

Wave-form sheeted contourite drift on the Barra Fan, NW UK continental margin

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Abstract: The lithology of a 30 m long piston core (MD95-2006) and high-resolution, seismic profiles from the lower Barra Fan, Rockall Trough, reveal a sheeted drift form with internal sediment waves deposited over the last glacial–interglacial cycle. Deposition of these mainly fine-grained deposits was controlled by a combination of downslope and alongslope transport mechanisms that interacted with the positive topography created by debrite lobes on the lower fan. The core penetrates a small field of sediment waves (wavelength approx. 1 km, height 3–6 m), which onlap a debrite lobe dated to the last glacial maximum. The sedimentary sequence shows: (1) silty-muddy contourites deposited during the mid-Devensian (Marine Isotope Stage 3), (2) glacimarine hemipelagites and sandy turbidites deposited between 26 and 18 C¹⁴ ka BP, followed by a short phase of erosion and redeposition by bottom currents, and (3) glacimarine hemipelagites and silty-muddy contourites representing the glacial to Holocene transition. On the distal fan edge, a drift sequence with upslope-migrating sediment waves (wavelengths approx. 3 km, height 15–30 m) onlaps the tongue of a previous slide event (pre-Devensian?). These bedforms were probably generated by decelerating, low-density glacigenic turbidity currents, but pirated by contour-following bottom currents on the distal part of the drift.

Contourite drifts in continental slope settings have often been related to a process continuum whereby sediments supplied by downslope transport mechanisms are progressively subjected to winnowing and preferential settling by slow moving, but persistent, geostrophic currents (Heezen *et al.* 1966; Tucholke & Laine 1983; Stanley 1993; Masse *et al.* 1998). But because the transfer from downslope gravity-driven currents to contour-tracing bottom currents may occur gradually over tens to hundreds of kilometres it is difficult to establish reliable facies models, which can lead to identification of downslope-alongslope process interaction. A particular aspect of this problem is how sandy contourites can be distinguished from bottom current reworked fine-grained turbidites (Stow *et al.* 1998). Integration of high-resolution seismics across drift sequences covered by long core stratigraphies is critical to the elucidation of the complex relationship between downslope and alongslope processes in a deep marine setting. Here we present detailed seismic and sediment facies data and attempt an interpretation of the depositional processes that resulted in the wave-form sheeted drifts on the lower Barra fan in the Rockall Trough (Fig. 1).

Core MD95-2006 (depth 2120 m) penetrated 30 m into a small sediment wave field on the northern fringe of the Barra Fan. This region is covered by several high-frequency 6 kV deep-tow boomer profiles collected by the British Geological Survey as part of their offshore reconnaissance mapping programme. In addition, we present a high-resolution sleeve-gun profile across the distal fan edge, obtained through the European ENAM2 research programme (Fig. 2).

Geological and oceanographic setting

The Rockall Trough forms a narrow northeast extension of the East Atlantic basin that trends along the continental margin of the British Isles (Fig. 1). It is confined to the west by the Rockall Plateau and to the north by the Wyville–Thomson Ridge, which forms a sill at < 500 m depth between the northern Rockall Trough and the Faroe–Shetland Channel. Water depths range

from 4000 m in the southwest part, where the basin deepens into the Porcupine Abyssal Plain, to less than 1000 m in the northeast.

Sedimentation induced by bottom currents, centred on the flanks of the Rockall Trough, is known to have occurred since the late Eocene (Jones *et al.* 1970; Miller & Tucholke 1983; Stow & Holbrook 1984). The mid-upper Cenozoic succession of the eastern margin is characterised by overlapping sheeted and mounded drifts, in many cases showing development of upslope migrating sediment waves (Stoker *et al.* 1998). The sediment drifts along the margin are separated by two slope-apron fan systems, the Sula Sgeir and Barra–Donegal fans, principally constructed by mass-flows supplied by glacimarine processes during glacial periods (Stoker 1995; Vorren & Laberg 1997).

The seismo-stratigraphic structure, comprising four major slide events that form the bulk architecture of the Barra Fan was demonstrated by Holmes *et al.* (1998). Recent alongslope and downslope sedimentation patterns on the upper to middle fan were described by Armishaw *et al.* (1998) using detailed analyses of seafloor morphology. Howe (1996) discussed the origin of sediment waves on the lower Barra Fan and in the NE Rockall Trough based on high-resolution seismic profiles and gravity cores.

The lower Barra Fan presently lies under the influence of a deep poleward current derived from North Atlantic Deep Water (NADW), which is partially mixed with Labrador Sea Water (LSW) from above and Antarctic Bottom water (AABW) from (McCartney 1992). In the southern Rockall Trough this water mass, centred at 2000–3000 m depth, has been recorded with peak flow velocities between 27 and 39 cm s⁻¹ (Dickson & Kidd 1986). A component of Norwegian Sea Deep Water (NSDW) intermittently overflowing the Wyville–Thomson Ridge may also contribute to the semi-cyclonic pattern of bottom water circulation in the northern Rockall Trough (Ellett & Roberts 1973; Dickson & Kidd 1986). At depths down to about 1000 m, the Barra Fan is affected by a strong northward-flowing slope current linked to the North Atlantic Current (Kenyon 1986). On the Hebrides Slope, peak flow velocities of this water mass have been measured at 15–25 m s⁻¹ (Howe & Humphery 1995).

