



## Research Networking Programmes

### Cold-Water Carbonate Mounds in Shallow and Deep Time – The European Research Network (COCARDE-ERN)

#### Short Visit Grant N. 6964

## Scientific Report

**Agostina V. Vertino**

*University of Milano-Bicocca  
Department of Earth and Environmental Sciences  
Piazza della Scienza 4, 20126, Milan, Italy  
agostina.vertino@unimib.it*

**Proposal Title: Mediterranean vs. NE Atlantic CWC mounds: decoding the paleoenvironmental signal of carbonate benthic assemblages (Pleistocene - Holocene) - PART II**

**Application Reference N°: 6964**

### 1) Purpose of the visit

The purpose of the short scientific visit carried out at the National Oceanography Centre of Southampton (NOCS) was to subsample two gravity cores (MD13-3451; MD13-3452) for paleontological studies. These two cores were collected in the Melilla coral mound field (Alboran Sea) during the MD194-Gateway cruise carried out in June 2013 aboard the Marion Dufresne research vessel. The MD194 expedition was planned in the framework of the Eurofleets Transnational Access Activities (TNA), it was led by the University of Ghent and involved other 12 scientific institutions from both European and extra-European countries (Van Rooij et al. 2013). The primary goal of the cruise was to core long sediment sections from two CWC mound provinces at either sides of the Gibraltar Strait: 1. *Melilla mounds*, Southern Alboran Sea; 2. *Pen Duick mounds*, Gulf of Cadiz. The expedition allowed the successful collection of 22 gravity cores, 6 Calypso cores, 6 giant square boxcores as well as water column profiles/samples and additional geophysical data (Van Rooij et al. 2013). The combined analysis of seismic profiles, sediment cores and water samples is

aimed at a better understanding of the Gibraltar gateway dynamics and their influence on cold-water coral bioconstructions during the Quaternary.

The two gravity cores (MD13-3451G and MD13-3452G) subsampled at NOCS were collected in the recently discovered "West Melilla Mound Field", west to the Cape Tres Forcas (Fig. 1). In this area up to 103 CWC mounds organized in two main clusters occur within a depth range of 299–590 m (Lo Iacono et al. 2014). Core MD13-3451G (5.22 m long) was collected on a 35 m tall and 370 m deep mound of the eastern cluster; core MD13-3452G (5.58 m long) was recovered from a 10 m tall and 305 m deep mound of the western cluster. According to seismic data, groundtruthed by ROV and seafloor samples, most west Melilla mounds are inactive and buried under fine-grained sediments of variable thickness probably accumulated during the last sea-level rise (Lo Iacono et al., 2014). The paleontological analysis that I plan to carry out on the gravity cores subsampled during this visit aims at highlighting faunal modifications within the core sediment. Paleoecological results will be combined with sedimentological, geochemical and chronostratigraphic data (currently under study at NOCS) to investigate correlations between changes of fossil assemblages and oceanographic processes at regional and global scale.

