Short Cruise Report

RV Meteor Leg M61/3: Development of carbonate mounds along the Celtic continental margin

In the past years, the EU-projects ECO-MOUND, GEOMOUND and ACES have revealed many new results regarding the large carbonate mound provinces at the NW-European continental margin. Rresults of these projects confirm that particular external environmental factors have a significant influence on the latest development of the mounds and on the cold water corals living on the mounds flanks and summits. However, the investigation of the mound surfaces and their uppermost layers is still in its early days. There are many open questions, that are dealt with in the scope of the ESF-Euromargins project MOUND-FORCE, and were addressed during the leg M61/3.

Work programme during Leg M61/3

The working programme during leg M 61/3 focussed on the application of the deep diving remotely operated vehicle (ROV) QUEST, based at Marum / Uni-Bremen, and the sampling of sediments by box corer and gravity corer, accomplished by CTD casts and hydroacoustic surveys to examine parts of the large carbonate mound provinces at the NW-European continental margin off Ireland.

The variable appearance of carbonate mounds in different individual mound provinces is an indication of varying cause-and-effect relationships. In order to study these various relationships, carbonate mounds from four different provinces were examined during the M 61/3 cruise.

For all of the four working areas (Galway Mound, Propeller Mound, West Rockall Bank, North Porcupine Bank, Fig. 1) the working programme was based on a similar sampling strategy including (1) an initial hydroacoustic characterisation of the selected mound structures (Hydrosweep, Parasound), (2) dives with Bremen's remotely operated vehicle QUEST, (3) supplemental CTD casts, (4) sampling of sediments with gravity and box corer. Appropriate sediment sampling sites were selected based on site-survey and visual information after the ROV dives, with the exception of Propeller Mound. The QUEST ROV was also essential for a targeted sampling of carbonate crusts, hard grounds and very steep slopes. Spatial distributions of the faunas on these carbonate mounds were filmed during video transects over different mound areas (e.g. mound crest, luff and lee flanks, moats).
Although the time budget available for different sampling campaigns at Galway Mound and the West Rockall Bank was limited, information already available from the earlier leg M 61/1 allowed an effective planning of sampling campaigns and ROV dives.

Narrative of the cruise and first results

The third leg of the M61 cruise lasted 18 days. It started in Cork, Ireland, on the 4th of June, and ended in Ponta Delgada, Azores Islands, Portugal, on 21st of June. After the scientific equipment was loaded aboard RV Meteor, mobilisation of the 4000 m deep diving remotely operated vehicle ROV QUEST of the University of Bremen took place. Beside the vehicle and its scientific payload, a new deployment frame and a new underwater positioning system were installed aboard the vessel. Mobilisation was finished with a successful QUEST dive test at the pier in Cork harbour. RV METEOR departed from Cork in the early afternoon of June 4th, towards the Porcupine Seabight west of Ireland. Sailing down the river Lee provided a scenic background for the first TV-film work of the participating NDR TV-team.

The first work area (Belgica Mound Province) around Galway Seamound on the north western edge of the Porcupine Seabight at 51°26,7N 11°45,03W was reached on 5th of June, and started the scientific program during night with 2 CTD profiles and water samples. Station work was followed by the deployment of an elevator-mooring designed for the ROV-based recovery of 7 combined CTD/currentmeter devices. Recovery of these probes, which were set during 2003 with the help of the french ROV VICTOR, was the major goal of 2 dives with QUEST at Galway Mound. The sensor units, consisting of inductive currents meter and CTDs, had been deployed on north-south and east-west transects over the structure to collect data on the small scaled flow field around Galway Mound. With sampling intervals of 10 minutes, the recorded data are sufficient to provide information on possible tidal influences on the mound. Being installed in the frame of the EU-project MOUNDFORCE, the main task was to create a data base for the correlation of the current regime at Galway Mound with different biological and geological facies. After successful recovery of these probes, work was followed by a series of boxcorer stations and gravity cores across the Galway Mound. During June 7th, the easterly situated Poseidon Mound at 51°26,6N 11°41,8W was sampled with 3 additional boxcores. A time-series of eight CTD profiles with one-hour interval between each cast indicated the influence of tidal waves at 600–700 m water depth. To detect such processes is important for the understanding of the deep-water coral ecosystem as the corals take advantage of the high nutrient availability, the strong currents and the pumping dynamic of internal waves.

After finishing station work in the Belgica Mound Province on June 9th, RV Meteor moved towards West Rockall Bank, where carbonate mounds occur in regular chains perpendicular to the slope and often form complex amalgamated structures with several summits and with mound bases merged into one another. These structures are very different to those occurring in the Porcupine Seabight and suggested a different origin and control of the mounds. On the way, a short stopover on Propeller Mound, Hovland Mound Province, was used to complete previous sampling of sediment surfaces with box cores and get CTD casts across the mound.

