frontiers | Frontiers in Marine Science

TYPE Mini Review
PUBLISHED 02 June 2025
DOI 10.3389/fmars.2025.1611432

OPEN ACCESS

EDITED BY
Luigi Jovane,
University of São Paulo, Brazil

REVIEWED BY
Leon Hoffman,
Senckenberg am Meer Wilhelmshaven,
Germany

*CORRESPONDENCE
Dierk Hebbeln
dhebbeln@marum.de

†These authors have contributed equally to this work and share first authorship

RECEIVED 14 April 2025
ACCEPTED 14 May 2025
PUBLISHED 02 June 2025

CITATION
Hebbeln D and Wienberg C (2025) Unravelling the enigma of discontinuous sedimentary deposits in cold-water coral mounds in the Atlantic Ocean.
Front. Mar. Sci. 12:1611432.
doi: 10.3389/fmars.2025.1611432

Unravelling the enigma of discontinuous sedimentary deposits in cold-water coral mounds in the Atlantic Ocean

Dierk Hebbeln[1,2*†] and Claudia Wienberg[1†]

[1]Center for Marine Environmental Sciences (MARUM), University of Bremen, Bremen, Germany,
[2]Department of Geosciences, University of Bremen, Bremen, Germany

Cold-water coral mounds are common along the continental margins of the Atlantic Ocean. They are formed by coral growth and sediment accumulation and consist of coral fragments embedded in hemipelagic sediments. Coral mounds are expected to provide high-resolution palaeo-records due to their elevated morphology. However, most sediment cores from coral mounds exhibit significant hiatuses (stratigraphic gaps), often spanning more than 100 kyr, raising questions about the fate of deposits formed during these periods. Three processes behind the hiatuses are critically reviewed: gravity-induced mass wasting, non-deposition, and winnowing. While mass wasting could remove entire mound layers, hydrodynamically controlled processes like non-deposition and winnowing affect fine-grained sediments and do not mobilise larger coral fragments. Evidence for large-scale mass wasting events on coral mounds remains inconclusive, suggesting that hydrodynamic processes are the primary cause of the hiatuses in the *mound record*. Consequently, the *coral record* preserved on the mounds is typically complete. Mound formation occurs during active reef growth, while during periods without reef growth, strong hydrodynamics enhanced by the mound morphology increasing turbulence around the mound prevent sustained sediment accumulation, causing the frequently observed hiatuses.

KEYWORDS

cold-water coral mound, sedimentary record, hiatus, non-deposition, winnowing, mass wasting, baffling effect, mound effect

1 Introduction

Cold-water coral (CWC) mounds form through the prolonged growth of scleractinian reef-forming CWCs, in combination with the substantial accumulation of sediments (e.g., Hebbeln et al., 2016; Roberts et al., 2006). As a result, mound deposits comprise coral fragments embedded within a fine-grained hemipelagic sediment matrix, which includes both terrigenous and biogenic material (e.g., Titschack et al., 2015, 2016). Although CWCs are critical to the formation of coral mounds, coral fragments typically contribute less than 50% to the mound deposits, with the majority consisting of hemipelagic sediments (e.g., Pirlet et al., 2011;

Titschack et al., 2015, 2016). CWCs are widely distributed from the shelf to remote mid-ocean ridge environments (e.g., Mortensen et al., 2008; Roberts et al., 2006), whereas coral mounds occur only on continental shelves and slopes (e.g., Hebbeln and Samankassou, 2015; Lo Iacono et al., 2018; Wienberg and Titschack, 2017), where sufficient hemipelagic sediment to contribute to mound formation is supplied by slope-parallel currents and internal tides (summarised here as bottom currents; e.g., Hebbeln et al., 2016; White, 2007). Overall, the development of coral mounds is highly dependent on hydrodynamics, as bottom currents not only increase sediment delivery to the mounds, but also facilitate coral growth through the lateral delivery of food particles ingested by the sessile CWCs (Figure 1; e.g., Mienis et al., 2007; Portilho-Ramos et al., 2022).

The coral mound itself interacts with bottom currents in two different ways. First, the elevated mound morphology accelerates the water flow around the mound, with this *mound effect* becoming more pronounced when the mound size increases (e.g., Cyr et al., 2016; van der Kaaden et al., 2021). This can potentially double the current velocity at the mound's top and upper flanks (e.g., Dorschel et al., 2007; Mienis et al., 2012) similar to other elevated seafloor structures like seamounts and isolated banks (Genin et al., 1986). Consequently, coral mounds experience more energetic conditions compared to the surrounding seafloor (e.g., Frederiksen et al., 1992; Mohn et al., 2014). Second, CWC reefs thriving on the mound cause a local deceleration of the bottom currents when these pass the large, dense framework, allowing suspended sediments to settle