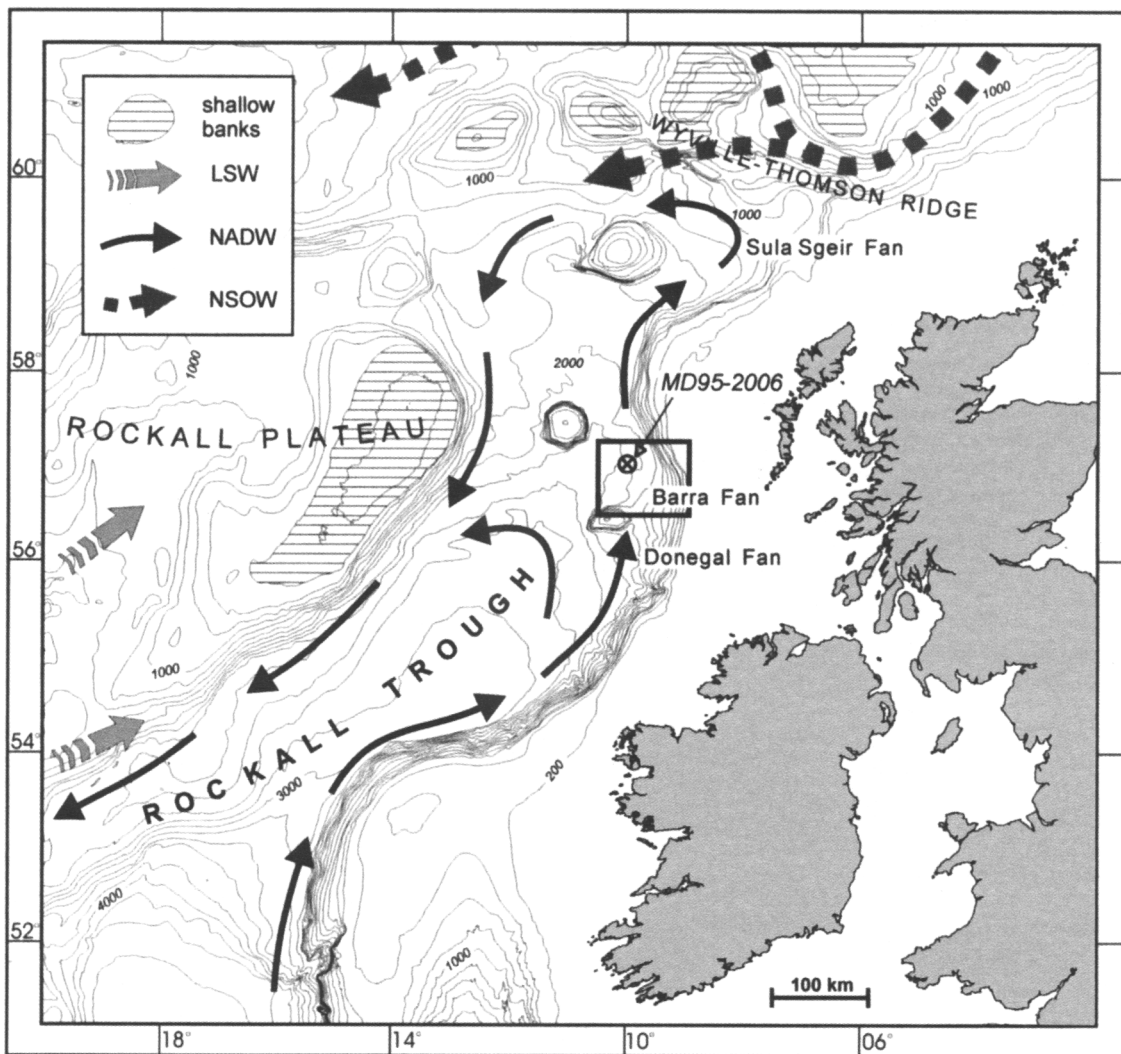


Fig. 1. Deep-water sources and circulation pattern in the Rockall Trough. LSW, Labrador Sea Water; NADW, North Atlantic Deep Water; NSOW, Norwegian Sea Overflow Water. Core site of MD95-2006 is indicated. Black box represents study area shown in Figure 2.

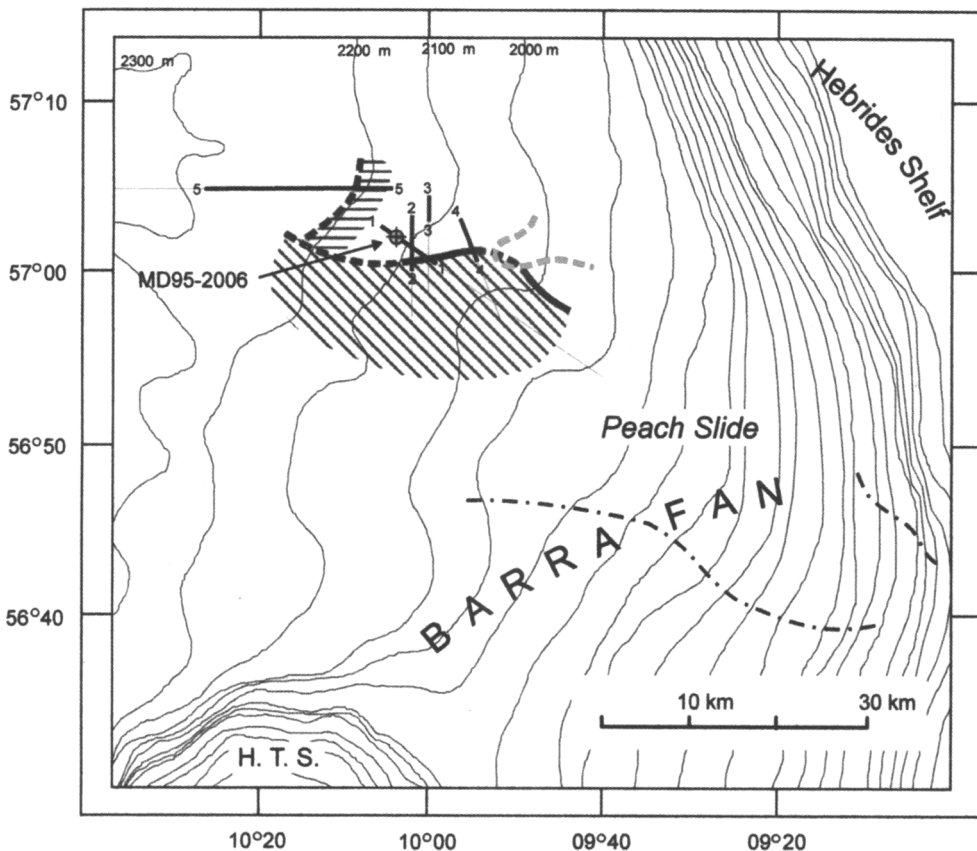


Fig. 2. Position of seismic lines and MD95-2006 in relation to debris flow lobes on the northern Barra Fan. Diagonal lines depict the scarp formed by debris flow 3 (DF 3) while the horizontal lines demarcate the scarp of an older slide event associated with debrite sequence 2 (DF 2) (Holmes *et al.* 1998). The grey broken line shows the possible outline of a younger debris lobe that impinges on the margin of DF 3. Major scarps bounding the Peach Slide are shown with thin stippled lines. H.T.S. is the Hebrides Terrace Seamount.

Sediment facies and interpretation

A detailed lithological description of MD95-2006 based on sediment texture, structures, colour, qualitative estimates of calcium carbonate content and degree of bioturbation, has allowed us to define seven distinct sediment facies (Fig. 3). Interpretation of depositional environments is based on facies characteristics, magnetic susceptibility patterns and grain size analyses (Fig. 4). The facies recognized are as follows:

Facies A: silty to fine sandy mud, light olive brown, high carbonate content, intense bioturbation, no dropstones.

Facies B: structureless silty mud, olive brown to greyish brown, low-medium carbonate content, moderate to intense bioturbation, no dropstones.

Facies C: heterogeneous silty to sandy mud, dark greyish brown, low carbonate content, abundant Fe-sulphides, weak to absent bioturbation, few dropstones.

Facies D: structureless clayey mud, olive brown, very low carbonate content, abundant Fe-sulphides, weak bioturbation, rare dropstones.

Facies E: silty to fine sandy mud and silt, olive grey, variable carbonate content, moderate to intense bioturbation, diffuse layering in silts, rare dropstones.

Facies F: silty mud, dark grey to olive grey, variable carbonate content, abundant Fe-sulphides, weak to moderate bioturbation, rare dropstones.

Facies G: graded silt laminae and thin sand layers, sharp-based, sands up to coarse granule size, with immature composition and glacially-weathered lithic clasts.

Contourites

The top part of the core comprising facies A–B is interpreted as a late Glacial to Holocene contourite development (Fig. 4). The silty and mottled character of facies A indicates intensive sediment winnowing, presumably reflecting the modern current regime. A similar silty-sandy mud facies has been described from seven gravity cores recovered along the seismic profile 1, a short distance upslope from MD95-2006 (Howe 1996). Facies B is a non-distinct, homogeneous mud with a hemipelagic character, but