First target area in the West Rockall Mound area was a previously discovered elevation on the seafloor, where after detailed hydroacoustic mapping the 5th dive with QUEST was scheduled for the evening of June 10th . Since video-observation suggested that the structure was an old volcanic plateau with only very sporadic coral growth, the dive was interrupted and RV Meteor moved west towards Franken Mound, a promising structure discovered during M61/1, at 56°29,93N 17°18,21W. A major work program covering nearly the complete

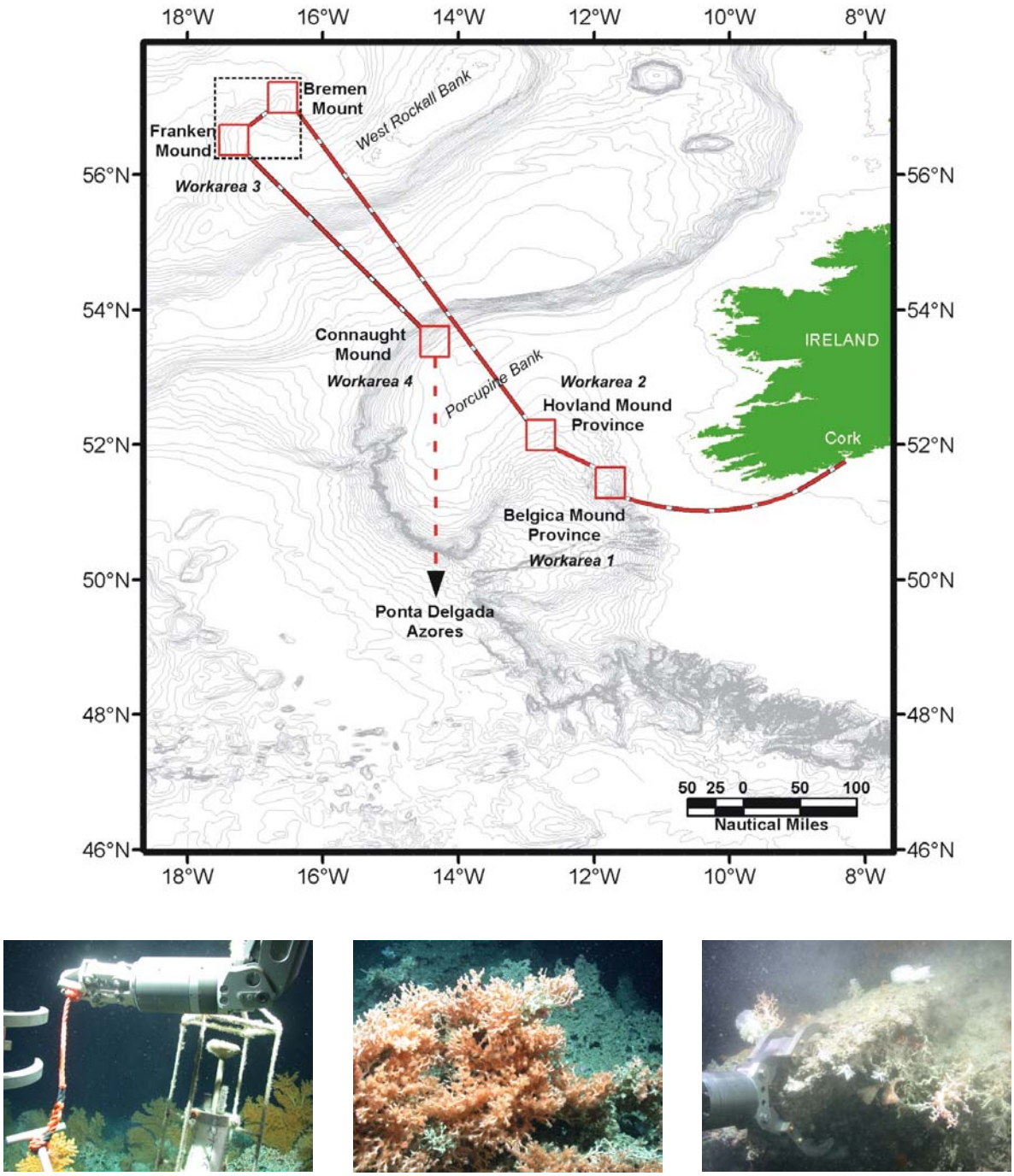

Fig. 1 *upper*: Map of the Celtic continental slope and the four work areas during leg M61/3
lower (l): recovery of currentmeters with QUEST manipulator at Galway Mound *(m) Lophelia sp.* colony at Franken Mound *(r)* sampling carbonate crusts at Connaugh Mound

mound surface could be performed at this site between June 11th and 13th, including extensive sediment surface and gravity core sampling, CTD casts and 4 complementary ROV dives. Result of this station work is a complimentary dataset of oceanography, detailed in-situ observations, mapped surface structure extensions and a large variety of sediment and surface samples. Due to changing weather conditions we decided to spend the remaining time not in

the West Rockall Bank area as originally planned, but to move further south towards Northern Porcupine Bank. After intense inspection of TOBI sidescan images provided by the Geological Survey of Ireland, a prominent edge structure with a small mound was chosen as next dive and sampling target. At the socalled Connaught Mound at 53°30,92N 14°21,16W, station work lasted from evening of June 14th through June 16th, providing spectacular video footage during 2 dives, a variety of lithified carbonate crust samples and coral specimen as well as extensive boxcore, gravity core and water samples. As an important result of the opportunity to sample carbonate crusts with QUEST at different sites, hardground samples recovered from the higher-resistant layers on Franconian Mound and the Connaught Mound can be divided two major facies: a) poorly to moderately lithified pelagic foraminiferal-nannoplankton oozes, and b) highly lithified fossil coral reef framework.

Station work was finished in the morning of June 16th. In total, 79 stations with 106 deployments were carried out during M61/3. The ROV QUEST could be deployed for 9 dives. RV Meteor returned to Ponta Delgada, Azores, in the morning of June 21st, where scientific equipment was unloaded and the scientific crew left the ship.