

Good neighbours in vigorous currents: contourites and cold-water corals

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Abstract: Being both triggered by intense bottom currents, contourites and cold-water corals often occur side by side along many continental margins in the world. Whereas the interaction between bottom currents and sediments can form large contourite depositional systems, cold-water corals can build-up impressive seabed structures called coral carbonate mounds. The co-occurrence of contourite drift deposits and coral carbonate mounds frequently aligns such prominent seabed structures in a given region. These can form high-resolution paleo-archives preserving detailed paleo-environmental records, especially with regard to the prevailing bottom current systems. After five respectively two decades of intense research, providing significant knowledge about contourites and cold-water corals, new ideas and concepts may arise from a close collaboration of scientists from these two fields.

Key words: Cold-water corals, contourites, bottom currents, continental margins.

INTRODUCTION

Contourites are linked to the activity of bottom currents by definition, whereas this is less obvious for cold-water corals. The distribution of cold-water corals is controlled by their sensitivity to a number of physico-chemical parameters such as temperature, salinity, and oxygen content. However, in addition to find a suitable habitat fitting their physico-chemical needs, sufficient food supply is another crucial factor controlling the distribution of cold-water corals (Fig. 1).

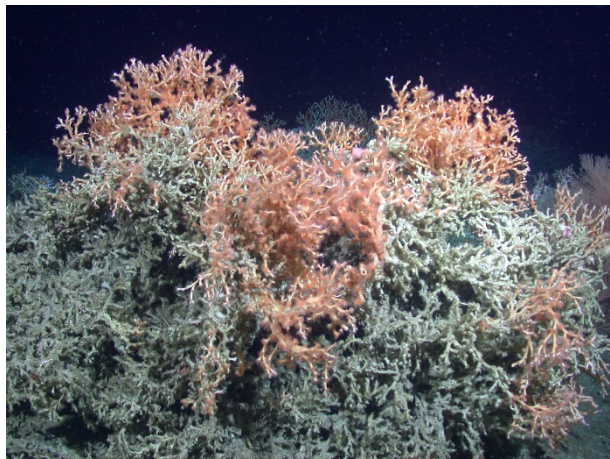


FIGURE 1. Extensive framework of the cold-water coral *Lophelia pertusa* on a coral carbonate mound in the Belgica Mound Province, Irish continental margin (© MARUM).

As sessile suspension feeders cold-water corals rely on a steady or periodic delivery of food particles to their tentacles. Compared to the quasi-vertical pelagic particle flux in a setting without any lateral currents, a quasi-horizontal transport of particles induced by a vigorous bottom current regime (associated with processes such as geostrophic currents, internal tides/waves, downwelling, cascading, etc.) considerably enhances the probability for the corals to catch a food particle. Consequently, all thriving cold-water coral ecosystems are intrinsically linked to a dynamic bottom

water regime (see e.g., White et al., 2005) as it is documented, for example, in the association of ripples and dunes with coral carbonate mounds (Fig. 2). In addition, past changes in bottom current strength have been identified to control the occurrence of these ecosystems through time (Dorschel et al., 2005).



FIGURE 2. Rippled seabed covered with cold-water coral fragments within the Belgica Mound Province, Irish continental margin, illustrating the close link between bottom currents and the occurrence of cold-water corals (© MARUM).

DISTRIBUTION

Contourites can basically form in all water depths. In contrast, the physico-chemical requirements of the cold-water corals limit their occurrence largely to shallow and intermediate depths. However, along these depths they are widely distributed. As both are dependent on the presence of a dynamic bottom current regime, the occurrence of cold-water corals is usually intimately linked to the occurrence of contourites (Fig. 2).

The majority of cold-water coral settings explored so far, are concentrated in the North Atlantic, but every year new sites all over the World are being discovered. By now it appears that they occur along almost all continental margins around the entire Atlantic Ocean and at various places in all the other ocean basins.