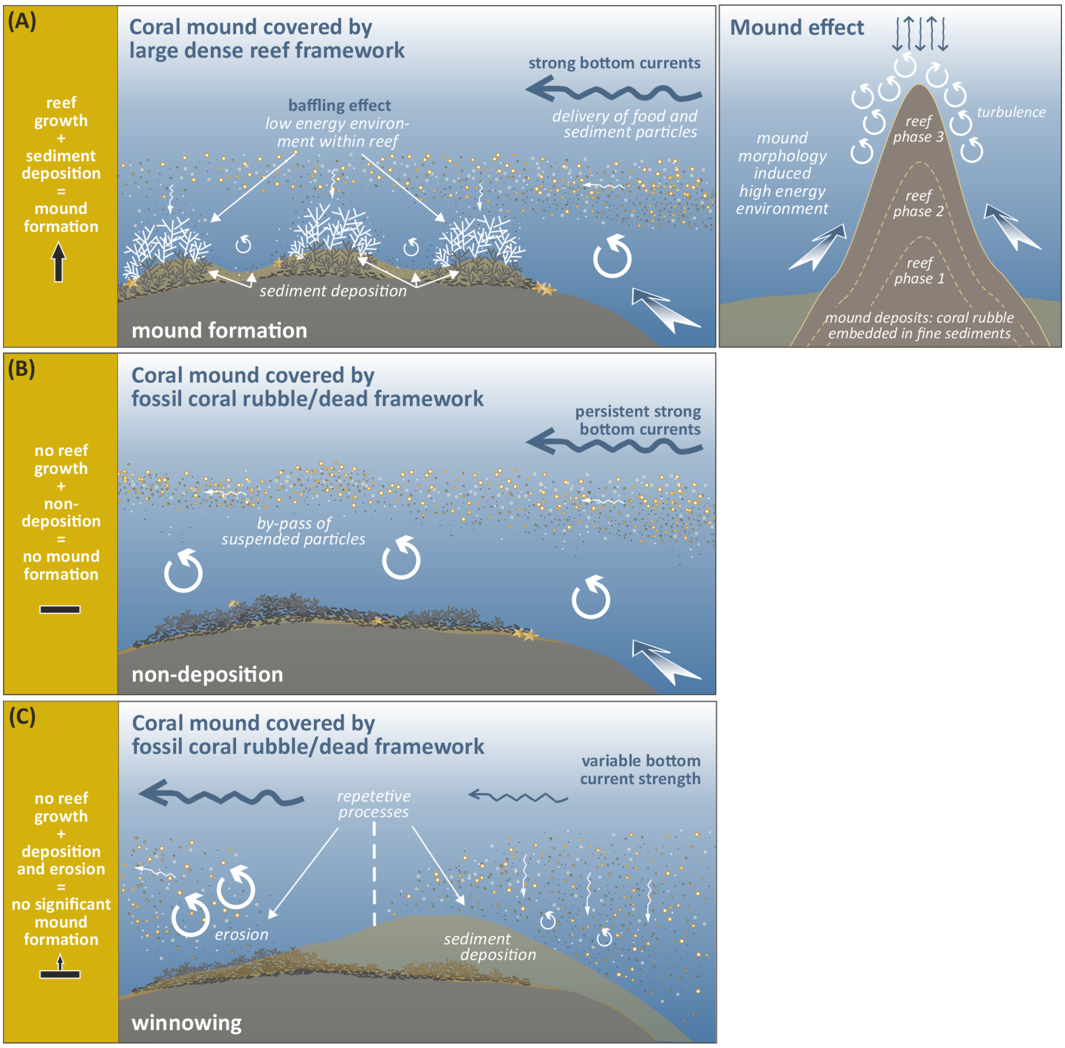

FIGURE 1
(A) Coral mound formation strongly depends on strong bottom currents, which deliver food and sediment particles to facilitate reef growth and sediment deposition, both being important for reef/mound growth. The elevated mound morphology (formed through repetitive reef growth phases) enhances bottom currents and turbulence around the mound (mound effect; inset), while the large dense coral framework covering the mound locally decelerates the current velocity allowing suspended material to become deposited between the coral branches (baffling effect). **(B)** Persistent strong bottom currents, further enhanced by the mound effect, keep particles in suspension and prevent them from settling. This hydrodynamically-driven process primarily affects the mound during times without reef growth and leaves fossil corals at the surface of a mound exposed for 10^3 to 10^5 years. **(C)** Winnowing describes the selective erosion and mobilisation (displayed on the left side) of previously deposited fine-grained sediments (displayed on the right side), while coarser sediment components (i.e. centimetre-sized coral fragments) are not affected and remain at their place of deposition.

between the coral branches (Figures 1, 2; e.g., Bartzke et al., 2021; Guihen et al., 2013; Huvenne et al., 2009; Wheeler et al., 2008). This *baffling effect* facilitates the deposition of fine-grained sediments on the mound, even under otherwise turbulent hydrodynamic conditions generated by the *mound effect* (Figure 1).

Coral mounds rise to a few metres to more than 300 m above the surrounding seafloor (e.g., Wienberg and Titschack, 2017), and many of them have considerable subseafloor extensions (e.g., Colman et al., 2005; Van Rooij et al., 2003). Hence, coral mounds, which apparently grow faster as sediments accumulate around them, have great potential to provide exceptionally high-resolution palaeo-records of environmental change and ecosystem response (e.g., Korpanty et al., 2023; Thierens et al., 2010). However, already the first sediment core-based stratigraphic records from coral mounds in the Porcupine Seabight off Ireland, where modern coral mound research gained momentum in the late 1990s (see Henriet et al., 2014), revealed significant stratigraphic gaps (hiatuses), some spanning over 100 kyr (e.g., Dorschel et al., 2005; Kano et al., 2007). These gaps highlight the incomplete nature of the *mound record*, which complicates comprehensive palaeo-environmental reconstructions. Ongoing research has identified such intermittent (i.e. discontinuous) stratigraphic records from coral mounds as a common pattern not only off Ireland, but across the Atlantic Ocean (e.g., Beisel et al., 2025; Bonneau et al., 2018; Correa et al., 2012; Matos et al., 2015; Raddatz et al., 2020; Wefing et al., 2017; Wienberg et al., 2010, 2018) as well as in the Mediterranean Sea and Gulf of Mexico (Corbera et al., 2022; Fentimen et al., 2023; Matos et al., 2017; Roberts and Kohl, 2018; Stalder et al., 2015; Wienberg et al., 2022).

Regionally consistent periods of CWC reef growth (e.g., de Carvalho Ferreira et al., 2022; Fink et al., 2015; Frank et al., 2011) have been linked to the dependence of CWCs on environmental forcing factors (e.g., Davies et al., 2008; Portilho-Ramos et al., 2022). This suggests that, despite the hiatuses and incompleteness in the *mound record*, the *coral record*, i.e. the preservation of corals that once lived on the mound, may be sufficiently complete to allow for palaeo-ecological interpretation. This raises the question of the origin of the hiatuses. If they represent periods without CWC reef growth, fine hemipelagic sediments should have been deposited on the mounds during these long intervals. However, coral mounds typically contain predominantly coral-bearing sediments, while *mound records* containing substantial layers of fine sediment without coral fragments are comparatively rare (e.g., Foubert and Henriet, 2007; Kenyon et al., 2003; Mangini et al., 2010; Raddatz et al., 2020). For example, in some regions (Ireland, Gulf of Mexico, Mediterranean Sea), *mound records* only document interglacial CWC reef growth, while glacial deposits are absent, despite the widespread presence of corresponding glacial sediments around these mounds (e.g., Dorschel et al., 2005; Wienberg et al., 2020; Matos et al., 2017).

Several explanations have been proposed for the dominant processes causing these hiatuses, including: (a) non-deposition of sediments on the coral mound due to persistent strong bottom currents amplified by the *mound effect* (b) winnowing (deposition followed by erosion) of fine sediments from the mound's surface by recurrent strong bottom currents, and (c) mass wasting eroding thick sediment layers from the coral mound. Among these, only gravity-driven mass wasting would impair the completeness of the *coral record* as it potentially mobilises sediment layers containing large CWC fragments, while hydrodynamic-induced winnowing and non-deposition would only affect the fine-grained mound deposits (Figure 1).

Previous studies have linked the ubiquitous occurrence of hiatuses in *mound records* to the above-mentioned processes in a rather general way, without providing a clear attribution or detailed explanation. This general approach still accepts the possibility of an incomplete *coral record* due to mass wasting, which would affect reliable conclusions about the past development of CWCs. Thus, by discussing the likely processes that have caused these hiatuses in the light of recent observations made across the Atlantic Ocean, this

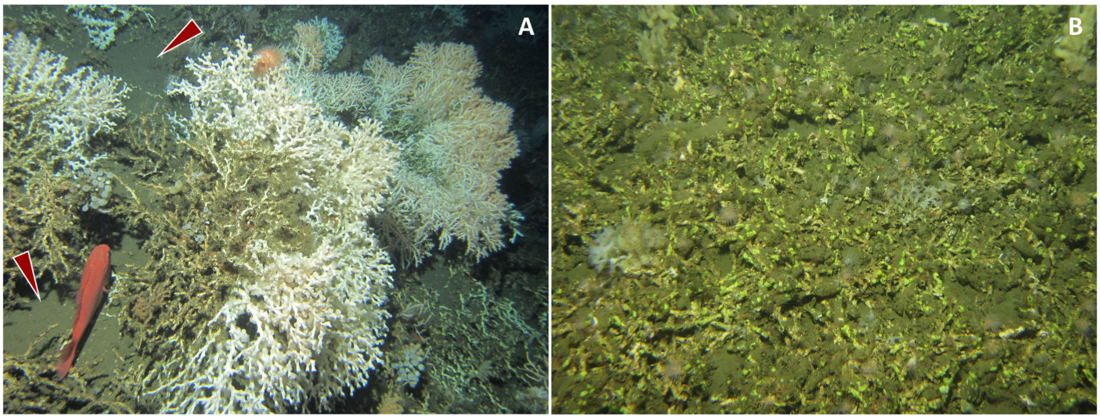

FIGURE 2
(A) Cold-water coral mound on the Angolan continental slope (~370 m water depth) covered by dense living coral reef framework (*Lophelia pertusa* and *Madrepora oculata*; see Orejas et al. 2021; Wienberg et al., 2023). Note the deposition of fine-grained sediments between the coral framework (red arrows). **(B)** Cold-water coral mound on the Namibian continental shelf (~220 m water depth) covered by exposed dead coral framework (*L. pertusa*) with minimal sediment cover. Corals on the mound surface were dated back to ~5 kyr (Tamborrino et al., 2019). Images are copyright of ROV MARUM SQUID and were recorded during RV METEOR expedition M122 (ANNA).

review provides a comprehensive assessment of the reliability of *coral records* for reconstructing CWC reef and mound development through time.

