Characterization of water masses in Blanes Canyon in relation to CWC communities and connectivity pathways in the Mediterranean Sea

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CWC in the Mediterranean Sea

Cold-water corals (CWC) form ecosystems composed of corals belonging to orders Scleractinia, Antipatharia and Octocoralia. They can form dense aggregations which attract mobile and sessile fauna, such as fish, crinoids, urchins etc. In the Mediterranean Sea they are commonly found in submarine canyons which provide suitable habitats for CWC in terms of hard substrate for larvae settlement and enhanced water dynamics (food availability and current).

CWC distribution in the Mediterranean Sea has been associated to the Levantine Intermediate Water (LIW), a saline (>38.5) and warm (13.5°C-13.8°C) water mass that flows from the Eastern basin, where it is formed, to the Western basin.

Water mass properties are some of the controlling factors for CWC distribution and growth (Findaly et al., 2014). The Mediterranean Sea is considered suboptimal for scleractinian CWC, as the intermediate and deep water masses have a higher density (>29 kg/m^3) envelope than optimal (27.3-27.6 kg/m^3) (Puig et al., 2013, Flögel et al., 2014).

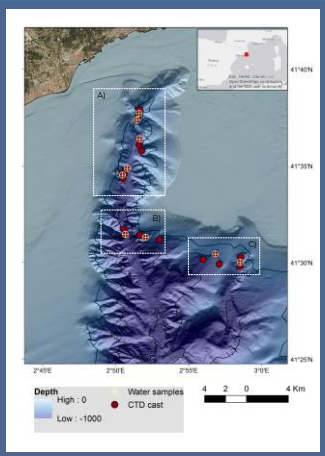

Fig.1. Map of Blanes Canyon, showing the locations of CTD casts and station where water samples were taken. ROV transects (not shown here) were preformed on the canyon walls adjacent to CTD casts. A) North Canyon; B) South Canyon; C) East Canyon

Blanes Canyon

Blanes Canyon is a shelf-incising canyon located in the NW Mediterranean Sea. It is found only several kilometers from the shoreline and bottom – trawling fishing grounds targeting blue and red shrimp *Aristeus antennatus* are located on the canyons flanks, rims and upper canyon axis (Paradis et al., 2018). Previous studies, such as ABIDES project, encountered sporadic CWC on the canyon walls below 300m depth, which was support for more research in the canyon (De Leo et al., 2019).

In February 2020, ABRIC cruise was set to explore the canyon walls with the aim of locating CWC and providing a detailed description of their distribution.

Roughly three areas could be distinguished based on CWC communities found: Fig.1.A - the north part of the canyon that is dominated by scleractinian corals such as *Desmophyllum pertusum* and *Madrepora oculata*. Fig.1.B - the southern part of the canyon similar to the northen part, but deeper (~ 1000m) and Fig.1.C – east part that is dominated by black coral *Leiopahtes glaberrima* and octocoral *Muriceides lepida* (Bilan et al., 2020).

Materials and Methods

The ABRIC-1 cruise was conducted on R/V Sarmiento de Gamboa (Fig.2A) Surrounding each ROV site, three CTD casts were preformed, while water samples were taken only from the last cast of the site.

Fig.2. A) R/V Sarmiento de Gamboa B) Deployment of rosette C) Filtration of seawater samples collected with the rosette

The rosette was equipped with Sea-Bird SBE 11 plus and 24 12L Niskin bottles (Fig2.B). Seawater was sampled at fixed depths: bottom, 50mab (meters above bottom), 100mab, 200 mab and at Chl-*a* max. Nutrient samples were stored at -20°C until analysis with an auto-analyzer (Bran + Luebbe AA3) at ICM-CSIC, following Hansen, 1999. Chl-*a* (x3) was determined from 5L seawater filtered on 47mm GFF frozen at -20°C until analysis, following Yentsch & Menzel, 1963 at ICM-CSIC (Fig.2.C). Nutrient results were grouped by area (Fig.1) and water mass based on seawater density as follows: oAW <29.0 kg/m^3; 29.0 kg/m^3 <LIW<29.1 kg/m^3, WMDW > 29.1 kg/m^3. Kruskall Wallis test was used to compare distinct nutrient concentrations between areas and deeper water masses.

