



The development of cold-water coral mounds along the Moroccan Atlantic and Mediterranean margins revealed by MeBo drillings

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Cold-water corals (CWC) mostly occur in intermediate water depths between 200 m and 1000 m and are capable of forming substantial seafloor structures, so-called coral carbonate mounds. These mounds can reach heights from a few meters up to >300 m and are composed of a mixture of CWC (and other shell) fragments and hemipelagic sediments, that both individually serve as distinct paleo-archives. IODP Leg 307 drilled through Challenger Mound at the Irish margin and revealed for the first time the full life history of a coral mound. However, although CWC occur almost worldwide, the 155 m long Challenger Mound record was for many years the only record from a coral mound exceeding 10 m in length.

During expedition MSM36 with the German R/V MARIA S. MERIAN in spring 2014, several coral mounds along the Moroccan margin, both in the Atlantic Ocean and in the Mediterranean Sea, were drilled (actually: push-cored) by applying the Bremen Seafloor Drill Rig MeBo. The MeBo is a remotely controlled drilling system that is lowered from the vessel to the seafloor. Energy supply and video control are secured by an umbilical linking the MeBo to the vessel. The scientific foci of expedition MSM36 were to investigate (1) the long-term development of CWC mounds in both areas over the last several 100,000 years in relation to changes in the ambient environmental conditions in the respective intermediate waters, (2) the life time history of these mounds, and (3) the forcing factors for the initiation and decease of individual mounds.

In both working areas, a total amount of 11 sites were successfully drilled with MeBo. Eight drillings were conducted at CWC mounds (on-mound sites) and 3 drillings in the direct vicinity of the mounds (off-mound sites) in order to obtain continuous paleoceanographic records. Drilling depths ranged between 17 m and 71 m with the latter corresponding to the maximum drilling depth of MeBo. The core recoveries varied between the sites and ranged between 47% and 96%. The coral-bearing on-mound cores were frozen and opened (i.e. cut lengthwise) with a stone saw to avoid a destruction of the original sediment texture with the embedded coral fragments. After opening, it became obvious that the quality of the MeBo cores is excellent and that it allows detailed post-cruise analyses at the MARUM laboratories in Bremen.

By obtaining on-mound records reaching lengths of >70 m (focus #1), supplemented by the full penetration of three coral mounds (foci #2 and #3) and by a >45-m-long double drilling at an off-mound site located between numerous fossil and buried mounds (allowing to put their full life history into a wider paleoceanographic context; foci #1 to #3), the major technical goals of this MeBo expedition were fully accomplished.

The critical factor in applying MeBo is the sea state as during deployment and recovery dynamic loads on the umbilical might reach critical limits. Although during expedition MSM36 several MeBo deployments were done by wind speeds of 6 Bft, the sea state especially in the Mediterranean Sea allowed MeBo operations without any restrictions. On the Atlantic side, a high swell, which actually exceeded the operational limit given for secured MeBo operations, could be overcome by reducing the payload (i.e. reducing the maximum drill depth). Hence, the operational window could be widened allowing for almost continuous MeBo operations also in this area.