Cold-water coral occurrence and critical bottom current conditions in the Pen Duick Escarpment (Gulf of Cadiz, Moroccan margin)

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Abstract

The Pen Duick Escarpment is located at about 35°20'N latitude in the El Arraiche mud volcano province (southern Gulf of Cadiz) and was formed by the complex interplay of tectonic ridges and mud volcanoes, active from the Neogene to present. Subsequently, bottom currents interacted with the rising topographic obstacles and led to the development of a contourite drift along the escarpment's southern foot. The top of the Pen Duick Escarpment, nowadays ranging between 500 to 600 m water depth, constitutes in turn a so-called graveyard of past flourishing cold-water coral (CWC) ecosystem. Being suspension feeders, the scleractinian CWC are found in various deep sea habitats as they tolerate a wide range of temperatures, salinities and dissolved oxygen concentrations. Nowadays, environmental conditions are favourable for CWC in the Pen Duick Escarpment although living specimen have rarely been observed. In contrast, the Pen Duick Escarpment CWC seem to periodically thrive and decay within well-defined time intervals, closely associated with past glacial periods such as MIS2-4, MIS6 and MIS8. Previous studies demonstrated that CWC strongly depends on primary productivity which constitutes the base of their food chain. Additionally, the co-occurrence of CWC ecosystems and enhanced hydrodynamic environment widely prevails. Bottom currents are known to induce sediment and nutrient resuspension, lateral transport and vertical mixing, which play a substantial role in term of food particle availability for the living CWC.

However, the extent to which bottom currents play a role in providing and sustaining a favourable environment for CWC growth is still poorly understood and poorly constrained. This study is based on the multi-proxy analysis of a sediment core recovered from the Pen Duick drift at 642 m of water depth. When compared to known CWC occurrences over the last 45 kyr, results indicate that CWC growth periods are associated with regional enhanced bottom current regime, mainly inducing sediment bypass and/or sediment erosion. Such critical bottom current conditions, that prevent sedimentation over adjacent CWC thriving sites, were also observed in many other sites from the northeast Atlantic margin, across different time scales. This limited sedimentation largely hampered the characterisation of CWC palaeo-environment variability. We here promote bottom currents (along with primary productivity) as a limiting factor for cold-water coral growth.