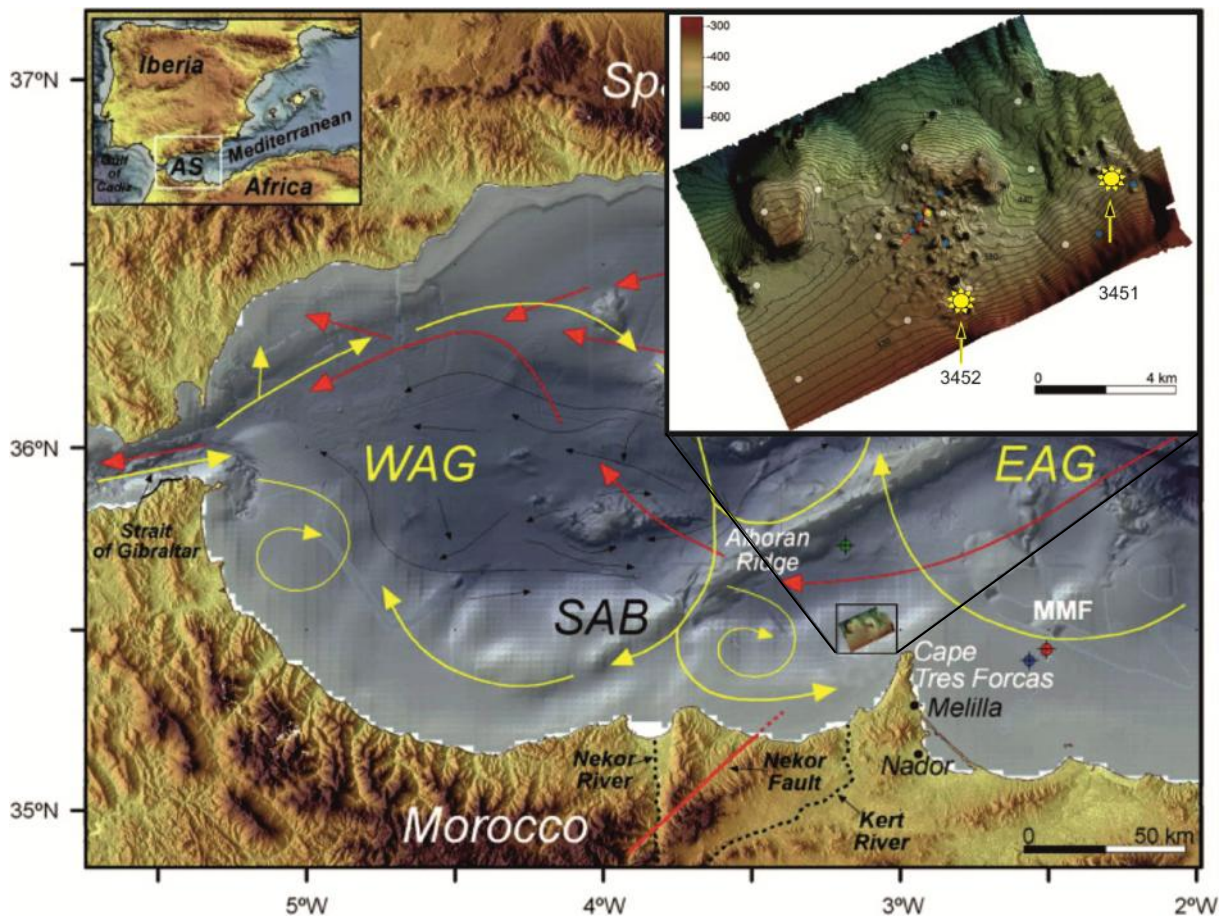


Fig. 1: Topographic and bathymetric map of the Alboran Sea and surrounding margins. SAB: South Alboran Basin, WAG: Western Alboran Gyre, EAG: Eastern Alboran Gyre. Inset in the upper right corner: Location of the cores MD 13-3451 and MD13-3452 indicated by yellow stars and arrows. Modified after Lo Iacono et al. (2014).

## 2) Description of the work carried out during the visit

During the visit I subsampled the sediment of cores MD13-3451 and MD13-3452 for macro- and micropaleontological studies in the core laboratory of the National Oceanography Centre of Southampton. Prior to subsampling, the surface of the working core half was cleaned by removing a thin (<1 mm) layer of sediment with a spatula, photographed and described. Subsampling was performed at irregular depth intervals (Table 1, see Appendix) corresponding to faunal and/or sediment variations along the cores. After filling the voids created during subsampling with pieces of styrofoam, working core half was sealed with plastic wrap.

In the afternoon of the last day I participated in a meeting with Dr Claudio Lo Iacono and Dr Veerle Huvenne (NOCS) to discuss about Mediterranean CWC mounds and in particular the West Melilla Mound field. We exchanged our preliminary impressions about the two subsampled cores and set out a timeline for a common publication about the West Melilla Mound.

## 3) Description of the main results obtained

Sample treatment and analysis are in progress at the Earth Science Department of the University of Milano-Bicocca and at NOCS. On the basis of the observations carried out so far, both cores are characterized by loose sediment consisting of gravel-sized scleractinian coral fragments embedded in a muddy matrix rich in sub-mm to mm-sized carbonate bioclasts. The coral fragment density varies within and between the two cores and on the whole it seems to be much higher in MD13-3452.