2 Hydrodynamic controlled processes affecting cold-water coral mound formation

2.1 Non-deposition of fine sediments

The non-deposition of suspended fine-grained sediment particles on the seabed requires the constant flow of strong bottom currents that keep the particles in suspension and prevent them from settling (Figure 1). Current ripples, often observed adjacent to coral mounds or on lower mound flanks (e.g., López Correa et al., 2012; Foubert et al., 2005; Kenyon et al., 2003; Lim et al., 2017; Wienberg et al., 2008), are an indicator of prevailing strong bottom currents that are capable of transporting suspended particles up to a grain size that is in equilibrium with the current velocity (sensu Hjulstrom, 1935). The strong bottom currents are further enhanced by the *mound effect*, thus, preventing the deposition of suspended particles on the mound by causing continuous by-pass conditions. Even if hydrodynamic conditions fundamentally change, e.g., on glacial-interglacial time scales, the morphology-driven *mound effect*, which leads to relatively stronger bottom currents on the mound, may also prevent on-mound deposition of the suspension load during times of generally weak bottom currents (see Wang et al., 2021).

This probably explains the presence of exposed fossil coral rubble pavements without significant sediment cover observed in many coral mound regions (Morocco, Mauritania, Namibia, Mediterranean Sea). In these areas, coral fragments lying exposed on the mound surface (Figure 2) reveal ages ranging from 5 kyr to >100 kyr, often with consistent regional patterns (Tamborrino et al., 2019; Wienberg et al., 2010, 2018, 2022). Although non-deposition over time scales of 1,000 to 100,000 years seems unlikely at first glance, the *mound effect* could have led to prolonged periods of non-deposition on coral mounds. This may also explain why most *mound records* are primarily composed of coral-bearing deposits, indicating that vertical mound growth was largely confined to periods of CWC reef growth, when sediment accumulation was enhanced by the *baffling effect* (e.g., Corbera et al., 2022; Wang et al., 2021).

When dead or fossil coral skeletons are exposed at the seabed, they are subject to bioerosion, which leads to their degradation and fragmentation into smaller particles (e.g., by grazing and boring fungi and sponges; Beuck and Freiwald, 2005; Bromley, 2005; Wisshak, 2006). In open-water conditions, bioerosion rates can approach the growth rates of live CWCs (Büscher et al., 2019), but are significantly reduced when coral skeletons are buried by sediments (Beuck and Freiwald, 2005). Since fossil corals exposed on mounds are often at least partially sediment-covered (Figure 2), bioerosion likely occurs, but at a reduced rate. Over timescales of several kiloyears, progressing bioerosion might potentially impact the completeness of the *coral record*, but this would also a require a mechanism to concurrently remove the resulting fine coral debris. Considering (i) the presumably slow combined effect of bioerosion and the removal of its products and the surrounding sediment matrix, (ii) typical mound growth rates of several decimetres to meters per kiloyear (e.g., Frank et al., 2009; Wienberg et al., 2018), (iii) the temporal resolution of mound records based on radiometric dating, and (iv) the regionally consistent age patterns of exposed fossil corals (see above), bioerosion is considered to have - if at all - a negligible effect on the *coral record* and its interpretation.

2.2 Winnowing: repetitive deposition and erosion of fine sediments

Similar to non-deposition, winnowing is a hydrodynamically induced process, but it describes the selective erosion and mobilisation of previously deposited fine-grained sediments, while coarser sediment components are not affected and remain at their place of deposition (Compton, 1962). In contrast to the process of non-deposition, winnowing involves more variable bottom currents whose (repeated) amplification promotes the erosion of sediments deposited under less dynamic conditions (Figure 1).

Assuming that deposition of fine-grained sediments occurred on the coral mounds during the time intervals represented by the hiatuses (up to >100 kyr), significant amounts of sediment must be assumed when considering the surrounding sedimentary conditions. In coral mound regions where deposits of the last glacial period (~10–70 kyr BP) are absent in the *mound record* (e.g., Gulf of Mexico, Ireland, Mediterranean Sea), mean glacial sedimentation rates in the adjacent areas ranged from ~4 to 15 cm kyr^{-1} (Fink et al., 2013; Matos et al., 2017; Rüggeberg et al., 2005; Van Rooij et al., 2007), which would have resulted in the deposition of sediment layers with a thickness of ~240–900 cm. Given the potential for sediment compaction within such substantial sediment layers, it would have been challenging to remove them by winnowing. Nevertheless, winnowing may have occurred as a repetitive process, with thin layers of (non-consolidated) fine sediment being repeatedly eroded during periods of increased current velocities (Figure 1). As winnowing involves erosion, it is in principle a different process than non-deposition. However, in terms of hydrodynamic forcing, both processes can be seen as a kind of continuum controlled by the strength of bottom currents.

3 Extensive erosion by mass wasting: does it affect mound formation?

Mass wasting is a gravitationally induced process that describes the sudden downslope movement of large volumes of sediments, triggered by, for example, earthquakes, sea-level changes, or gas hydrate dissolution (e.g., Crutchley et al., 2016; Leynaud et al., 2009; Masson et al., 2010). During mass-wasting events, sediment material is mobilised as large sediment packages or layers with the potential to transport particles in the size of coral fragments (centimetre to decimetre), which would affect the completeness of the *coral record*. Although headwalls are known to be preferred

CWC habitats, suggesting a link between mass wasting and coral mound formation (De Mol et al., 2009), convincing evidence for mass-wasting events that removed substantial sediment volumes from coral mounds has yet to be provided.

Early studies on NE Atlantic coral mounds discussed mass wasting as the potential cause for the hiatuses documented in the *mound records*. These studies either mentioned it as the dominant process (e.g., Eisele et al., 2008), discussed it as one of several relevant processes (e.g., Dorschel et al., 2005; Correa et al., 2012), or dismissed it as an unlikely explanation (e.g., Kano et al., 2007). Several criteria were used to underpin the possibility of frequent mass-wasting events occurring on coral mounds, which are critically evaluated below.

3.1 Lack of large dropstones in mound records

Marine sediments in the NE Atlantic are characterised by dropstones, which typically range in size from gravel (>2 mm) to boulders (>250 mm), although sand-sized (>0.15 mm) terrigenous particles embedded in finer sediments are also classified as dropstones (e.g., Bennett et al., 1996). Dropstones are ice-rafted debris dropped by melting icebergs that repeatedly reached this region during the last glacial period (e.g., Bond et al., 1992; Scourse et al., 2009). Consequently, dropstones would be expected to accumulate occasionally also on coral mounds in the NE Atlantic. This expectation is supported by observations of gravel- to boulder-sized dropstones commonly found on various Irish coral mounds (e.g., Foubert et al., 2005; Heindel et al., 2010; Lim et al., 2017; Wienberg et al., 2008). However, the first sediment cores collected from these coral mounds revealed an apparent absence of larger, centimetre-sized dropstones. Initially, this absence was attributed to mass wasting, which was considered the only process capable of removing such coarse material from the mounds (e.g., Dorschel et al., 2005; Eisele et al., 2008). Alternatively, this could simply be a result of the coring process as sediment core tubes typically have diameters of less than 12 cm (Hebbeln, 2002), which significantly limits the likelihood of recovering larger dropstones. Moreover, layers enriched in sand-sized dropstones have been found in cores from NE Atlantic coral mounds aligning with observed hiatuses, which can be seen as (possibly winnowed) relicts of glacial sedimentation (e.g., Dorschel et al., 2005; Huvenne et al., 2009; Kenyon et al., 2003; Thierens et al., 2010). Given that dropstone deposition on these mounds clearly occurred during the last glacial period, the absence of substantial fine-grained glacial sediments (see above) suggests that non-deposition or winnowing, rather than mass wasting, affected these mounds.