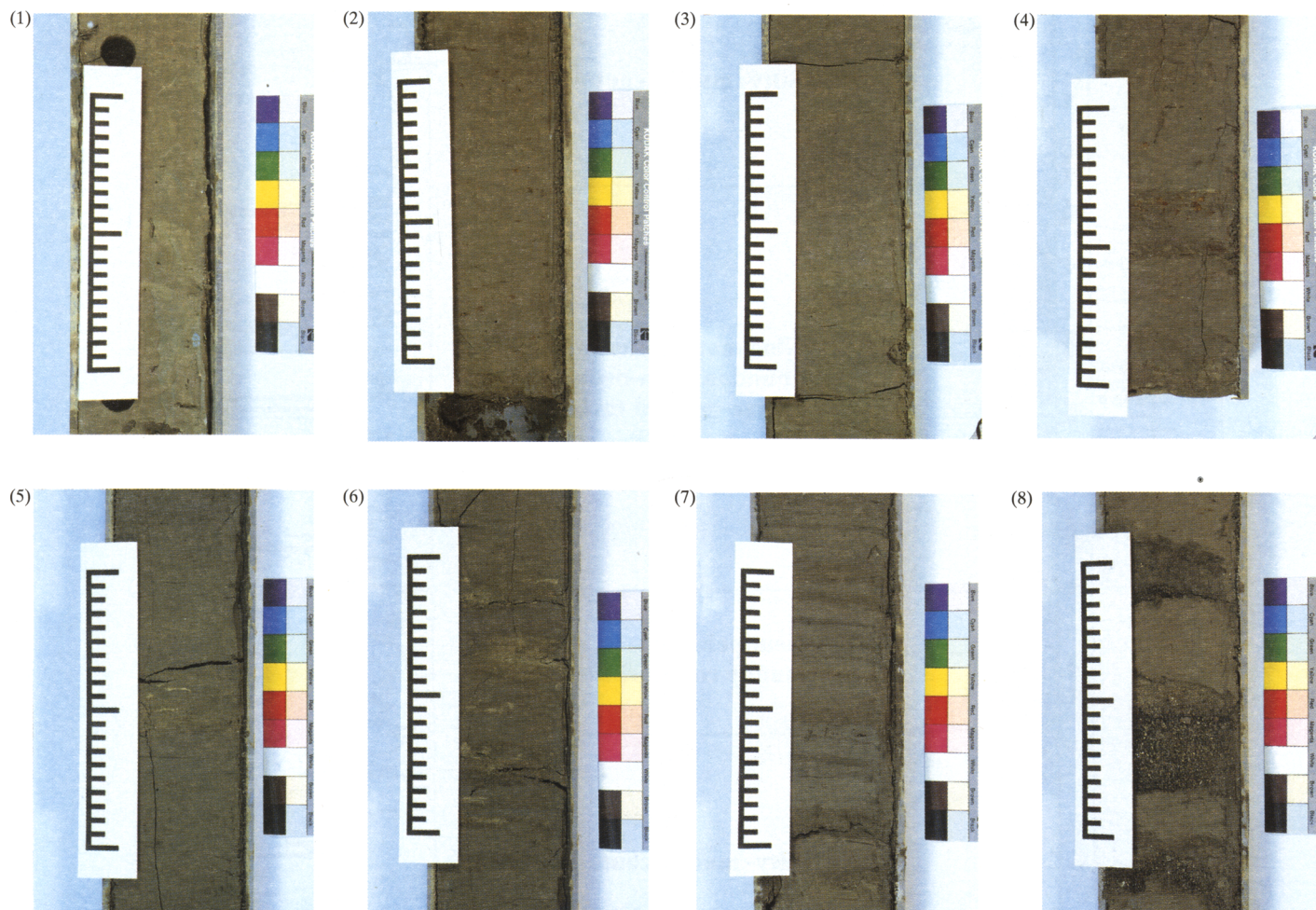
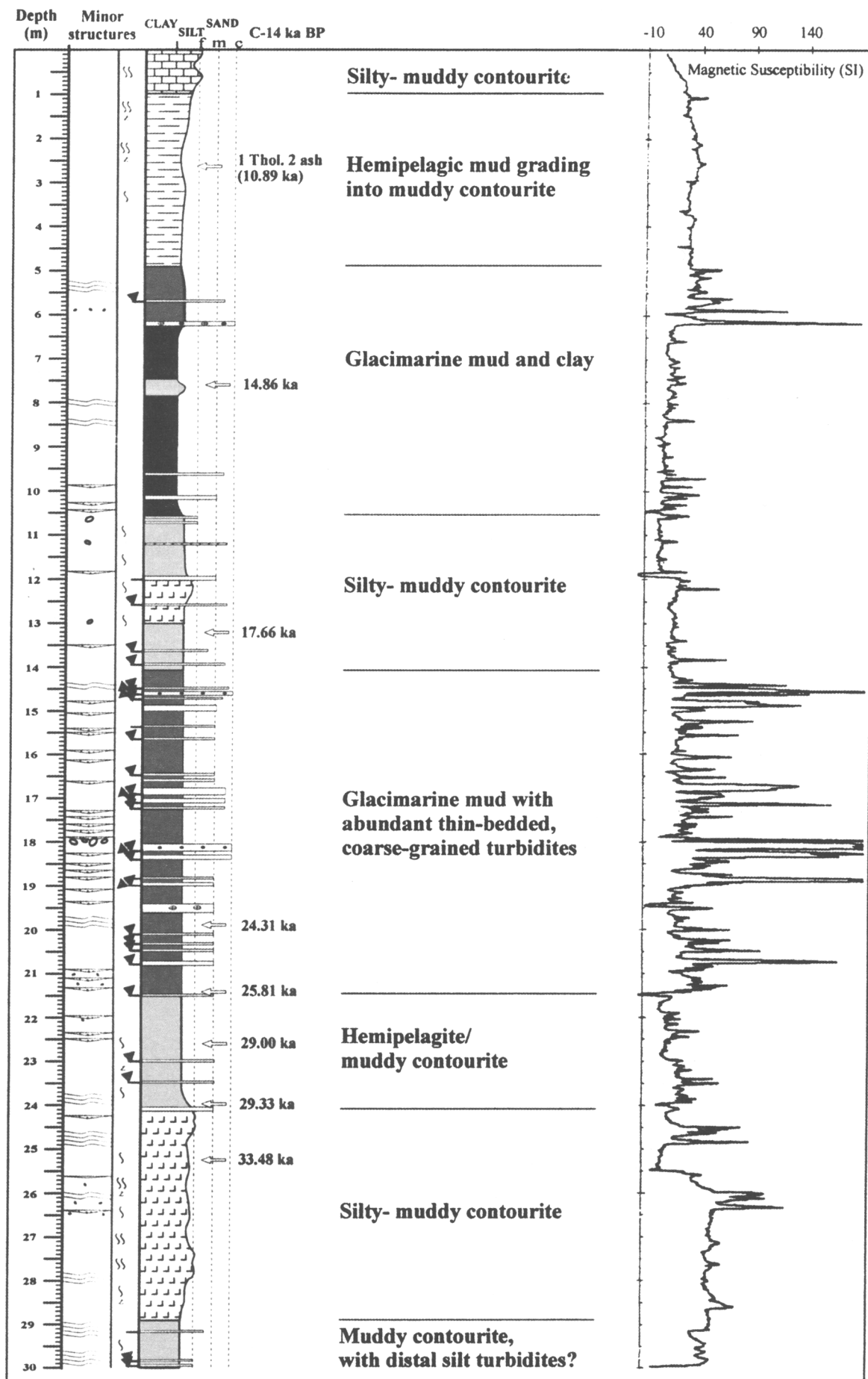
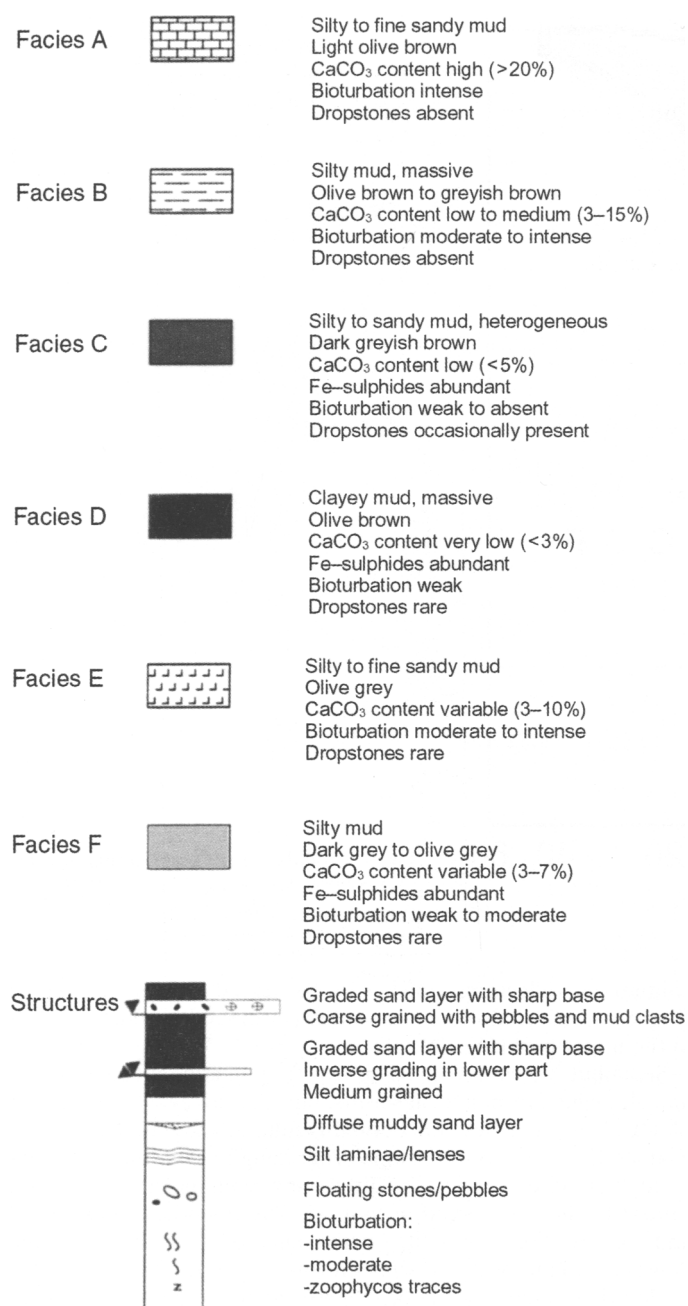


Fig. 3. Representative core photographs of the different sediment facies in core MD95-2006. Scale bar is 20 cm long.

