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Environmental control on cold-water carbonate mounds development

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Cold-water coral reefs are very abundant along the European continental margin in intermediate water depths and are able to build up large mound structures. These carbonate mounds particularly occur in distinct mound provinces on the Irish and British continental margins. Previous investigations resulted in a better understanding of the cold-water coral ecology and the development of conceptual models to explain carbonate mound build-up. Two different hypotheses were evoked to explain the origin and development of carbonate mounds, external *versus* internal control (e.g., Freiwald et al. 2004 *versus* e.g. Hovland 1990). Several short sediment cores have been obtained from Propeller Mound, Northern Porcupine Seabight, indicating that cold-water corals grew during interglacial and warm interstadial periods of the Late Pleistocene controlled by environmental and climatic variability supporting the external control hypothesis (e.g. Dorschel et al. 2005, Rüggeberg et al. 2007).

The recent discovery of Dullo et al. (2008) highlights the impact and importance of the external (environmental) control hypothesis with coral growth and distribution following the structure of seawater density, i.e. the potential density anomaly sigma-theta. This study evidences that all studied living coral reef sites of the NE Atlantic are occurring in water masses with a specific density window of sigma-theta = 27.5 $\pm$ 0.15 kg/m^3, whereas dead reefs are outside this density range. In order to transfer this idea to the paleo-record, we used the method of Lynch-Stieglitz (2001) and others for the determination of paleo-densities using stable oxygen isotope measurements (δ^{18}O) on benthic foraminifera. The accuracy of the density reconstruction is well known for the Holocene, the Last Glacial Maximum, and past interglacials.

With this knowledge we tested whether paleo-densities might be an important prerequisite for growth and development of cold-water coral reefs during the past interglacials and during mound initiation. δ^{18}O records of benthic foraminifera from sediment cores of Propeller Mound indicate that paleo-density values have a similar range during interglacials and interstadials of the past 300 kyr as for the present-day settings. However, the method is only valid for temperatures between 5° and 30°C. Therefore, mean glacial values of 27.8 kg/m^3 are minimum estimates considering possible glacial temperatures below 5°C, but are clearly offset to the living-coral-reef-density-range of 27.35–27.65 kg/m^3. We also tested this application on sediments from IODP Exp. 307 core 1317 C indicating that seawater densities are in a similar range during mound initiation at around 2.6 Ma (Kano et al. 2007).

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