ELSEVIER

Marine Geology 224 (2005) 57–82

MARINE GEOLOGY
INTERNATIONAL JOURNAL OF MARINE GEOLOGY, GEOCHEMISTRY AND GEOPHYSICS

www.elsevier.com/locate/margeo

Palaeoclimatology and palaeohydrography of the glacial stages on Celtic and Armorican margins over the last 360 000 yrs

M. Mojtahid [a,1], F. Eynaud [a,*], S. Zaragosi [a], J. Scourse [b], J.-F. Bourillet [c], T. Garlan [d]

[a] *Département Géologie et Océanographie, UMR-CNRS "EPOC" 5805, Université Bordeaux I, Avenue des Facultés, F-33405 Talence, France*
[b] *School of Ocean Sciences, University of Wales (Bangor), Menai Bridge, Anglesey, LL59 5EY, UK*
[c] *IFREMER, Département Géosciences Marines, Laboratoire Environnements Sédimentaires, BP 70- 29280 Plouzané, France*
[d] *EPSHOM, 13, rue du Chatellier- BP 30316- 29603 BREST Cedex, France*

Received 14 February 2005; received in revised form 19 July 2005; accepted 21 July 2005

Abstract

Core MD03-2692 was retrieved in a water-depth of 4064 m on the Celtic margin (Bay of Biscay) during the SEDICAR cruise onboard the *RV Marion Dufresne II*. It covers the last 360 ka in a total length of 39 m. Multidisciplinary analyses have been applied to this sequence with the aim of studying the palaeoclimatic and palaeoenvironmental signals of the last few climatic cycles. The analyses undertaken include: (1) non-destructive logging with: physical properties (magnetic susceptibility, sediment colour), X-ray radiography and measurement of the major elements by X-ray-fluorescence, (2) analyses of planktonic and benthic foraminifera, lithic grains and stable isotopic measurements (oxygen and carbon). We have focused on the long-term evolution of glacial stages (with special attention to terminations and Heinrich events). The results obtained confirm the close correlation between deep-sea sedimentation recorded on the Celtic margin and changes in the terrestrial environment of the adjacent continent. Heinrich layers have been identified in MIS 2, 3, 6 and 8. We note the occurrence of laminated facies within deglacial sequences deposited during Termination I and MIS 6. These facies are closely linked to disintegration phases of the British–Irish Ice Sheet (BIS). The laminations contain lower ice-rafted detritus (IRD) concentrations than the equivalent Heinrich layers and are linked to abrupt changes in sea-surface palaeotemperatures. We suggest that the laminations are formed by an annual cycle of meltwater and iceberg release from the disintegrating BIS generating cascading plumes of dense turbid meltwater coeval with IRD release.

Keywords: Celtic margin; glacial terminations; British–Irish Ice Sheet; laminated sediments

* Corresponding author.
E-mail addresses: mojtahid.meryem@caramail.com (M. Mojtahid), f.eynaud@epoc.u-bordeaux1.fr (F. Eynaud), s.zaragosi@epoc.u-bordeaux1.fr (S. Zaragosi), j.scourse@bangor.ac.uk (J. Scourse), jfb@ifremer.fr (J.-F. Bourillet), garlan@shom.fr (T. Garlan).
[1] Now at: Laboratory for the Study of Recent and Fossil bio-indicators, CNRS UPRES EA 2644, Angers University, 2 Boulevard Lavoisier, 49045 Angers Cedex, France.

0025-3227/$ - see front matter © 2005 Elsevier B.V. All rights reserved.
doi:10.1016/j.margeo.2005.07.007

1. Introduction

Not all the terminations which mark the abrupt transitions between the glacial and interglacial stages of the Quaternary (Broecker and van Donk, 1970) are accurately constrained. In the high latitudes of the North Atlantic Ocean, terminations are marked by abrupt changes of microfauna from polar to diversified subpolar assemblages (McIntyre et al., 1972) as a direct consequence of orbitally forced global warming. These transitions, which are also clearly expressed in temperate sediments of the North Atlantic Ocean, are coeval with marked palaeotemperature fluctuations and water mass reconfigurations (McIntyre et al., 1972; Ruddiman and McIntyre, 1976; Sarnthein and Tiedemann, 1990). These water mass changes are linked to global changes via the disruption of the Atlantic meridional overturning circulation (MOC) component of the thermohaline circulation (THC, e.g. Broecker et al., 1990).