- (1) Facies B – hemipelagite passing up into muddy contourite (core depth 0.8–1.1 m).
- (2) Facies F – silty/muddy contourite-hemipelagite (core depth 11.6–11.9 m)
- (3) Facies F – silty/muddy contourite with diffuse lamination (core depth 27.3–27.6 m)
- (4) Facies F – silty contourite (mottled, indistinctly laminated) within muddy contourite facies (core depth 22.25–22.45 m)
- (5) Facies E – silty contourite layers (mottled, indistinctly laminated) within silty muddy contourite facies (core depth 24.45–24.75 m)
- (6) Facies E – silty contourite layers (mottled, indistinctly laminated) within silty muddy contourite facies (core depth 24.75–25.05 m)
- (7) Facies G – graded silt-laminated turbidites (core depth 21.2–21.5 m)
- (8) Facies G – graded thin-bedded sandy turbidites (core depth 14.45–14.75 m)





the upward increasing grain size trend (Fig. 6b) suggests it represents a gradual development from hemipelagic to bottom current influenced sedimentation. Facies E–F are interpreted as glacial silty and muddy contourites, following the definitions of Stow & Piper (1984) and Stoker *et al.* (1998). Facies E displays a variable mottled silty texture characteristic of a silty-muddy contourite, occasionally with thin sandy contourite intervals. The more uniform texture of facies F suggests a hemipelagic depositional environment.

Grain size analyses from core MD95-2006 reveal high frequency fluctuations of the coarse clastic silt component through facies A–B and E–F (Fig. 6b). These silt cycles are apparently unrelated to glacial source variations as determined by ice-rafted debris (IRD) content but co-vary with high abundances of planktonic foraminifers, particularly in the lower part of the core. The silty intervals are inferred to represent periods of sediment winnowing by strong (>15 cm s⁻¹) bottom currents (McCave *et al.* 1995b). The alternating depositional patterns in MD95-2006 are associated with variations in flow intensity of North Atlantic Deep Water and corresponds to stadial-interstadial cycles in the North Atlantic climate record (Knutz *et al.* 2001).

The high background level of magnetic susceptibility through facies A–B and facies E (Fig. 4) could be an effect of current winnowing and concentration of high-density, magnetic minerals in the silt fraction (e.g. Ledbetter 1984). However, shifts in background values may also be related to fine-clastic source variations (for instance input from point-sourced glacial plumes versus input from the shelf-nepheloid layer). The decrease in magnetic susceptibility towards the core top (facies A) reflects an increase in biogenic carbonate diluting the fine-clastic carriers of the magnetic signal. Decimetre thick layers of well-sorted and fairly homogeneous silt to fine sand at 12.0 and 24.0 m core depth, corresponding to abrupt decreases in magnetic susceptibility, may represent sandy contourite deposits. However, the identification of such bottom current related features from sandy turbidites is difficult without data on regional facies and grain size trends (Stow *et al.* 1998).

Glacial marine sediments and turbidites

Facies C and D are interpreted as glacial marine muds formed by hemipelagic settling and gravity flows (Fig. 4). A large proportion of clay size material may have been supplied by meltwater overflow plumes. The graded silt laminae and medium to coarse-grained sand layers of facies G are interpreted as glacial turbidites based on their clear turbidite structures, immature composition and the presence of glacially weathered lithic clasts. Turbidites are most common in facies C and D but also occur less abundantly in facies F. The pattern of downslope sedimentation through the core is clearly displayed by high-frequency, high-amplitude magnetic susceptibility peaks produced by the high abundance of Ti-magnetite bearing basalts in these layers. The cyclic pattern of magnetic susceptibility peaks within facies C reflects the magnitude of gravity flow events because basal concentrations tend to increase with layer thickness and average grain size. At some levels, ice-rafted debris may contribute to the magnetic susceptibility signal but this source is mostly masked by the presence of sandy turbidites.

Grain size data

The lithology of MD95-2006 is dominated by silty clay with clay (<2 µm) ranging between 30 and 75% (Fig. 6b). A general increase in clay content is displayed from about 26 m up to 6 m core depth followed by a decrease towards the core top. The muddy contourite intervals defined by facies A, B and E are generally more silt rich (> 40 wt%) than the bulk part of the grain

Fig. 4. Detailed lithology, magnetic susceptibility and interpretation of depositional environments of core MD95-2006.

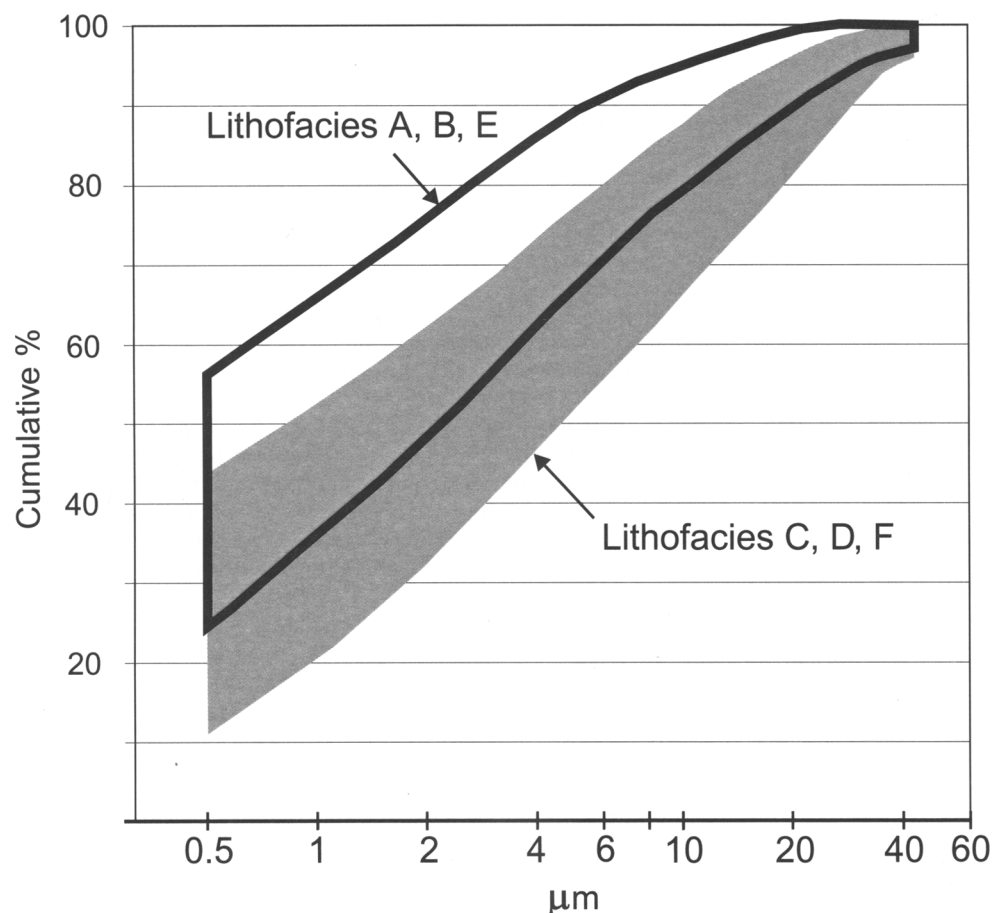


Fig. 5. Cumulative grain size domains from MD95-2006. Grey area, Facies A, B, E; Enclosed area, Facies C, D, F.

size spectrum (Fig. 5). There is, however, a large overlap between grain sizes from silty-muddy contourite and glacimarine hemipelagic intervals which may reflect the fine-scale variation in grain sizes within these facies. Hence, it is not feasible to identify contourite-related facies in MD95-2006 on the basis of cumulative grain size curves alone. A more characteristic feature of the silty-muddy contourites lies in the fluctuating concentrations in coarse silt, particularly evident in the lower part of the core.