The progress of our knowledge regarding the distribution of cold-water coral settings resembles somewhat the case of contourites. This is a common picture for relatively young fields of research, where first advances are often made in the well-studied North Atlantic. Thus, especially with respect to the Pacific and Indian Oceans new findings of contourite and cold-water coral sites have to be expected for the years to come.

SHAPING THE SEABED

Contourite Depositional Systems can be quite extensive reaching hundreds of kilometres in length and thicknesses of up to 2km (Rebesco et al. 2014). The positive morphological structures formed by contourites are often aligned with moats additionally indicating bottom current activity.

Especially framework-forming scleractinian cold-water corals, as e.g., the most prominent species *Lophelia pertusa* (Fig. 1), have the capability to form large and three-dimensional seabed structures, so-called coral carbonate mounds. Over a period of ~2.4Ma the giant coral carbonate mounds off Ireland have been grown to >300m above the surrounding seafloor. Although an individual mound structure only reaches perimeter of hundreds to maybe a few kilometres in diameter, the clustering of such mounds to large mound provinces eventually can cover several 10s of square kilometres (e.g., Hebbeln et al. 2014).

HIGH-RESOLUTION PALEO-ARCHIVES

Similar to contourite drift deposits, the coral carbonate mounds act as paleoenvironmental archives that can be characterised by rather high sedimentation rates. For instance, along the Moroccan margin in the Alboran Sea (see also Fig. 3) individual mounds reveal for specific time intervals sedimentation rates of >4m per thousand years (Fink et al. 2013).

The differing capacity of either of the two systems in preserving paleoenvironmental signals (see for example Dorschel et al. 2005) opens the door for significantly improved paleoenvironmental reconstructions.

Combining different signal carriers as well as records with different temporal resolutions (sometimes alternating between both archives) will be one among many promising tasks for future cooperation of contourite and cold-water coral researchers.

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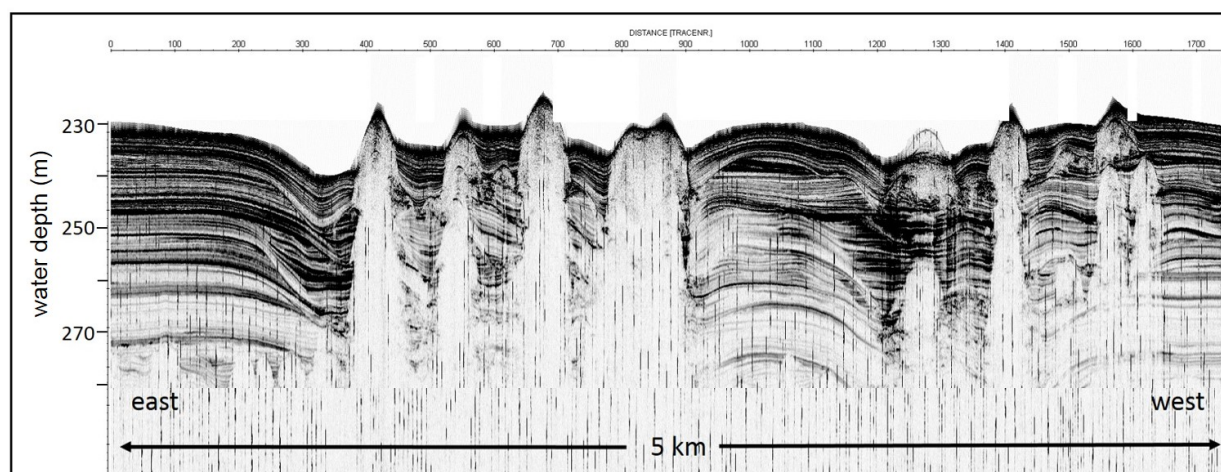


FIGURE 3. Close association of coral carbonate mounds and contourite drift deposits along the Moroccan margin in the Alboran Sea.