Up to now all MD13-3452 samples collected for macrofaunal studies (Table 1 in Appendix) have been dried, weighed and sieved into 8 grain size fractions (8mm, 4mm, 2mm, 1mm, 0.5 mm, 0.25 mm, 0.125 mm, 0.063 mm) at the Earth and Environmental Department of the University of Milano-Bicocca. Preliminary semi-quantitative observations of the coarse grain size fraction (> 2 mm) of core MD13-3452 indicate that corals are not uniformly distributed within the 558 cm of sediment but are much more abundant and denser in the lower 3 m. Over 90% of the scleractinian fragments observed so far consist of the two frame-building species *Lophelia pertusa* and *Madrepora oculata*. Thin branch fragments of *M. oculata* dominate the upper 200 cm of the core whereas large and thick-walled *L. pertusa* fragments characterize most part of the lower core sediment. In particular, very dense *Lophelia* assemblages, presumably corresponding to flourishing Atlantic-like reefs, have been found in the following intervals: 270-340 cm, 405-465 cm and 485-555 cm. The preservation state of *Madrepora* and *Lophelia* species is highly variable along the core due to the different degree of bioerosion and encrustation. However, their skeletal

inner structure is well preserved and does not show any evidence of dissolution.

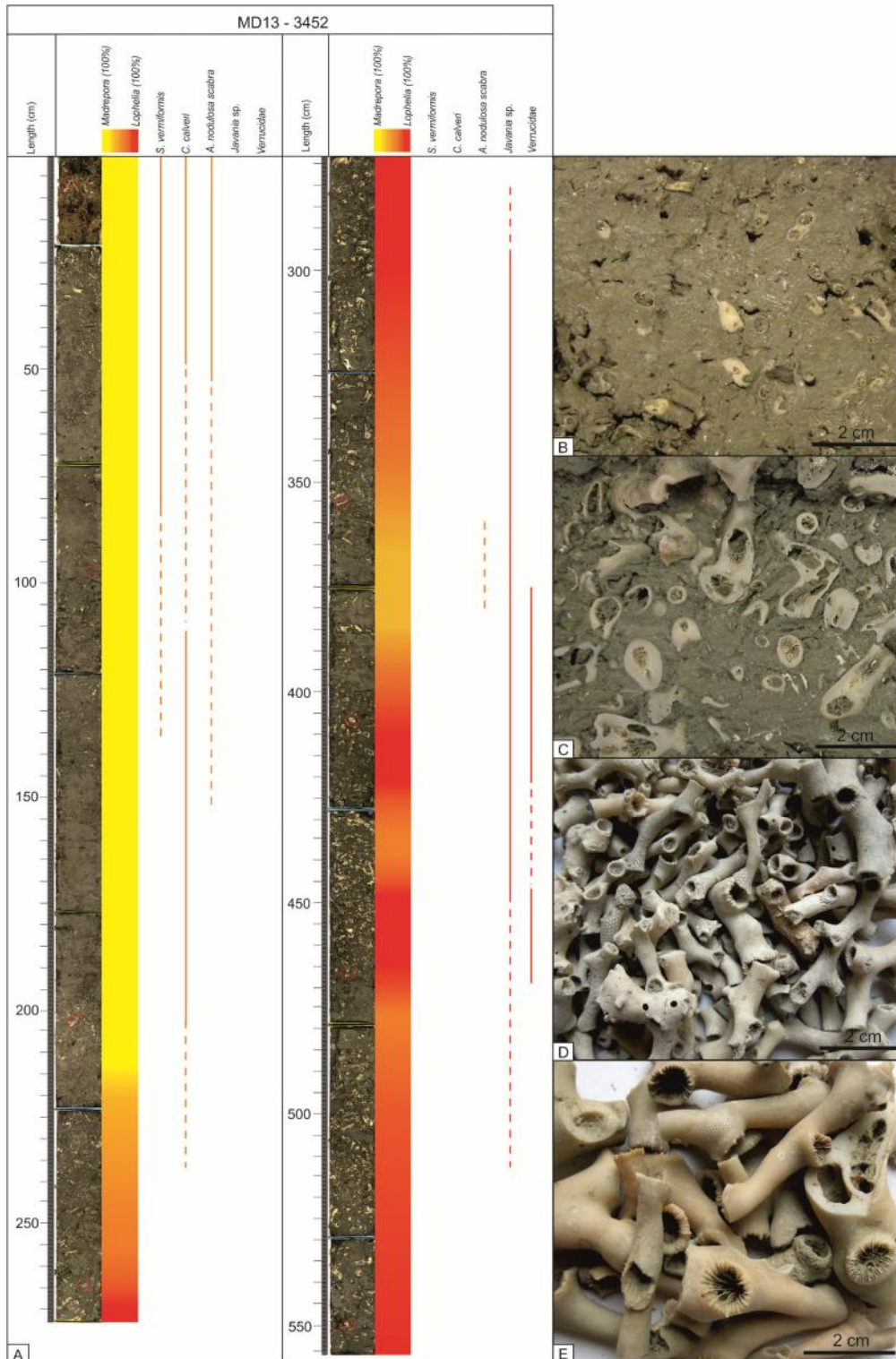


Fig. 2: A. Schematic description of core MD13-3452 based on preliminary paleontological observations carried out on the sediment gravel fraction (> 2 mm); B. *Madrepora*-dominated layer (33-41 cm); C. *Lophelia*-dominated layer ("reef" facies; 450 - 458 cm); D. Sediment fraction (8 mm mesh sieve) exclusively made up of *M. oculata* (21-26 cm); E. Sediment fraction (8 mm mesh sieve) exclusively made up of *L. pertusa* (405-410 cm)