3.2 Lack of hardground formation on exposed mound surfaces

Prolonged exposure of mound surfaces to strong bottom currents for periods of 10^3 to 10^5 years, indicated by the hiatuses, should promote early diagenetic hardground formation (e.g., Noé et al., 2006). Video observations occasionally documented hardgrounds on lower flanks of coral mounds in the Porcupine Seabight (e.g., Heindel et al., 2010; Dorschel et al., 2009). However, none of the numerous sediment cores from these mounds recovered hardgrounds, while at the more oceanic Rockall Bank, they are common in the *mound record* (e.g., Bonneau et al., 2018; de Haas et al., 2009). At Rockall Bank, carbonate-rich matrix sediments surrounding the coral fragments likely promote hardground formation, whereas the predominantly siliciclastic matrix sediments of coral mounds in the Porcupine Seabight seemingly do not support extensive hardground formation (van der Land et al., 2014). As most coral mounds occur along upper continental margins, where siliciclastic sediments dominate, hardground formation may be generally limited. Thus, the absence of hardgrounds might be explained by the composition and chemistry of the matrix sediments rather than by mass wasting.

3.3 Exposed fossil cold-water corals at the top of coral mounds

Fossil CWC fragments exposed on coral mounds without significant sediment cover (Figure 2) are widespread across various Atlantic mound regions, suggesting that non-deposition plays a key role in mound formation (see above). However, such exposed old mound surfaces have also been linked to mass wasting (e.g., Dorschel et al., 2005), as this process could explain the removal of missing younger deposits. However, consistent regional patterns with nearly identical surface coral ages across multiple mounds are a common observation. For example, coral ages cluster at 4.8-5.4 kyr (13 mounds) on the Namibian shelf (Tamborrino et al., 2019), at 14.3-15.7 kyr (5 mounds) and 30.1-34.5 kyr (4 mounds) off Morocco (Frank et al., 2011; Wienberg et al., 2009, 2010), and at 3.6-5.4 kyr (4 mounds) and 102–106 kyr (2 mounds) in the western Mediterranean Sea (Wang et al., 2019; Wienberg et al., 2022). These patterns indicate that CWC reef growth ceased after those specific times rather than mass wasting consistently eroded mounds to the same stratigraphic level.

Moreover, if mass wasting-induced erosion caused the hiatuses in the *mound record*, its erosional products should be more frequently observed. However, while turbidite and slump deposits have occasionally been found near coral mounds, they rarely contain CWC fragments (e.g., Lindberg and Mienert, 2005; Rüggeberg et al., 2007). Instead, sedimentological evidence suggests only small-scale slumping on the flanks of coral mounds (e.g., de Haas et al., 2009; Huvenne et al., 2009; Eisele et al., 2014), with no clear indications of large-scale erosion capable of removing an entire mound surface layer. Furthermore, CWC fragments embedded in fine muddy sediments are interpreted to stabilise the mound flanks enabling slope inclinations of 20-80° (Freiwald, 2002), and thus to prevent slope failure on coral mounds (Kenyon et al., 2003). Consequently, mass wasting does not appear to be a dominant process shaping coral mounds.

4 Conclusion

Most sedimentary records from coral mounds exhibit significant hiatuses, some spanning over 100 kyr. Three potential causes for theses hiatuses have been critically reviewed. Non-deposition and winnowing explain the absence of fine hemipelagic sediments, but do not affect larger CWC fragments, preserving the *coral record* despite gaps in the *mound record*. In contrast, mass wasting can mobilise large sediment volumes, including coral fragments, resulting in an incomplete *coral record*.

Hydrodynamically-controlled non-deposition and winnowing, enhanced by the *mound effect* that amplifies bottom currents around the mound, are common processes on coral mounds. Only when CWC reefs thrive on the mound, their framework locally decelerates currents, allowing fine sediments to accumulate on the mound (*baffling effect*). The role of mass wasting in mound formation remains inconclusive, with small-scale slumping affecting mound flanks but playing a minor role overall. The exposure of fossil CWCs (10^3 to 10^5 years old) on mound surfaces, with consistent regional age patterns, suggests that reef growth ceased at specific times rather than younger mound deposits being consistently eroded to the same stratigraphic level by mass wasting. This implies that hiatuses represent periods without reef growth, and the preserved *coral record* in the *mound record* is generally complete, providing a valuable palaeo-archive of CWC reef development. This is supported by evidence linking CWC reef growth and decline to major palaeo-environmental changes (e.g., Bahr et al., 2020; Corbera et al., 2021; Fentimen et al., 2023; Frank et al., 2009; Matos et al., 2015; Mienis et al., 2009; López Correa et al., 2012; O'Reilly et al., 2022; Pirlet et al., 2011; Portilho-Ramos et al., 2022; Raddatz et al., 2016, 2020; Wienberg et al., 2010, 2022).

Stratigraphically, sediment cores from coral mounds document short reef growth phases (10^3 to 10^4 years) interrupted by hiatuses spanning much longer time periods (up to 10^5 years). Thus, while the elevated mound morphology already suggests a high temporal resolution of the *mound record*, its incompleteness results in an even higher resolution for the preserved *coral record*, documenting reef and mound growth rates of several metres per kiloyear (e.g., Frank et al., 2009; Raddatz et al., 2022; Stalder et al., 2015; Titschack et al., 2015; Wefing et al., 2017; Wienberg et al., 2018). Consequently, coral mounds serve as reliable short-term yet exceptionally well-resolved palaeo-records, especially for the poorly studied intermediate water depths of the oceans.

Author contributions

DH: Conceptualization, Visualization, Writing – original draft, Writing – review & editing. CW: Conceptualization, Visualization, Writing – original draft, Writing – review & editing.

Funding

The author(s) declare that no financial support was received for the research and/or publication of this article.

Acknowledgments

Special thanks to all colleagues who have contributed to unravel the enigma of the cold-water coral mound record over the past 25 years.

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Generative AI statement

The author(s) declare that no Generative AI was used in the creation of this manuscript.

Publisher's note

All claims expressed in this article are solely those of the authors and do not necessarily represent those of their affiliated organizations, or those of the publisher, the editors and the reviewers. Any product that may be evaluated in this article, or claim that may be made by its manufacturer, is not guaranteed or endorsed by the publisher.