Seismic characteristics

Four stratified sedimentary units A1, A2, B and C can be identified in seismic profile 1 across the core site of MD95-2006 (Fig. 6a), and in adjacent seismic sections (Fig. 7a–c). These units can be tied to the lithology of MD95-2006 (Fig. 6b). Debrite sequence 3 (DF 3) of the Peach Slide (Holmes *et al.* 1998) is recognized by its chaotic reflection pattern and hummocky surface, typically expressed by weak, broadly spaced, hyperbolic reflections. The E–W trending edge of DF 3 can be traced on several, closely-spaced shallow seismic profiles, oriented perpendicular to the margin of the Peach Slide (Fig. 2). Correlation with the dated core sequence suggests that DF 3 was deposited between 18–21 C¹⁴ ka BP. The presence of a younger debrite tongue that appears to have overrun DF 3 from an easterly direction is indicated on Figure 2. A mega-debrite unit DF 2, associated with a previous slide event, impinges below a large drift sequence about 8 km NW from the MD95-2000 core site (Figs 2 & 8).

Unit A1 forms a semi-transparent drape covering debrites and older stratified units on the lower fan. Close to the DF 3 scarp, this unit shows a more variable seismic signature characterised by wavy stratification and migrating, clinoformal bedforms that internally comprise discontinuous, medium to high-amplitude reflectors, typically truncated at the top (Figs 6 & 7). The wave-forming reflectors converge downslope into two weak, parallel,

continuous reflectors, which can be traced across the region (Fig. 8). *Unit A1* also contains a distinct mounded sediment drift in the upper part (Fig. 7c).

Sediment waves in *unit A1* appear to mimic the morphology of *unit A2*, which form a local seismic unit that extends from the toe of DF 3 and pinches out between units A1 and B. *Unit A2* is characterized by sets of upslope prograding to aggrading, medium to high-amplitude reflectors, producing cannibalizing bedforms, similar to those observed in *unit A1*. The boundary between A1 and A2 is unconformable, with signs of truncation on the downslope flank of the wavy bedforms (Figs 6 & 7).

Unit B contains a series of at least five weak, parallel and continuous reflectors that appear to dip below DF 3 (Figs 6a & 7a). This unit can be traced further downslope on seismic line 5 as a parallel-stratified unit that condenses, or is eroded at the top, above the scarp of DF 2 (Fig. 8). The seismic resolution is not sufficient to trace *unit B* beyond the margin of DF 2. It is, however, likely that this unit corresponds to the upper part of the wavy drift sequence showing reflector patterns of onlapping channel-fill and upslope migrating sediment waves.

Unit C is present near the depth limit of seismic penetration on the boomer profile but can be discerned by at least two semi-continuous, sub-parallel, reflectors (Fig. 7a–c). *Unit C* is not detectable on seismic line 5 but is assumed to underlie *unit B* (to the east, above DF 2). The strong reflector below *unit B* may form an internal feature of *unit C* or represent the contact between *unit C* and the underlying debrite.

Interpretation of seismic units

Unit A1 forms a regional drape that can be traced across the lower fan into the basin of the Rockall Trough and is equivalent to the Gwaelo sequence (Stoker 1995). In MD95-2006 this unit is represented by an upward-coarsening, fine clastic sequence

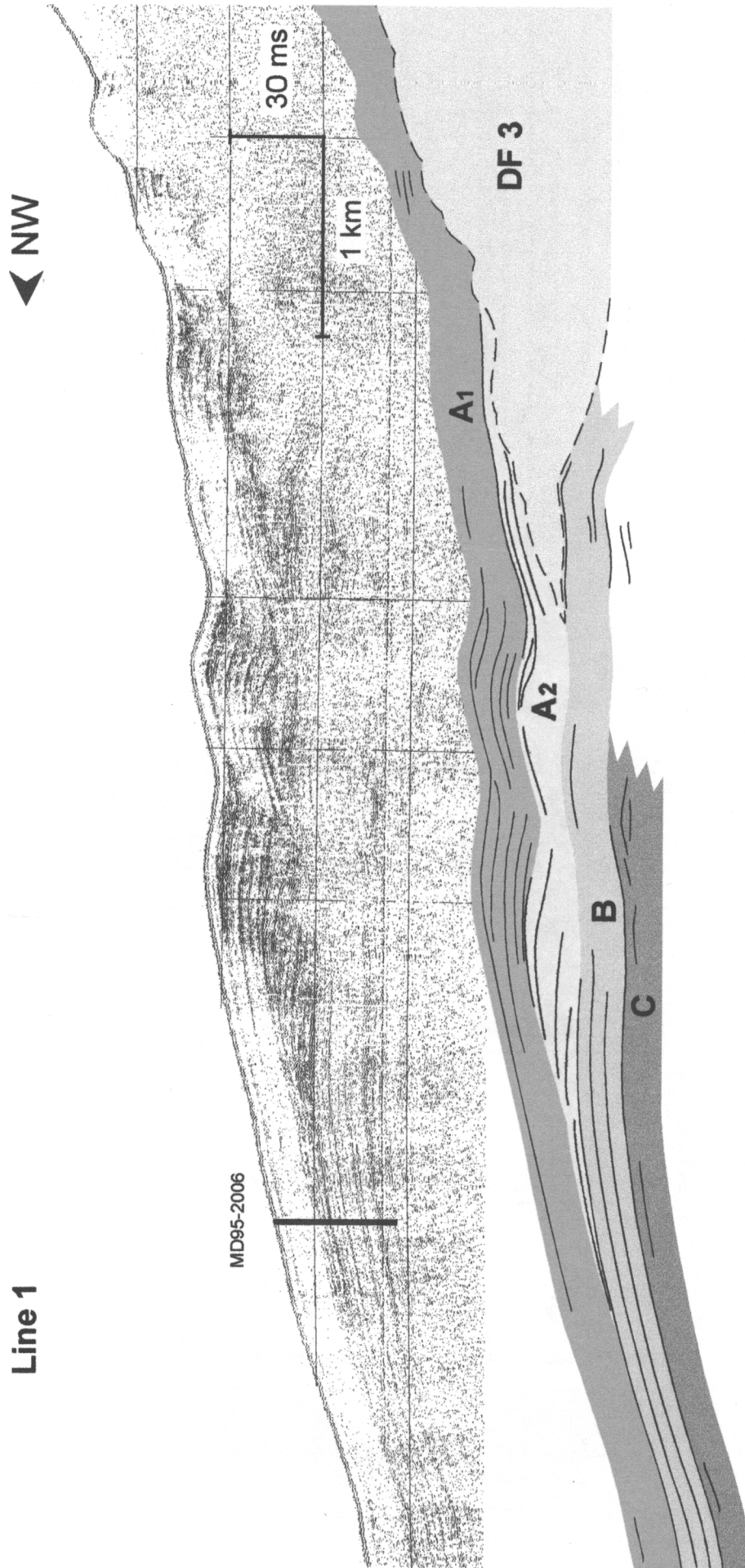


Fig. 6. (a) Deep tow boomer profile 1 showing position of MD95-2006 and interpretation of seismic units. See Figure 2 for location of line. (b) Sedimentological data from MD95-2006 and correlation with seismic line 1. Paleoclimatic events Younger Dryas (Y-D) and Heinrich (H) events 1 to 4 are indicated. 30 ms TWT is equivalent to 23 m penetration based on an acoustic velocity of 1550 m s⁻¹.