CTD casts were processed in SBE Data Processing 7.26.7 and Ocean Data View 10.5.

References: Findlay et al., Scientific Reports 4.1. (2014) 1-10.; Puig et al., Progress in Oceanography 111 (2013) 1-23; Flögel et al., Deep-Sea Research II 99 (2014) 19-26, Paradis et al., Progress in Oceanography 169 (2018) 241-252, De Leo et al., 7th International Symposium Deep-Sea Corals (2019), Bilan et al., eDSBS conference (2020), Hansen., In Methods of Seawater Analysis Wiley & Sons (1999), Yentsch & Menzel, Deep-Sea Research 10 (1963) 221-231.

Results and Discussion

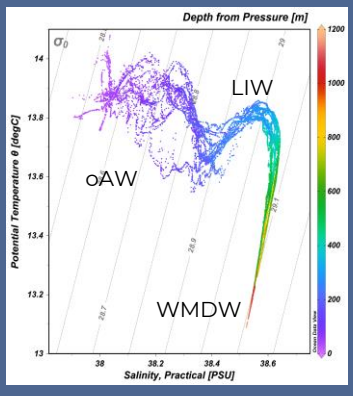

Fig.3. Θ-S diagram with isopycnals of water masses in Blanes Canyon measured during ABRIC-1 cruise in February 2020.
oAW – old Atlantic Water;
LIW – Levantine Intermediate Water;
WMDW – West Mediterranean Deep Water

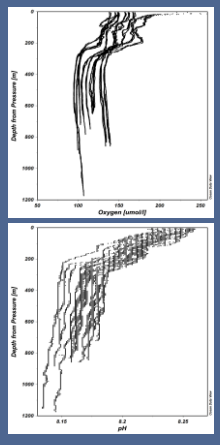

Fig.4. Vertical profiles of dissolved oxygen and pH measured during ABRIC-1..

The oAW was the main water mass in the surface with temperature 13.6-14.0°C and salinity 38.0-38.2 (Fig.3). The Chl-*a* max was found 20-45m depth ranging from 0.16-0.36 µg Chl-*a*/L. The intermediate depths (~300-750m) were characterized by LIW with temperature 13.5-13.8°C and salinity 38.4-38.5. Below 750m depth we detected WMDW with temperatures below 13.2°C and salinity higher than 38.5 (Fig.3). Dissolved oxygen and pH both decreased with depth. Below ~300m depth (coral zone) they ranged between 95-135µmol/L and 8.13-8.19, respectively (Fig.4).

Nutrient ranges are presented in Fig.5. Nitrate, phosphate and silicate were higher in deeper layers in comparison with the surface layer, which was expected. Nitrate did not show any differences between water masses or areas. Phosphate in the east part of the canyon was significantly different from other areas (χ2=13.809, df=2, p=0.001), while silicate was significantly different between two deeper water masses (χ2=12.429, df=, p=0.0004.).

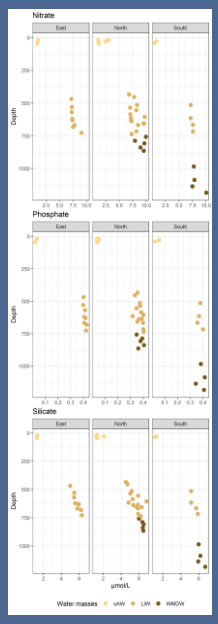

Fig.5. Vertical profiles nitrate, phosphate and silicate in Blanes Canyon

Overall, the results of water mass characteristics are within expected ranges for the west Mediterranean Sea, highlighting the importance of WMDW for CWC communities in the west Mediterranean Sea.

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