References

Bahr, A., Doubrawa, M., Titschack, J., Austermann, G., Koutsodendris, A., Nürnberg, D., et al. (2020). Monsoonal forcing of cold-water coral growth off southeastern Brazil during the past 160 kyr. *Biogeosciences* 17, 5883–5908. doi: 10.5194/bg-17-5883-2020

Bartzke, G., Siemann, L., Büssing, R., Nardone, P., Koll, K., Hebbeln, D., et al. (2021). Investigating the prevailing hydrodynamics around a cold-water coral using a physical and a numerical approach. *Front. Marine Sci.* 8. doi: 10.3389/fmars.2021.663304

Beisel, E., Therre, S., Wienberg, C., Friedrich, R., and Frank, N. (2025). Status report of the Heidelberg Radiocarbon Laboratory: Precision and application in Mauritanian cold-water corals over the last 30,000 years. *Radiocarbon*, 1–11. doi: 10.1017/RDC.2025.7

Bennett, M. R., Doyle, P., and Mather, A. E. (1996). Dropstones: their origin and significance. *Palaeogeography Palaeoclimatology Palaeoecol.* 121, 331–339. doi: 10.1016/0031-0182(95)00071-2

Beuck, L., and Freiwald, A. (2005). "Bioerosion patterns in a deep-water Lophelia pertusa (Scleractinia) thicket (Propeller Mound, northern Porcupine Seabight)," in *Cold-water corals and ecosystems*. Eds. A. Freiwald and J. M. Roberts (Berlin, Heidelberg: Springer), 915–936.

Bond, G., Heinrich, H., Broecker, W., Labeyrie, L., McManus, J., Andrews, J., et al. (1992). Evidence for massive discharges of icebergs into the North Atlantic ocean during the last glacial period. *Nature* 360, 245–249. doi: 10.1038/360245a0

Bonneau, L., Colin, C., Pons-Branchu, E., Mienis, F., Tisnérat-Laborde, N., Blamart, D., et al. (2018). Imprint of Holocene climate variability on cold-water coral reef growth at the SW Rockall Trough Margin, NE Atlantic. *Geochemistry Geophysics Geosystems* 19, 2437–2452. doi: 10.1029/2018GC007502

Bromley, R. G. (2005). "Prelimnary studies of bioerosion in the deep-water coral Lophelia, Pleistocene, Rhodes, Greece," in *Cold-water corals and ecosystems*. Eds. A. Freiwald and J. M. Roberts (Berlin, Heidelberg: Springer), 895–914.

Büscher, J. V., Wisshak, M., Form, A. U., Titschack, J., Nachtigall, K., and Riebesell, U. (2019). *In situ* growth and bioerosion rates of Lophelia pertusa in a Norwegian fjord and open shelf cold-water coral habitat. *PeerJ* 7, e7586. doi: 10.7717/peerj.7586

Colman, J. G., Gordaon, D. M., Lane, A. P., Forde, M. J., and Fitzpatrick, J. (2005). "Carbonate mounds off Mauretania, Northwest Africa: status of deep-water corals and implications for management of fishing and oil exploration activities," in *Cold-water corals and ecosystems*. Eds. A. Freiwald and J. M. Roberts (Berlin, Heidelberg: Springer), 417–441.

Compton, R (1962) Manual of Field Geology. (New York: John Wiley & Sons), 378.

Corbera, G., Lo Iacono, C., Standish, C. D., Anagnostou, E., Titschack, J., Katsamenis, O., et al. (2021). Glacio-eustatic variations and sapropel events as main controls on the Middle Pleistocene-Holocene evolution of the Cabliers Coral Mound Province (W Mediterranean). *Quaternary Sci. Rev.* 253, 106783. doi: 10.1016/j.quascirev.2020.106783

Corbera, G., Lo Iacono, C., Standish, C. D., Gràcia, E., Ranero, C., Huvenne, V. A. I., et al. (2022). Glacial-aged development of the Tunisian Coral Mound Province controlled by glacio-eustatic oscillations and changes in surface productivity. *Marine Geology* 446, 106772. doi: 10.1016/j.margeo.2022.106772

Correa, T. B. S., Eberli, G. P., Grasmueck, M., Reed, J. K., and Correa, A. M. S. (2012). Genesis and morphology of cold-water coral ridges in a unidirectional current regime. *Marine Geology* 326–328, 14–27. doi: 10.1016/j.margeo.2012.06.008

Crutchley, G., Mountjoy, J., Pecher, I., Gorman, A., and Henrys, S. (2016). "Submarine slope instabilities coincident with shallow gas hydrate systems: insights from New Zealand examples," in *Submarine mass movements and their consequences*. Eds. G. Lamarche, J. Mountjoy, S. Bull, T. Hubble, S. Krastel, E. Lane, et al (Berlin, Heidelberg: Springer), 401–409. doi: 10.1007/978-3-319-20979-1_40

Cyr, F., van Haren, H., Mienis, F., Duineveld, G., and Bourgault, D. (2016). On the influence of cold-water coral mound size on flow hydrodynamics, and vice versa. *Geophysical Res. Lett.* 43, 775–783. doi: 10.1002/2015GL067038

Davies, A. J., Wisshak, M., Orr, J. C., and Roberts, J. M. (2008). Predicting suitable habitat for the cold-water coral *Lophelia pertusa* (Scleractinia). *Deep-Sea Res. Part I* 55, 1048–1062. doi: 10.1016/j.dsr.2008.04.010

de Carvalho Ferreira, M. L., Robinson, L. F., Stewart, J. A., Li, T., Chen, T., Burke, A., et al. (2022). Spatial and temporal distribution of cold-water corals in the Northeast Atlantic Ocean over the last 150 thousand years. *Deep Sea Res. Part I* 190, 103892. doi: 10.1016/j.dsr.2022.103892

de Haas, H., Mienis, F., Frank, N., Richter, T. O., Steinbacher, R., de Stigter, H., et al. (2009). Morphology and sedimentology of (clustered) cold-water coral mounds at the south Rockall Trough margins, NE Atlantic Ocean. *Facies* 55, 1–26. doi: 10.1007/s10347-008-0157-1

De Mol, B., Huvenne, V. A. I., and Canals, M. (2009). Cold-water coral banks and submarine landslides: a review. *Int. J. Earth Sci.* 98, 885–899. doi: 10.1007/s00531-008-0372-6

Dorschel, B., Hebbeln, D., Foubert, A., White, M., and Wheeler, A. J. (2007). Hydrodynamics and cold-water coral facies distribution related to recent sedimentary processes at Galway Mound west of Ireland. *Marine Geology* 244, 184–195. doi: 10.1016/j.margeo.2007.06.010

Dorschel, B., Hebbeln, D., Rüggeberg, A., and Dullo, W.-C. (2005). Growth and erosion of a cold-water coral covered carbonate mound in the Northeast Atlantic during the Late Pleistocene and Holocene. *Earth Planetary Sci. Lett.* 233, 33–44. doi: 10.1016/j.epsl.2005.01.035

Dorschel, B., Wheeler, A. J., Huvenne, V. A. I., and de Haas, H. (2009). Cold-water coral mounds in an erosive environmental setting: TOBI side-scan sonar data and ROV video footage from the northwest Porcupine Bank, NE Atlantic. *Marine Geology* 264, 218–229. doi: 10.1016/j.margeo.2009.06.005

Eisele, M., Frank, N., Wienberg, C., Titschack, J., Mienis, F., Beuck, L., et al. (2014). Sedimentation patterns on a cold-water coral mound off Mauritania. *Deep Sea Res. Part II* 99, 307–315. doi: 10.1016/j.dsr2.2013.07.004

Eisele, M., Hebbeln, D., and Wienberg, C. (2008). Growth history of a cold-water coral covered carbonate mound - Galway Mound, Porcupine Seabight, NE-Atlantic. *Marine Geology* 253, 160–169. doi: 10.1016/j.margeo.2008.05.006

Fentimen, R., Feenstra, E. J., Rüggeberg, A., Hall, E., Rosso, A., Hajdas, I., et al. (2023). Staggered cold-water coral mound build-up on an Alboran ridge during the last deglacial (East Melilla Mound Field, western Mediterranean). *Marine Geology* 457, 106994. doi: 10.1016/j.margeo.2023.106994

