Scientific drilling of a cold-water carbonate mound: Shipboard biogeochemical results from IODP Expedition 307

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Large mound stuctures associated with cold-water coral ecosystems commonly occur along the continental slope off W Ireland (Porcupine Seabight). Over 1500 mounds of up to 5 km in diameter and 250 m height lie at water depths 600 to 900 m. To establish a depositional model for cold-water carbonate mounds, Challenger Mound and adjacent continental slope sites were drilled during IODP Expedition 307 in May 2005.

The Challenger mound succession is 130 to 150 meters thick, and mainly consists of floatstone and rudstone facies formed of fine sediments and cold-water branching corals. Pronounced recurring cycles on the scales of several meters are recognized in carbonate content (up to 70% carbonate) and color reflectance, and are probably associated with Pleistocene glacial-interglacial cycles.

A role for methane seepage and subsequent anaerobic oxidation was discounted both as a hard-round substrate for mound initiation and as a principal source of carbonate within the mound succession. The zone of anerobic oxidation of methane occurs in the sub-mound Miocene sediments as indicated by a broad sulfate-methane transition (approximately 50 m thick). Interstitial water profiles of sulfate, alkalinity, Mg, and Sr suggest a tight coupling between carbonate diagenesis and mircrobial sulfate reduction. Depletion of Mg relative to Ca with increasing depth suggests that dolomite or another Ca-Mg carbonate mineral is precipitating within the mound succesion. Reaction of sulfide with siliciclastic iron-bearing minerals to form pyrite may further enhance diagenetic carbonate precipitation.