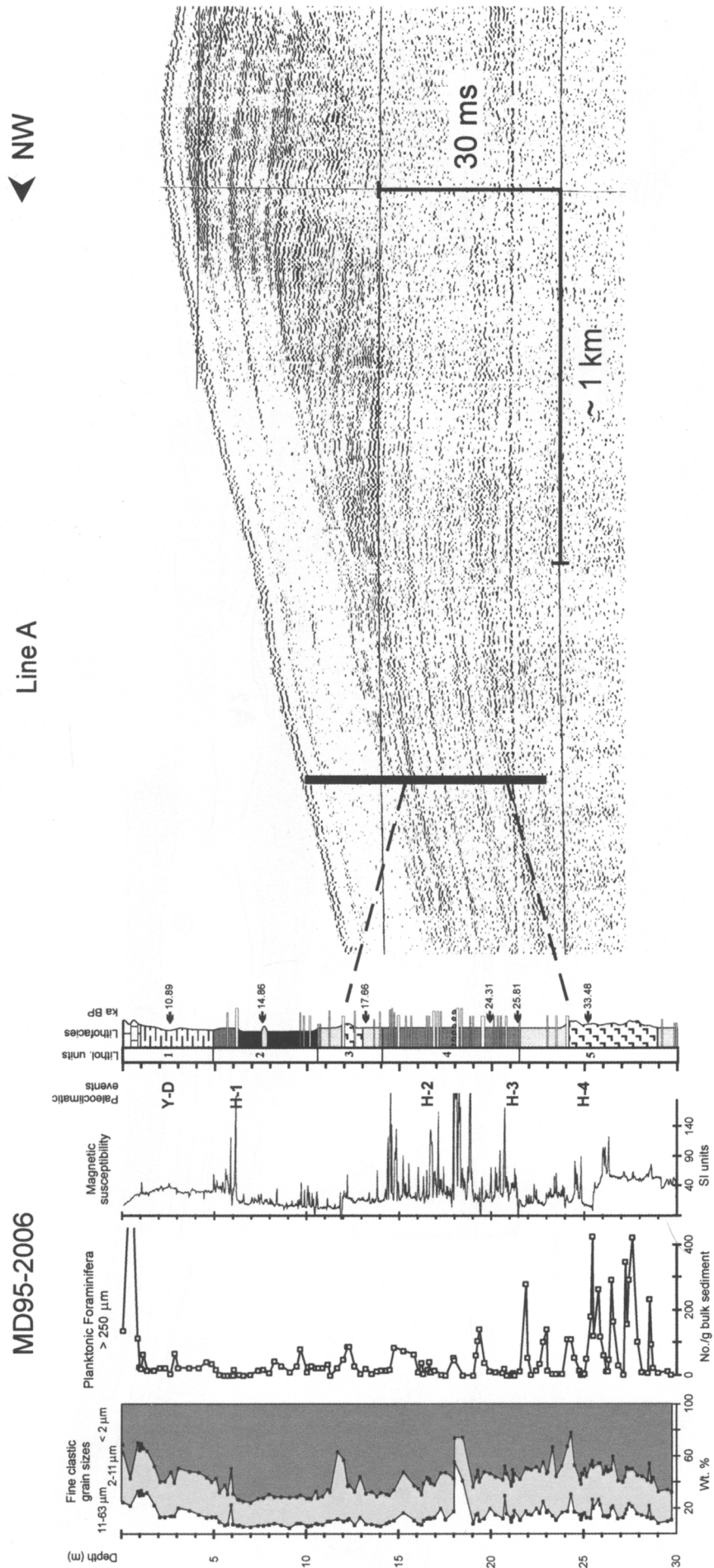


Fig. 6b.

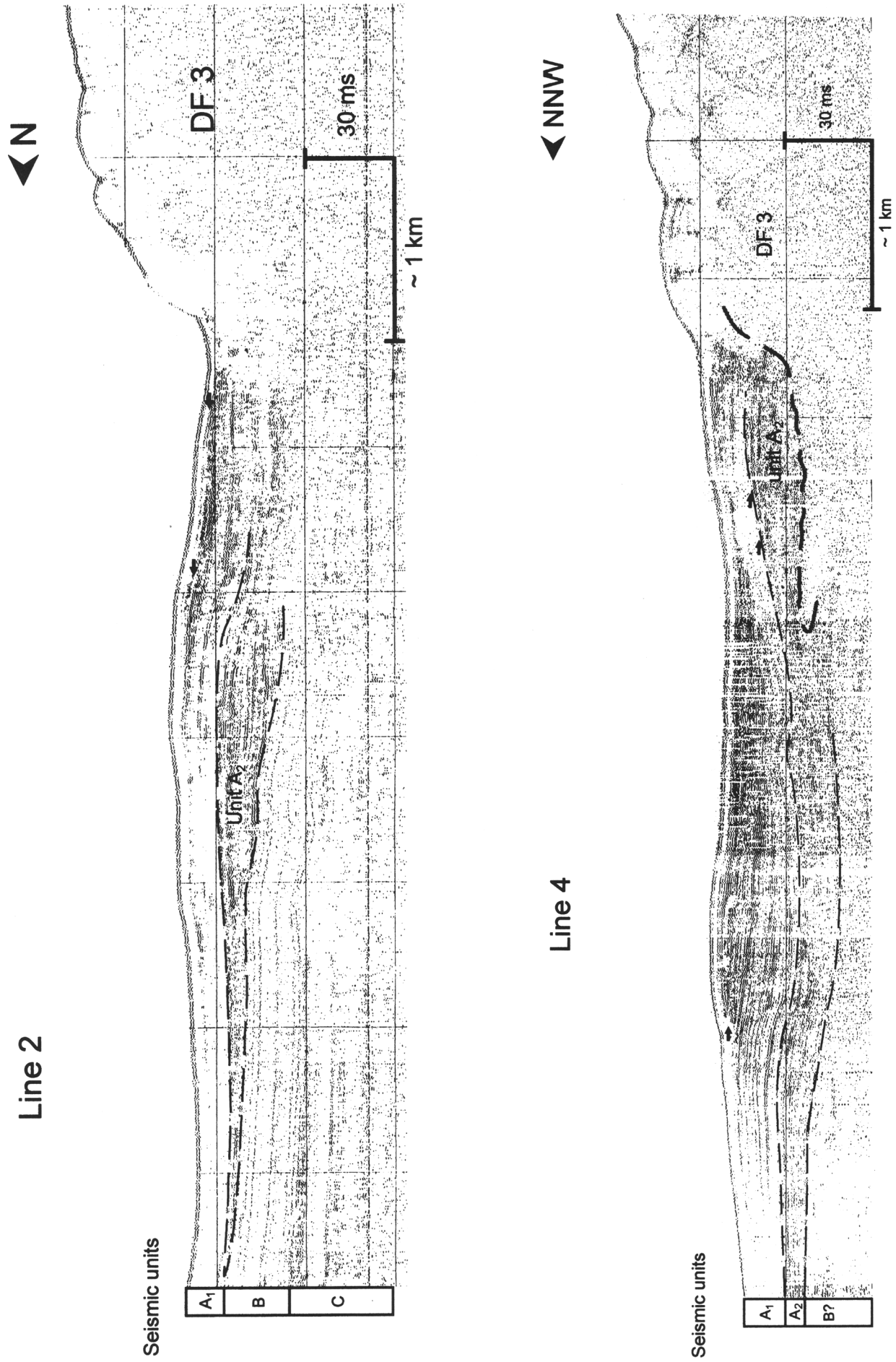


Fig. 7. (a-c) Deep tow boomer profiles 2-4 with seismic units shown. Arrows indicate erosional features related to bottom currents. See Figure 2 for locations.