Fink, H. G., Wienberg, C., De Pol-Holz, R., and Hebbeln, D. (2015). Spatio-temporal distribution patterns of Mediterranean cold-water corals (*Lophelia pertusa* and *Madrepora oculata*) during the past 14,000 years. *Deep-Sea Res. Part I* 103, 37–48. doi: 10.1016/j.dsr.2015.05.006

Fink, H. G., Wienberg, C., De Pol-Holz, R., Wintersteller, P., and Hebbeln, D. (2013). Cold-water coral growth in the Alboran Sea related to high productivity during the Late Pleistocene and Holocene. *Marine Geology* 339, 71–82. doi: 10.1016/j.margeo.2013.04.009

Foubert, A., Beck, T., Wheeler, A. J., Opderbecke, J., Grehan, A., Klages, M., et al. (2005). "New View of the Belgica Mounds, Porcupine, NE Atlantic: preliminary results from the Polarstern ARK-XIX/3a ROV cruise," in *Cold-water corals and ecosystems*. Eds. A. Freiwald and J. M. Roberts (Berlin, Heidelberg: Springer), 403–415.

Foubert, A., and Henriet, J.-P. (2007). *Nature and significance of the recent carbonate mound record* (Berlin, Heidelberg: Springer), 298.

Frank, N., Freiwald, A., Lopez Correa, M., Wienberg, C., Eisele, M., Hebbeln, D., et al. (2011). Northeastern Atlantic cold-water coral reefs and climate. *Geology* 39, 743–746. doi: 10.1130/g31825.1

Frank, N., Ricard, E., Lutringer-Paquet, A., van der Land, C., Colin, C., Blamart, D., et al. (2009). The Holocene occurrence of cold water corals in the NE Atlantic: Implications for coral carbonate mound evolution. *Marine Geology* 266, 129–142. doi: 10.1016/j.margeo.2009.08.007

Frederiksen, R., Jensen, A., and Westerberg, H. (1992). The distribution of scleratinian coral Lophelia pertusa around the Faroe Islands and the relation to intertidal mixing. *Sarsia* 77, 157–171. doi: 10.1080/00364827.1992.10413502

Freiwald, A. (2002). "Reef-forming cold-water corals," in *Ocean margin systems*. Eds. G. Wefer, D. Billett, D. Hebbeln, B. B. Jorgensen, M. Schlüter and T.C.E.v. Weering (Berlin, Heidelberg: Springer), 365–385.

Genin, A., Dayton, P. K., Lonsdale, P. F., and Spiess, F. N. (1986). Corals on seamount peaks provide evidence of current acceleration over deep-sea topography. *Nature* 322, 59–61. doi: 10.1038/322059a0

Guihen, D., White, M., and Lundälv, T. (2013). Boundary layer flow dynamics at a cold-water coral reef. *J. Sea Res.* 78, 36–44. doi: 10.1016/j.seares.2012.12.007

Hebbeln, D. (2002). "State of the art and future prospect of scientific coring and drilling of marine sediments," in *Ocean margin systems*. Eds. G. Wefer, D. Billett, D. Hebbeln, B. B. Jørgensen, M. Schlüter and T.C.E.v. Weering (Berlin, Heidelberg: Springer), 57–66.

Hebbeln, D., and Samankassou, E. (2015). Where did ancient carbonate mounds grow — In bathyal depths or in shallow shelf waters? *Earth-Science Rev.* 145, 56–65. doi: 10.1016/j.earscirev.2015.03.001

Hebbeln, D., Van Rooij, D., and Wienberg, C. (2016). Good neighbours shaped by vigorous currents: Cold-water coral mounds and contourites in the North Atlantic. *Marine Geology* 378, 171–185. doi: 10.1016/j.margeo.2016.01.014

Heindel, K., Titschack, J., Dorschel, B., Huvenne, V. A. I., and Freiwald, A. (2010). The sediment composition and predictive mapping of facies on the Propeller Mound—A cold-water coral mound (Porcupine Seabight, NE Atlantic). *Continental Shelf Res.* 30, 1814–1829. doi: 10.1016/j.csr.2010.08.007

Henriet, J. P., Hamoumi, N., Da Silva, A. C., Foubert, A., Lauridsen, B. W., Rüggeberg, A., et al. (2014). Carbonate mounds: From paradox to World Heritage. *Marine Geology* 352, 89–110. doi: 10.1016/j.margeo.2014.01.008

Hjulstrom, F. (1935). Studies of morphological activity of rivers as illustrated by the river fyris. *Bull. Geological Institute Univ. Uppsala* 25, 221–527.

Huvenne, V. A. I., Masson, D. G., and Wheeler, A. J. (2009). Sediment dynamics of a sandy contourite: The sedimentary context of the Darwin cold-water coral mounds, Northern Rockall Trough. *Int. J. Earth Sci.* 98, 865–884. doi: 10.1007/s00531-008-0312-5

Kano, A., Ferdelman, T. G., Williams, T., Henriet, J.-P., Ishikawa, T., Kawagoe, N., et al. (2007). Age constraints on the origin and growth history of a deep-water coral mound in the northeast Atlantic drilled during Integrated Ocean Drilling Program Expedition 307. *Geology* 35, 1051–1054. doi: 10.1130/G23917A.1

Kenyon, N. H., Akhmetzhanov, A. M., Wheeler, A. J., van Weering, T. C. E., de Haas, H., and Ivanov, M. K. (2003). Giant carbonate mud mounds in the southern Rockall Trough. *Marine Geology* 195, 5–30. doi: 10.1016/S0025-3227(02)00680-1

Korpanty, C. A., Hoffman, L., Portilho-Ramos, R., Titschack, J., Wienberg, C., and Hebbeln, D. (2023). Decline in cold-water coral growth promotes molluscan diversity: A paleontological perspective from a cold-water coral mound in the western Mediterranean Sea. *Front. Marine Sci.* 9. doi: 10.3389/fmars.2022.895946

Leynaud, D., Mienert, J., and Vanneste, M. (2009). Submarine mass movements on glaciated and non-glaciated European continental margins: A review of triggering mechanisms and preconditions to failure. *Marine Petroleum Geology* 26, 618–632. doi: 10.1016/j.marpetgeo.2008.02.008

Lim, A., Wheeler, A. J., and Arnaubec, A. (2017). High-resolution facies zonation within a cold-water coral mound: The case of the Piddington Mound, Porcupine Seabight, NE Atlantic. *Marine Geology* 390, 120–130. doi: 10.1016/j.margeo.2017.06.009

Lindberg, B., and Mienert, J. (2005). "Sedimentological and geochemical environment of the Fugløy Reef off northern Norway," in *Cold-water corals and ecosystems*. Eds. A. Freiwald and J. M. Roberts (Berlin, Heidelberg: Springer), 633–650.