The observed scleractinian assemblages secondarily contain also other species, such as *Desmophyllum dianthus*, *Stenocyathus vermiformis*, *Caryophyllia calveri* and *Javania* sp.. In all observed samples the gravel fraction is exclusively biogenic and generally made for over 95% of skeletal rests of benthic organisms. The most common species associated to coral fragments belong to the following taxonomic groups, listed in order of abundance: bivalves (mostly *Heteranomia parvula*, *Bahyarca philippiana*, *Hiatella arctica*, *Asperarca nodulosa scabra*, Pectinidae, Nuculidae), bryozoans (mostly erected forms, such as ?*Leiosella* sp. and *Reteporella sparteli*), serpulids (*Serpula* sp, *Filogranula gracilis*, *Hyalopomatus* spp., *Metaveremia multicristata*, *Placostegus tridentatus*), gastropods (e.g. *Danilia* sp., Columbelloidea, *Alvania cimicoides*, *Emarginula* spp., *Anatoma* sp.), echinoderms (echinoid spines/plates and ophiuroid vertebral ossicles), decapods, brachiopods (*Megerlia truncata*, *Gryphus vitreus*, *Terebratulina retusa*), verrucids, dentaliids and poriferans. On the whole the benthic associations hint at circalittoral to epibathyal environments but some samples contain species of shallower waters. Further taxonomic studies have to be carried out to clarify this issue. The remnant biogenic gravel fraction (less than 5%) is normally composed of pteropods (mostly *Clio pyramidata*) and fish otoliths.

On the basis of the observations carried out so far, most benthic species occur from the bottom to the top of the MD13-3452 core. Nevertheless, some taxa are dominant or exclusive in some layers and there seem to be an important faunal change at around 260-300 cm core depth. Indeed, the corals *M. oculata*, *S. vermiformis*, *C. calveri* and the bivalve *A. nodulosa scabra* characterize the upper half of the core (Fig. 2A, B, D). Instead, as mentioned above, thick-walled fragments of *L. pertusa* are much more common in the lower 300 cm of the core (Fig. 2A, C, E). Moreover, the solitary scleractinian *Javania cailleti*, verrucids and large fragments of branched bryozoans (thicker than 2 mm and longer than 10 mm) seem to be exclusive of the lower part of the core (Fig. 2A). Further paleontological analyses will be carried out on the finer sediment fraction to verify these findings and to identify further fossil assemblage boundaries.