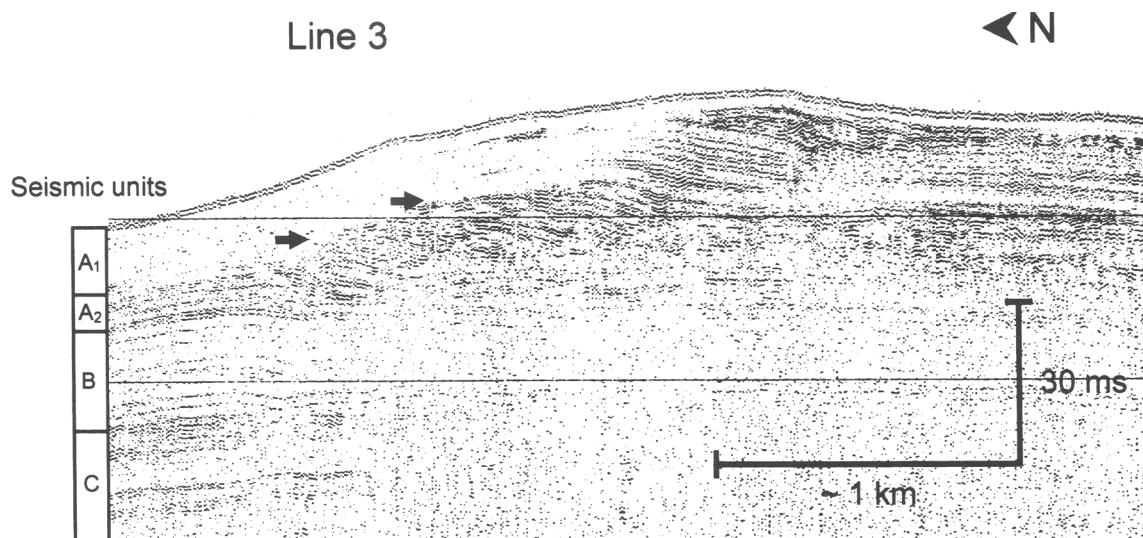


Fig. 7c.

comprising lithological units 1–2 (Fig. 6b), interpreted as the development from a glacimarine hemipelagic to a silty-muddy contourite environment representing the last deglaciation and early Holocene. The two internal reflectors in unit A1 are related to thin-bedded turbidites and ice-rafting events linked to climatic cooling during Heinrich event I and the Younger Dryas (Howe 1996; Knutz *et al.* 2001). An asymmetric, mounded reflector pattern in the upper part of unit A1 (Fig. 7b) may represent a local silty-sandy contourite drift developed during the Holocene. The geometry of unit A1 and the erosive bedforms at the base of DF 3 (Fig. 7a) suggest the presence of a channel formed by bottom currents routed along the edge of the debris flow.

Unit A2 is interpreted as sandy to silty-muddy contourites on the basis of the discontinuous reflector configuration and migrating, cannibalizing bedforms. The medium-high amplitude wave-forming reflectors in units A1 and A2 have not been penetrated by coring but the downslope pinch-out of unit A2 is represented by a silty-muddy contourite interval in MD95-2006 (Fig. 6b). The sediments of unit A2 may have been deposited by across-fan bottom currents eroding and reworking the exposed surface of DF 3.

Unit B is interpreted as a muddy glacimarine sequence with continuous parallel reflectors associated with thin sandy turbidites of facies D deposited between 26–18 C¹⁴ ka BP (Fig. 4). These turbidites may represent thin depositional lobes produced by unchannelised, decelerating, gravity flows that reached the lower fan through a series of distributary canyons located across the mid-upper slope region (Armishaw *et al.* 1998). The release of gravity flows from proglacial environments on the shelf edge could have been triggered by either (1) slope instability caused by loading of ice lobes on the shelf edge (Mulder & Moran 1995) or, (2) periodic meltwater discharge (Hesse *et al.* 1997) associated with phases of glacial advance and retreat on the Hebridean margin. The fine-grained tail of these gravity flows may have been carried further downslope as low-density turbidity currents that interacted with the pre-existing drift topography and alongslope contour currents to form the large sediment waves present on the distal fan (Fig. 8).

The weak reflectors within unit C (Fig. 7a) correspond to the silty-muddy contourite represented by facies E. This unit may also correspond to the aggrading drift sequence that overlies the DF 2 sequence (Fig. 8). Seismic facies patterns and topographic features on the lower Barra Fan suggest that two pathways of bottom currents were established subsequent to deposition of

DF 3 (18–21 C¹⁴ ka BP) (Fig. 9): (1) lower NADW tracing the edge of the distal fan and producing erosional scars in the Glacial–Holocene section of the drift sequence associated with DF 2; (2) obliquely downslope oriented bottom currents producing the small-scale wave field along the edge of DF 3. The latter flow component is possibly controlled by NADW deflected across the fan and funnelled through a wide channel, bordered to the south–southwest by the positive topography of DF 3. However, a bottom flow regime across the Barra Fan may also be influenced by deep eddies produced by the strong upper slope current (Howe *et al.* 1994).

Discussion and conclusions

The Late Pleistocene drift sequence on the lower Barra Fan shows evidence of rapid depositional changes influenced by glacimarine slope processes, hemipelagic sedimentation and deep water circulation in the Rockall Trough. Within this climatically controlled depositional sequence upslope migrating sediment waves (or mud waves) have developed parallel or oblique to topographic steps formed by debrite lobes. Similar large-scale bedforms, described from a variety of continental margin settings, have been related to both downslope sedimentation events and alongslope bottom currents (Jacobi *et al.* 1975; Damuth 1979; Roberts & Kidd 1979; Normark *et al.* 1980). In both cases, upcurrent migration of bedforms tends to dominate (McCave *et al.* 1982; Flood & Shoor 1988). The formation of such sediment waves has been compared to that of fluvial antidunes developed under flow conditions with Froude numbers >1 as a result of internal standing waves (Fox *et al.* 1968; Normark *et al.* 1980). An alternative model (Flood 1988) suggests that mud waves are generated by lee-waves caused by upstream obstructions to the flow. While the original lee-wave model could only explain formation of mud waves oriented perpendicular to the flow, an extended version by Blumsack & Weatherly (1989) predicts that fluctuations in the mean current flow can produce maximum bedform growth at oblique angles to the flow direction. This is in accord with observations on mud waves in the Argentine Basin (Weatherly 1993).

The wave fields on the Barra Fan appear to have developed in response to the positive topography generated by debrite units DF 2 and DF 3. Howe (1996) suggested that the sediment waves within seismic unit A1 were deposited from by low-density turbidity currents, a conclusion based on the presence of two

