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Cold-Water Coral Ecosystem Functioning through Time in the Deep Sea: The example of cold-water coral carbonate mounds in the northeast Atlantic (from IODP307 to EuroMARC - CARBONATE)

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Along the European Atlantic continental margin, recent to young (late Quaternary) fossil carbonate mounds and build-ups by cold-water corals (predominantly the framework forming ahermatypic corals *Lophelia pertusa* and *Madrepora oculata*) occur from northern Norway to the Gulf of Cadiz with an emerging global distribution pattern showing a European concentration (see Roberts *et al.*, 2006). These have been the focus of multi-disciplinary European investigations that has moved from the discovery phase (where and what are they) to a more applied stage (how do they function and what do we need to know). One key question is how do these ecosystems function through time and how do they respond to environmental forcing.

Investigations so far reveal that all mounds possess different growth histories depending on the environmental setting and the involved faunal associations. Unfortunately, existing cores only penetrated the upper few meters of the mounds thus limiting mound research to the very late stage of mound development. Access to the longer sequences preserved in giant carbonate mounds was overcome in May 2005 when the IODP Expedition 307 (Porcupine Mound Drilling) recovered complete sedimentary records from the 155 m high "Challenger Mound" in the Porcupine Seabight west off Ireland, including the underlying strata and the enigmatic mound base. Shipboard and preliminary shore based investigations of the recovered sediments exposed complex internal mound sedimentary structures and sedimentary fabrics. Coral occurrences throughout the core stressed the biological influence on mound development and construction. The common occurrence of hardgrounds is indicative of harsh environmental controls on mound formation and development with diagenetic effects playing a progressive role in internal mound geochemical environment influencing cementation, dissolution, porosity and permeability.

Up to now the carbonate stored in carbonate mounds has not been considered in any global carbonate budget or linked to any global carbon budget involving greenhouse gases. A major challenge exists to quantify the amount and flux of carbon stored by these newly discovered areas of enhanced carbonate accumulation in intermediate water depth (e.g. carbonate mounds). The only existing integrative cold-water coral carbonate budget that has been performed is on short, post-glacial cores relevant to the Norwegian shelf only, which suggests that these small cold-water coral carbonate mounds alone may account for an additional 1% of total marine carbonate production (Lindberg *et al.*, 2005).

IODP has delivered one complete record from base to top of one carbonate mound in the Belgica Mound Province, Porcupine Seabight, NE Atlantic. EU FP projects have revealed late stage history of giant mounds in different settings showing that different mounds respond in different ways to environmental forcing factors with no one mound being typical of all. EuroMARC – CARBONATE hopes to study sequences through various mounds in different environmental settings. By understanding how biogeochemical processes control the development of these carbonate mounds and their response to climate change, we will make an important step in quantifying their role as mid-latitude carbonate sinks. In the end, a better understanding of the processes involved in mound formation and development may also result in new views on fossil analogues many of which are less accessible hydrocarbon reservoirs.