#### **4) Future collaboration with host institution (if applicable)**

Both the University of Milano-Bicocca (Uni-MiB) and NOCS are actively involved in scientific programmes focused on modern and past cold-water coral ecosystems. Since the beginning of 2013, as a follow-up of the meeting entitled "Cold-Water Coral mounds in the Mediterranean Sea" (see ESF Lo Iacono visit grant N. 5356), a collaboration has been set up between NOCS and UniMiB aimed at the creation of a relational database on modern and fossil Mediterranean CWC bioconstructions.

This dataset will include all occurrences of Pleistocene to modern CWC mounds/frameworks known so far in the Mediterranean Sea. The main goal of this project is to allow scientists to highlight major modifications in abundance, composition and spatial distribution through time of Mediterranean CWC bioconstructions. Through a careful analysis of this database it might be possible to correlate changes of typology and/or abundance of CWC frameworks to major oceanographic changes occurred during the Quaternary. In order to include the Mediterranean dataset in the more general COCARDE mound database ("Moundbase"), currently under development at the University of Fribourg, all Mediterranean records will be stored following the COCARDE data standardization. My visit in Southampton represents a step forward in developing the COCARDE mound database and in setting up future collaborations between the University of Milano-Bicocca and the National Oceanography Centre of Southampton.

#### **5) Projected publications / articles resulting or to result from the grant**

The results on the West Melilla Mound Field deriving from my visit in Southampton will be presented in a publication that we intend to submit to an international journal by Summer 2015. Moreover, this data will be included in the COCARDE "Moundbase".

#### **References cited in the text**

- Lo Iacono C., Gracia E., Ranero C., Emelianov M., Huvenne V.A.I., Bartolome R., Booth-Rea G., Prades J., MELCOR Cruise party, 2014. The West Melilla cold water coral mounds, Eastern Alboran Sea: Morphological characterization and environmental context. *Deep-Sea research II* 99, 316-326.
- Van Rooij, D., Hebbeln, D., Comas, M., Vandorpe, T., Delivet, S. & the MD194 shipboard scientists (2013). EuroFLEETS Cruise Summary Report "MD194 GATEWAY", Cádiz (ES) - Lissabon (PT), 10-21 June 2013. Ghent University, Belgium, 214 pp.

## APPENDIX

Samples for macrofauna (core interval depth: cm)		Samples for microfauna (core depth: cm)	
MD13 - 3451	MD13 - 3452	MD13 - 3451	MD13 - 3452
0-5	0-3	3	2
15-20	8-13	18	-
32.5-34	21-26	-	22
45-50	31-36	48	35
-	-	-	40
61-63	45-48	-	45
75-80	48-50	78	50
100-105	66-71	103	65
115-120	75-80	118	78
140-142	85-88	-	86
155-160	88-90	158	-
170-175	100-105	173	102
195-200	116-121	198	117
205-210	125-130	208	127
215-220	140-145	-	142
230-235	155-160	233	157
250-255	171-176	253	177
280-285	183-188	283	185
-	-	-	195
285-290	200-205	288	202
300-305	210-215	303	-
330-333	216-221	-	-
333-335	230-235	-	-
350-355	245-250	353	-
370-375	260-265	373	-
375-380	271-276	-	-
395-400	295-300	398	298
402.5-405	317-321	405	320
-	-	408	-
423.5-425	335-340	420	338
435-440	340-342.5	438	-
455-460	342.5-345	458	-
460-463	352-355	-	-
485-490	360-365	488	362
-	-	-	370
490-495	385-390	493	-
505-510	390-392.5	508	390
510-515	400-405	513	402
-	405-410	-	-
-	421-425	-	423-
-	424-429	-	-
-	450-452.5	-	4253
-	452.5-455	-	453
-	460-465	-	460
-	485-490	-	488
-	-	-	504
-	-	-	512
-	525-530	-	528
-	545-550	-	550

Table 1: List of the samples collected from the two cores (MD13-3451 and MD13-3452) for macro-and microfauna analysis.