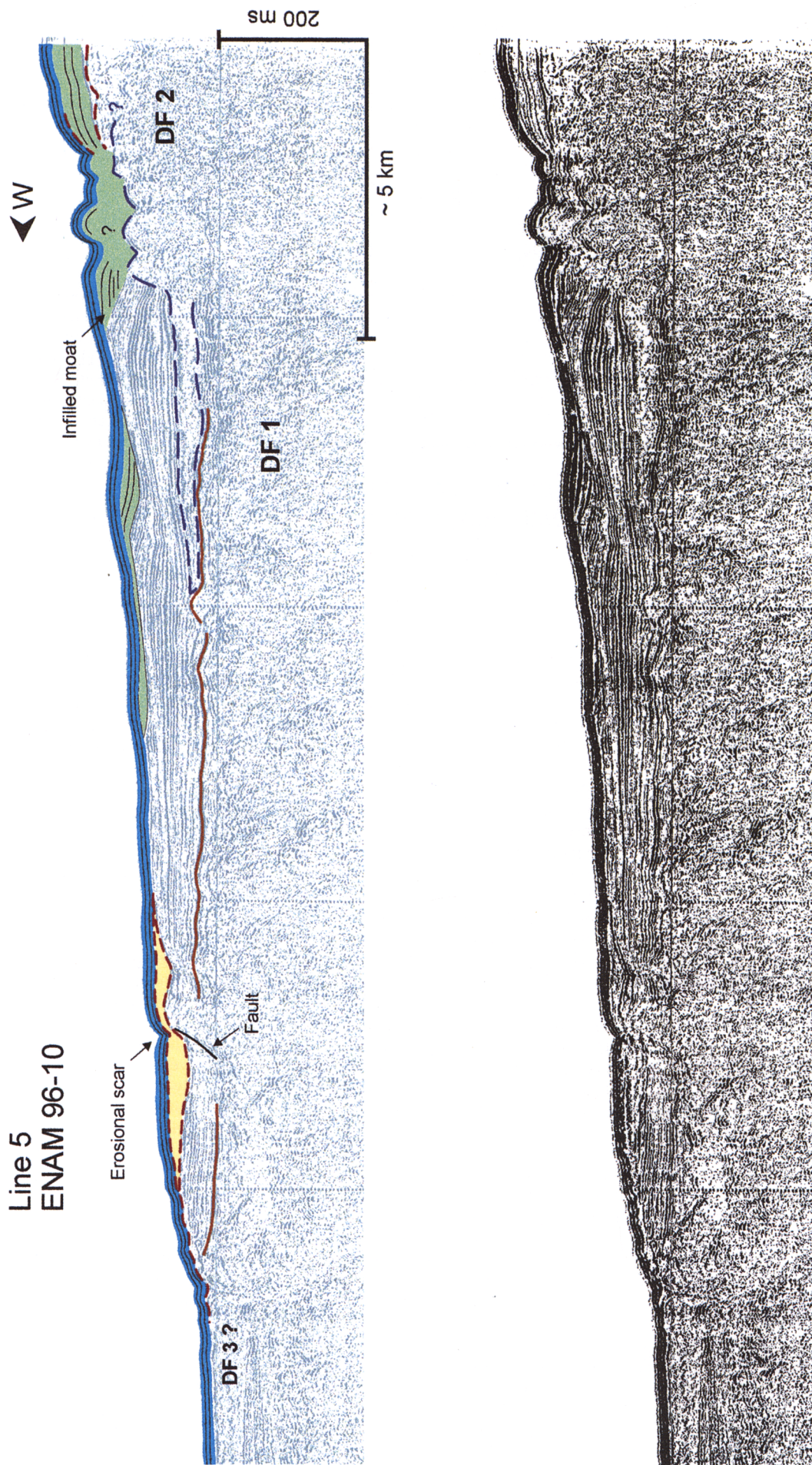


Fig. 8. High-resolution sleeve-gun profile (line 5) with interpretation. Brown line demarcates base of well-stratified drift sequence. Blue stippled line outlines debris flow sequence 2. Blue draping unit is equivalent to unit A1, while green unit corresponds to unit B. Yellow unit depicts infilling of erosional scars.

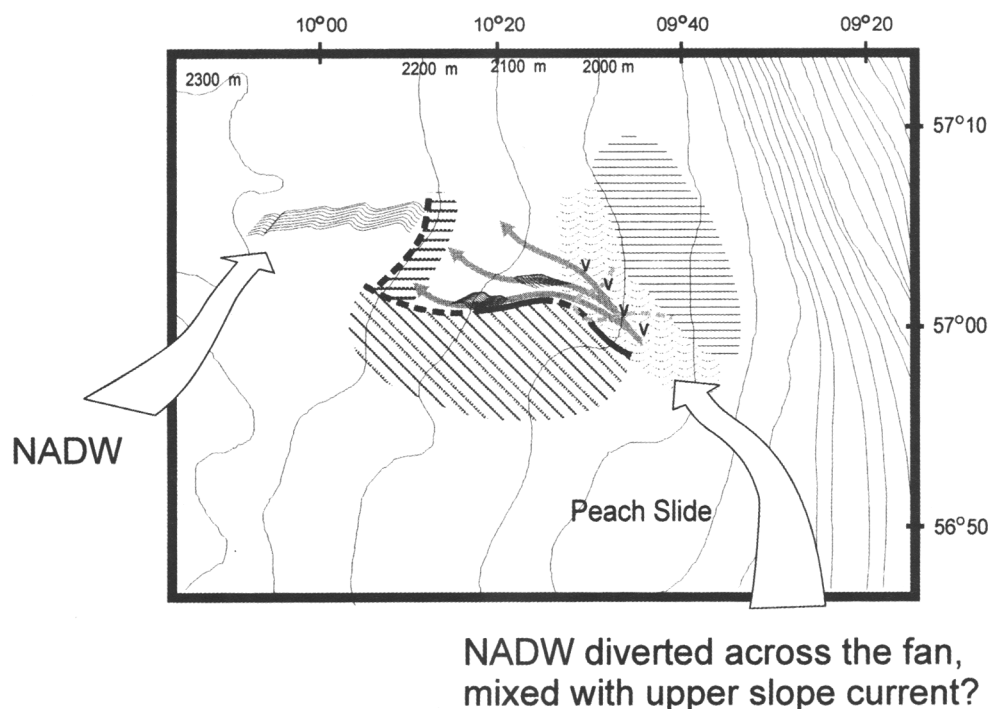


Fig. 9. Seismic patterns and inferred bottom current pathways on the northwestern edge of the Barra Fan. Wavy lines indicate areas where medium-high amplitude, discontinuous reflectors extend to the seafloor. Horizontal lines indicate areas where well-stratified seismic facies dominates below the sea floor. V-marks indicate locations of erosional furrows on seismic profiles. Dark horizontal and diagonal lines demarcate the debris flow lobes shown in Figure 2.

graded sand layers observed in shallow cores as well as the orientation of the wave-crests with respect to the fan. Downslope currents flowing oblique to the slope could have produced the observed differential erosion-deposition pattern (deposition on the upcurrent wave crest and erosion on the downslope facing flanks) in accordance with the revised lee-wave model of Blumsack & Weatherly (1989). However, the dominant facies of MD95-2006 and seismic features in the vicinity of the core site suggest that units A1-A2 were deposited in response to complex, semi-permanent bottom currents routed across the mass-flow controlled topography of the lower fan.

Late glacial to Holocene bottom currents appear to have produced substantial erosion and reworking of stratified drifts and underlying debrites. Much of this material may have been redeposited downslope as sandy-silty contourites associated with the medium-high amplitude, discontinuous reflectors of seismic units A1 and A2.

The flow component responsible for the development of the late glacial-Holocene contourite drifts is possibly derived from NADW diverted across the Barra Fan. The topography of DF 3 would have obstructed the flow path of this water mass and led to increasing competence of the bottom currents that were routed along the debris flow scarps. Unit A2 may thus have resulted from reworking and downslope transfer of sediments derived from the exposed surface of DF 2. A diverted flow of NADW across the fan is also inferred by Armishaw *et al.* (1998, 2000) based on the common occurrence of sandy contourites on the mid-upper slope of the Barra Fan. Alternatively, deep eddies produced by mixing between the upper and lower slope current systems may have influenced bottom current dynamics on the lower fan and contributed to drift morphologies, which are not concordant with the general flow direction (Howe 1996).

The large wave field oriented perpendicular or slightly oblique to DF 2 shows a transition from aggrading waves to upslope-migrating waves. The lower section of the drift may have developed in response to a north-flowing contour current tracing the edge of DF 2, while slower deposition, or erosion, occurred across the surface of DF 2. The prograding bedforms superim-

posed on the aggrading drifts were probably produced by the same glacial-Holocene gravity flows as recorded in the lithology of MD95-2006. During their passage downslope these may have transformed into turbidity currents with most of the coarse fraction deposited upslope from DF 2. The fading of migrating bedforms away from the fan and the corresponding development of an erosional scar on the distal part of the drift complex suggest that fine-grained turbidity currents became progressively pirated by alongslope bottom currents.

An erosive base of unit A1 suggests that strong bottom currents were active in the Rockall Trough around 16–18 ¹⁴C ka BP. This supports previous core studies from the southern Rockall Trough, reporting sedimentological evidence of late glacial deep water flow (Dowling & McCave 1993; McCave *et al.* 1995a). Dowling & McCave (1993) suggested that this current regime was generated by local production of deep waters in the Rockall Trough, similar to the convective process which occurs today in the Labrador Sea.

Large sediment drift morphologies are conventionally thought to develop over millions of years in response to semi-permanent bottom currents and a steady-state sediment supply (McCave & Tucholke 1986). The high sedimentation rates observed in MD95-2006 and the likelihood that the underlying sequence was deposited during the penultimate glaciation or the early Devensian, suggests that the Barra Fan drift formed over the last 100–200 ka. This rapid drift development was facilitated by high fluxes of glacialine sediments from the Hebrides Shelf margin, and the presence of topographic traps generated by debrite lobes. Further mapping of seismic and sediment facies is necessary to understand the complex interaction of downslope and alongslope currents, which appear to have shaped the wavy sediment drifts on the lower Barra Fan.

This research was mainly carried out as part of the senior author's PhD programme at Cardiff University, in association with the British Geological Survey. The results are published with permission of the Director of the British Geological Survey. DAVS acknowledges tenure of a Royal Society Industry Fellowship with BP-Amoco.

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