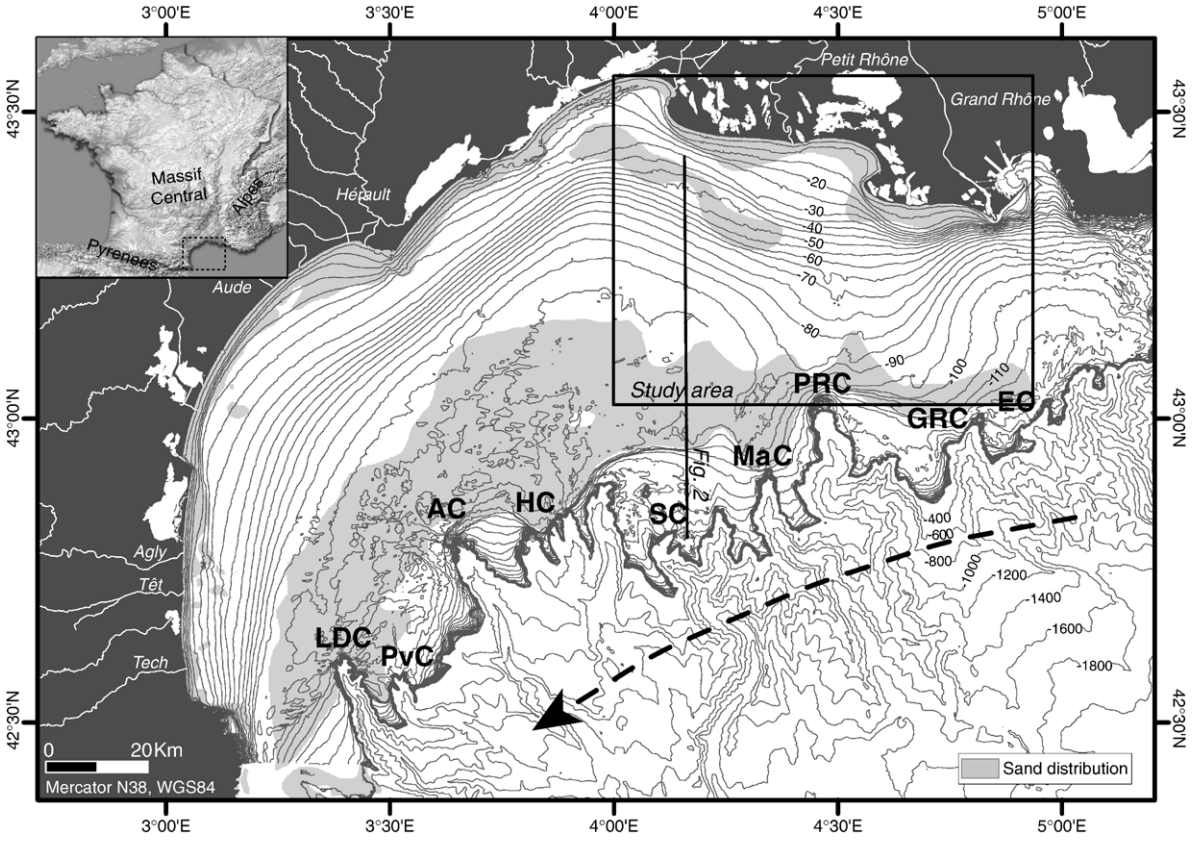

Fig. 1. General bathymetric map of the Gulf of Lions (based on Berné et al. (2001)). The distribution of sand is modified from Aloïsi (1986). Isobath contour line interval is 5 m from 0 to 150 m water depth, 200 m beyond 150 m. The arrow represents the direction of the Northern contour current. LDC: Lacaze-Duthiers Canyon; PvC: Pruvot Canyon; AC: Aude Canyon (or Bourcart canyon); HC: Hérault Canyon; SC: Sète Canyon; MaC: Marti Canyon; PRC: Petit Rhône Canyon; GRC: Grand Rhône Canyon; EC: Estaque Canyon.