Lo Iacono, C., Savini, A., and Basso, D. (2018). "Cold-water carbonate bioconstructions," in *Submarine geomorphology*. Eds. A. Micallef, S. Krastel and A. Savini (Berlin, Heidelberg: Springer International Publishing), 425–455. doi: 10.1007/978-3-319-57852-1_22

López Correa, M., Montagna, P., Joseph, N., Rüggeberg, A., Fietzke, J., Flögel, S., et al. (2012). Preboreal onset of cold-water coral growth beyond the Arctic Circle revealed by coupled radiocarbon and U-series dating and neodymium isotopes. *Quaternary Sci. Rev.* 34, 24–43. doi: 10.1016/j.quascirev.2011.12.005

Mangini, A., Godoy, J. M., Godoy, M. L., Kowsmann, R., Santos, G. M., Ruckelshausen, M., et al. (2010). Deep sea corals off Brazil verify a poorly ventilated Southern Pacific Ocean during H2, H1 and the Younger Dryas. *Earth Planetary Sci. Lett.* 293, 269–276. doi: 10.1016/j.epsl.2010.02.041

Masson, D., Wynn, R., Talling, P., Mosher, D., Moscardelli, L., Baxter, C., et al. (2010). "Large landslides on passive continental margins: Processes, hypotheses and outstanding questions," in *Submarine mass movements and their consequences*. Eds. D. Mosher, R. C. Shipp, L. Moscardelli, J. Chaytor, C. Baxter and H. Lee (Berlin, Heidelberg: Springer), 153–165. doi: 10.1007/978-90-481-3071-9_13

Matos, L., Mienis, F., Wienberg, C., Frank, N., Kwiatkowski, C., Groeneveld, J., et al. (2015). Interglacial occurrence of cold-water corals off Cape Lookout (NW Atlantic): First evidence of the Gulf Stream influence. *Deep Sea Res. Part I* 105, 158–170. doi: 10.1016/j.dsr.2015.09.003

Matos, L., Wienberg, C., Titschack, J., Schmiedl, G., Frank, N., Abrantes, F., et al. (2017). Coral mound development at the Campeche cold-water coral province, southern Gulf of Mexico: Implications of Antarctic Intermediate Water increased influence during interglacials. *Marine Geology* 392, 53–65. doi: 10.1016/j.margeo.2017.08.012

Mienis, F., De Stigter, H. C., De Haas, H., van der Land, C., and Van Weering, T. C. E. (2012). Hydrodynamic conditions in a cold-water coral mound area on the Renard Ridge, southern Gulf of Cadiz. *J. Marine Syst.* 96-97, 61–71. doi: 10.1016/j.jmarsys.2012.02.002

Mienis, F., de Stigter, H. C., White, M., Duineveld, G., de Haas, H., and van Weering, T. C. E. (2007). Hydrodynamic controls on cold-water coral growth and carbonate-mound development at the SW and SE Rockall Trough Margin, NE Atlantic Ocean. *Deep Sea Res. Part I* 54, 1655–1674. doi: 10.1016/j.dsr.2007.05.013

Mienis, F., van der Land, C., de Stigter, H. C., van de Vorstenbosch, M., de Haas, H., Richter, T., et al. (2009). Sediment accumulation on a cold-water carbonate mound at the Southwest Rockall Trough margin. *Marine Geology* 265, 40–50. doi: 10.1016/j.margeo.2009.06.014

Mohn, C., Rengstorf, A., White, M., Duineveld, G., Mienis, F., Soetaert, K., et al. (2014). Linking benthic hydrodynamics and cold-water coral occurrences: A high-resolution model study at three cold-water coral provinces in the NE Atlantic. *Prog. Oceanography* 122, 92–104. doi: 10.1016/j.pocean.2013.12.003

Mortensen, P. B., Buhl-Mortensen, L., Gebruk, A. V., and Krylova, E. M. (2008). Occurrence of deep-water corals on the Mid-Atlantic Ridge based on MAR-ECO data. *Deep Sea Res. Part II* 55, 142–152. doi: 10.1016/j.dsr2.2007.09.018

Noé, S., Titschack, J., Freiwald, A., and Dullo, W.-C. (2006). From sediment to rock: diagenetic processes of hardground formation in deep-water carbonate mounds of the NE Atlantic. *Facies* 52, 183–208. doi: 10.1007/s10347-005-0037-x

O'Reilly, L., Fentimen, R., Butschek, F., Titschack, J., Lim, A., Moore, N., et al. (2022). Environmental forcing by submarine canyons: Evidence between two closely situated cold-water coral mounds (Porcupine Bank Canyon and Western Porcupine Bank, NE Atlantic). *Marine Geology* 454, 106930. doi: 10.1016/j.margeo.2022.106930

Orejas, C., Wienberg, C., Titschack, J., Tamborrino, L., Freiwald, A., and Hebbeln, D. (2021). *Madrepora oculata* forms large frameworks in hypoxic waters off Angola (SE Atlantic). *Sci. Rep.* 11, 15170. doi: 10.1038/s41598-021-94579-6

Pirlet, H., Colin, C., Thierens, M., Latruwe, K., Van Rooij, D., Foubert, A., et al. (2011). The importance of the terrigenous fraction within a cold-water coral mound: A case study. *Marine Geology* 282, 13–25. doi: 10.1016/j.margeo.2010.05.008

Portilho-Ramos, R., Titschack, J., Wienberg, C., Siccha, M., Yokohama, Y., and Hebbeln, D. (2022). Major environmental drivers determine life and death of cold-water corals through time. *PloS Biol.* 20, e3001628. doi: 10.1371/journal.pbio.3001628

Raddatz, J., Liebetrau, V., Rüggeberg, A., Foubert, A., Flögel, S., Nürnberg, D., et al. (2022). Living on the edge: environmental variability of a shallow late Holocene cold-water coral mound. *Coral Reefs* 41, 1255–1271. doi: 10.1007/s00338-022-02249-4

Raddatz, J., Liebetrau, V., Trotter, J., Rüggeberg, A., Flögel, S., Dullo, W.-C., et al. (2016). Environmental constraints on Holocene cold-water coral reef growth off Norway: Insights from a multiproxy approach. *Paleoceanography* 31, 1350–1367. doi: 10.1002/2016PA002974

Raddatz, J., Titschack, J., Frank, N., Freiwald, A., Conforti, A., Osborne, A., et al. (2020). *Solenosmilia variabilis*-bearing cold-water coral mounds off Brazil. *Coral Reefs* 39, 69–83. doi: 10.1007/s00338-019-01882-w

Roberts, H. H., and Kohl, B. (2018). Temperature control of cold-water coral (*Lophelia*) mound growth by climate-cycle forcing, Northeast Gulf of Mexico. *Deep Sea Res. Part I* 140, 142–158. doi: 10.1016/j.dsr.2018.08.002

Roberts, J. M., Wheeler, A. J., and Freiwald, A. (2006). Reefs of the deep: The biology and geology of cold-water coral ecosystems. *Science* 312, 543–547. doi: 10.1126/science.1119861

Rüggeberg, A., Dorschel, B., Dullo, W.-C., and Hebbeln, D. (2005). "Sedimentary patterns in the vicinity of a carbonate mound in the Hovland Mound Province, northern Porcupine Seabight," in *Cold-water corals and ecosystems*. Eds. A. Freiwald and J. M. Roberts (Berlin, Heidelberg: Springer), 87–112.