The aim of this study was primarily to investigate the palaeoenvironmental history of terminations in the northern Bay of Biscay through the study of one of the longest cores ever retrieved in this area, core MD03-2692. This core covers the last three climatic cycles (with core base within Marine Isotopic Stage, MIS, 10) and provides, for the first time, an opportunity to document the last 360 ka in this area. One of the key attributes of sequences recovered from the Bay of Biscay is that they contain terrigenous material derived from the adjacent continent, enabling the identification of connections between the ocean, cryosphere (glacial collapse), continent and atmosphere. Previous studies in this part of the Bay of Biscay (Zaragosi et al., 2001; Locascio, 2003) have revealed the presence of a characteristic facies dominated by millimetric laminations and occurring recurrently across Terminations I and II. Such laminated facies were also present in core MD03-2692, to which we pay particular attention.

We have undertaken a multi-proxy investigation using physical, stratigraphical, geochemical, sedimentological, and micropaleontological tools, and have focused our work on identifying similarities and discrepancies between the different climatic cycles investigated. In particular we have analysed glacial stages containing evidence for abrupt events, including Heinrich events, and deglacial phases.

2. Present and past regional setting

Core MD03-2692 (46°50′ N, 9°31′ W) was retrieved from the Trevelyan escarpment (Fig. 1) in a water depth of 4064 m during the SEDICAR cruise onboard the oceanographic *RV Marion Dufresne II* of the Institut Polaire Paul-Emile Victor (IPEV). The scientific aims of this cruise (Bourillet and Turon, 2003) were to study sediment fluxes from estuaries towards the deep-sea during periglacial regimes (over the last few climatic cycles) including a detailed case study of "The Channel River/Manche system" (Bourillet et al., 2003; Gibbard and Lautridou, 2003; Lericolais et al., 2003). The Trevelyan escarpment, adjoining the Meriadzek terrace, is part of this fluvial system which extends from the southern North Sea to the Bay of Biscay. It comprises the continental shelf, the English Channel, a portion of the continental slope characterised by many erosive canyons, and a rise marked by the two recently discovered deep-sea turbidite systems, the Celtic and Armorican fans (Auffret et al., 1996; Droz et al., 1999; Zaragosi et al., 2000, 2001).

Core MD03-2692, 38.96 m in length, consists mainly of hemipelagic clays. Recent sedimentation is controlled by the local hydrography which is dominated by four water masses. The abyssal water mass is Lower Deep Water (LDW), a low salinity and low temperature water mass but with high silica content (van Weering et al., 1998; Frew et al., 2000; van Aken,

Fig. 1. (a) Physiography of the studied area. Bathymetric contour intervals are 50 m on the shelf (0–250 m), 500 m on the slope (500–4000 m) and 100 m on the deep-sea (4000–4900 m). The blue surface depicts the B.I.S. full glacial extension (after Stokes and Clark, 2001; Lambeck, 1995; Boulton et al., 1977); blue continuous arrows represent the Irish Sea Ice stream during the LGM (after Mc Cabe, 1998; Scourse et al., 2000 and Stokes and Clark, 2001). Red dotted line and red arrows represent Heinrich 1 ice limit and ice flows directions, respectively (after Bowen et al., 2002). The English Channel paleovalleys are also depicted for the oriental part (after Larsonneur et al., 1982) and the occidental part of the margin (after Bourillet et al., 2003) (Scilly glaciation after Scourse (1991)). (b) Location of the studied core and nearby cores with regards to the detailed geomorphology of the margin. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)