Rüggeberg, A., Dullo, W.-C., Dorschel, B., and Hebbeln, D. (2007). Environmental changes and growth history of a cold-water carbonate mound (Propeller Mound, Porcupine Seabight). *Int. J. Earth Sci.* 96, 57–72. doi: 10.1007/s00531-005-0504-1

Scourse, J. D., Haapaniemi, A. I., Colmenero-Hidalgo, E., Peck, V. L., Hall, I. R., Austin, W. E. N., et al. (2009). Growth, dynamics and deglaciation of the last British–Irish ice sheet: the deep-sea ice-rafted detritus record. *Quaternary Sci. Rev.* 28, 3066–3084. doi: 10.1016/j.quascirev.2009.08.009

Stalder, C., Vertino, A., Rosso, A., Rüggeberg, A., Pirkenseer, C., Spangenberg, J. E., et al. (2015). Microfossils, a key to unravel cold-water carbonate mound evolution through time: evidence from the eastern alboran sea. *PloS One* 10, e0140223. doi: 10.1371/journal.pone.0140223

Tamborrino, L., Wienberg, C., Titschack, J., Wintersteller, P., Mienis, F., Schroder-Ritzrau, A., et al. (2019). Mid-Holocene extinction of cold-water corals on the Namibian shelf steered by the Benguela oxygen minimum zone. *Geology* 47, 1185–1188. doi: 10.1130/G46672.1

Thierens, M., Titschack, J., Dorschel, B., Huvenne, V. A. I., Wheeler, A. J., Stuut, J. B., et al. (2010). The 2.6 Ma depositional sequence from the Challenger cold-water coral carbonate mound (IODP Exp. 307): Sediment contributors and hydrodynamic palaeo-environments. *Marine Geology* 271, 260–277. doi: 10.1016/j.margeo.2010.02.021

Titschack, J., Baum, D., De Pol-Holz, R., López Correa, M., Forster, N., Flögel, S., et al. (2015). Aggradation and carbonate accumulation of Holocene Norwegian cold-water coral reefs. *Sedimentology* 62, 1873–1898. doi: 10.1111/sed.12206

Titschack, J., Fink, H. G., Baum, D., Wienberg, C., Hebbeln, D., and Freiwald, A. (2016). Mediterranean cold-water corals – an important regional carbonate factory? *Depositional Record* 2, 74–96. doi: 10.1002/dep2.14

van der Kaaden, A.-S., Mohn, C., Gerkema, T., Maier, S. R., de Froe, E., van de Koppel, J., et al. (2021). Feedbacks between hydrodynamics and cold-water coral mound development. *Deep Sea Res. Part I* 178, 103641. doi: 10.1016/j.dsr.2021.103641

van der Land, C., Eisele, M., Mienis, F., de Haas, H., Hebbeln, D., Reijmer, J. J. G., et al. (2014). Carbonate mound development in contrasting settings on the Irish margin. *Deep Sea Res. Part II* 99, 297–306. doi: 10.1016/j.dsr2.2013.10.004

Van Rooij, D., Blamart, D., Richter, T., Wheeler, A. J., Kozachenko, M., and Henriet, J.-P. (2007). Quaternary sediment dynamics in the Belgica mound province, Porcupine Seabight: ice-rafting events and contour current processes. *Int. J. Earth Sci.* 96, 121–140. doi: 10.1007/s00531-006-0086-6

Van Rooij, D., De Mol, B., Huvenne, V., Ivanov, M., and Henriet, J. P. (2003). Seismic evidence of current-controlled sedimentation in the Belgica mound province, upper Porcupine slope, southwest of Ireland. *Marine Geology* 195, 31–53. doi: 10.1016/S0025-3227(02)00681-3

Wang, H., Lo Iacono, C., Wienberg, C., Titschack, J., and Hebbeln, D. (2019). Cold-water coral mounds in the southern Alboran Sea (western Mediterranean Sea): Internal waves as an important driver for mound formation since the last deglaciation. *Mar. Geol.* 412, 1–18. doi: 10.1016/j.margeo.2019.02.00

Wang, H., Titschack, J., Wienberg, C., Korpanty, C., and Hebbeln, D. (2021). The importance of ecological accommodation space and sediment supply for cold-water coral mound formation, a case study from the western Mediterranean Sea. *Front. Marine Sci.* 8. doi: 10.3389/fmars.2021.760909

Wefing, A.-M., Arps, J., Blaser, P., Wienberg, C., Hebbeln, D., and Frank, N. (2017). High precision U-series dating of scleractinian cold-water corals using an automated chromatographic U and Th extraction. *Chem. Geology* 475, 140–148. doi: 10.1016/j.chemgeo.2017.10.036

Wheeler, A. J., Kozachenko, M., Masson, D. G., and Huvenne, V. A. I. (2008). Influence of benthic sediment transport on cold-water coral bank morphology and growth: The example of the Darwin Mounds, north-east Atlantic. *Sedimentology* 55, 1875–1887. doi: 10.1111/j.1365-3091.2008.00970.x

Wienberg, C., Beuck, L., Heidkamp, S., Hebbeln, D., Freiwald, A., Pfannkuche, O., et al. (2008). Franken Mound: facies and biocoenoses on a newly-discovered "carbonate mound" on the western Rockall Bank, NE Atlantic. *Facies* 54, 1–24. doi: 10.1007/s10347-007-0118-0

Wienberg, C., Frank, N., Mertens, K. N., Stuut, J.-B., Marchant, M., Fietzke, J., et al. (2010). Glacial cold-water coral growth in the Gulf of Cadiz: Implications of increased palaeo-productivity. *Earth Planetary Sci. Lett.* 298, 405–416. doi: 10.1016/j.epsl.2010.08.017

Wienberg, C., Freiwald, A., Frank, N., Mienis, F., Titschack, J., Orejas, C., et al. (2023). "Cold-water coral reefs in the oxygen minimum zones off west africa," in *Cold-water coral reefs of the world*. Eds. E. Cordes and F. Mienis (Berlin, Heidelberg: Springer International Publishing), 199–235. doi: 10.1007/978-3-031-40897-7_8

Wienberg, C., Hebbeln, D., Fink, H. G., Mienis, F., Dorschel, B., Vertino, A., et al. (2009). Scleractinian cold-water corals in the Gulf of Cadiz-First clues about their spatial and temporal distribution. *Deep-Sea Res. Part I* 56, 1873–1893. doi: 10.1016/j.dsr.2009.05.016

Wienberg, C., Krengel, T., Frank, N., Wang, H., Van Rooij, D., and Hebbeln, D. (2022). Cold-water coral mounds in the western Mediterranean Sea: New insights into their initiation and development since the Mid-Pleistocene in response to changes of African hydroclimate. *Quaternary Sci. Rev.* 293, 107723. doi: 10.1016/j.quascirev.2022.107723

Wienberg, C., and Titschack, J. (2017). "Framework-forming scleractinian cold-water corals through space and time: A late Quaternary North Atlantic perspective," in *Marine animal forests: the ecology of benthic biodiversity hotspots*. Eds. S. Rossi, L.

Bramanti, A. Gori and C. Orejas Saco del Valle (Berlin, Heidelberg: Springer), 699–732. doi: 10.1007/978-3-319-17001-5_16-1

Wienberg, C., Titschack, J., Frank, N., De Pol-Holz, R., Fietzke, J., Eisele, M., et al. (2020). Deglacial upslope shift of NE Atlantic intermediate waters controlled slope erosion and cold-water coral mound formation (Porcupine Seabight, Irish margin). *Quaternary Sci. Rev.* 237, 106310. doi: 10.1016/j.quascirev.2020.106310

Wienberg, C., Titschack, J., Freiwald, A., Frank, N., Lundälv, T., Taviani, M., et al. (2018). The giant Mauritanian cold-water coral mound province: Oxygen control on coral mound formation. *Quaternary Sci. Rev.* 185, 135–152. doi: 10.1016/j.quascirev.2018.02.012

Wisshak, M. (2006). “High-latitude bioerosion: the kosterfjord experiment,” in *Springer series: lecture notes in earth sciences*, vol. 109. (Springer, Berlin, Heidelberg).

White, M. (2007) Benthic dynamics at the carbonate mound regions of the Porcupine Sea Bight continental margin. *Int. J. Earth Sci.* 96, 1–9. doi: 10.1007/s00531-006-0099-1