Exploring pristine deep-sea walls to reveal hidden deep-sea biodiversity in the Azores

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WILLING TO ATTEND WORKSHOP? YES

TARGET NAME: Deep-sea vertical walls (approximately 500m tall, from 200-1,000 m depth) around steep island slopes of the Azores

GEOGRAPHIC AREA(S) OF INTEREST WITHIN THE NORTH ATLANTIC OCEAN: South Central (between 37°N and 41°N)

RELEVANT SUBJECT AREAS: Biology, Conservation, Geology, Chemistry, Physical Oceanography

DESCRIPTION OF TOPIC OR REGION RECOMMENDED FOR EXPLORATION

Brief Overview of the Area

The Azores volcanic archipelago located in the northeast Atlantic, sits above a tectonically active triple junction between the North American, Eurasian and African plates, surrounded by numerous seamounts, deep fracture zones, trenches, a considerable extension of the Mid-Atlantic Ridge and abyssal plains deeper than 5,00 m. This diverse geomorphology holds an extraordinary diversity of benthic organisms, making this area a cold-water coral hotspot in the NE Atlantic (1). Vertical walls, defined as seabed structures >70 °, are common geological structures associated with the steep submarine morphology of island slopes and seamounts in the Azores (2). They have been recognized as important areas of increased biodiversity, namely cold-water corals (3,4), but have been seldom studied.

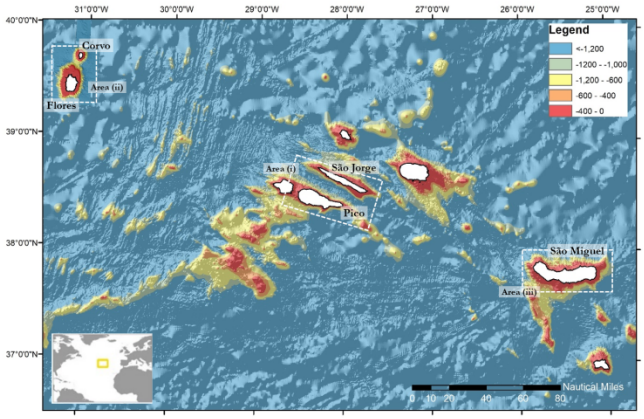

Fig. 1 Targeted geographical areas to be explored within the Azores

The primary target areas to explore are the South of Pico and São Jorge Islands (Figure 1) in the central group of islands (Area 1), where the existence of communities of interest in vertical walls has been identified. Additional areas will target the island slopes of Flores and Corvo in the western group of islands (Area 2) and S. Miguel in the eastern group (Area 3).

Brief Summary of Current State of Knowledge

The heterogeneous and abrupt topography of vertical walls provides hard substrate for attachment of sessile species and creates complex hydrodynamic patterns (3), enhancing food availability for filter and suspension feeders such as bivalves, cold-water corals and sponges. These particular conditions have been hypothesized as responsible for their diverse communities some that may be unique, displaying not only singular species composition, such as large and long-lived bivalves and cold-water corals (1,4), but also specific life strategies (e.g. dispersal and reproductive strategies, and morphological accommodations). Furthermore, the natural refuge they can offer to anthropogenic impacts (e.g. fishing) may facilitate the persistence of vulnerable species at regional scales by providing habitat and larval sources to areas impacted by human activities elsewhere. Past studies have shown the occurrence of a unique 'living-fossil community' formed by a long-lived deep-sea oyster and a cyrtocrinid in vertical walls of the Faial Channel (5). More recent submersible expeditions by the Blue Azores deep-sea explorations around the Azores led

by Telmo Morato and Marina Carreiro-Silva have found pristine cold-water coral communities associated with vertical walls around São Jorge and Pico Islands, not commonly found elsewhere in the region (Figure 1), such as tall black coral forests of the millenia-lived *Leiopathes* sp (6). The seemingly occurrence of these unique and fragile communities suggests the existence of vulnerable marine ecosystems (VMEs) of high biological and conservation importance on such vertical structures. These areas may constitute some of the last pristine areas of century to millennia old deep-sea communities documented in historical records but that are hardly encountered in present times.

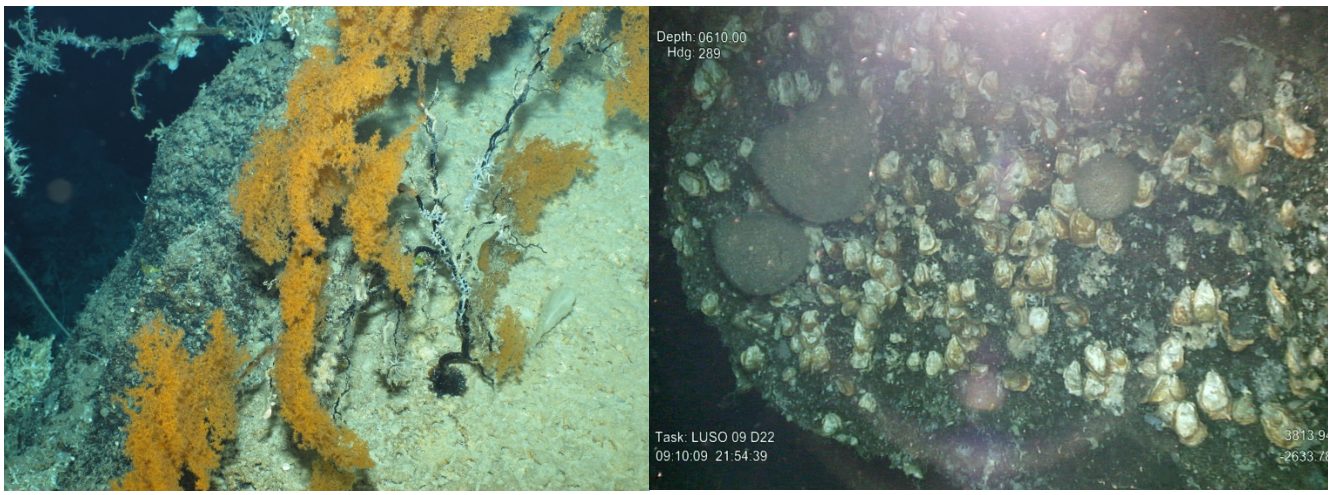

Fig 2. Examples of fauna associated with vertical walls (1) large black coral *Leiopathes* sp.; (2) deep-sea oyster *Neopycnodonte zibrowii*.

Rationale for Future Exploration

The proposed explorations in the Azores aim to (i) characterize and map the distribution of megafaunal communities associated with vertical walls in terms of species composition, diversity, abundance and size structure and to (ii) determine if these communities can be used as ecosystem reference sites to assess their good environmental status (GES). The results of this explorations will also contribute to identify the geomorphological and small-scale oceanographic variables that explain horizontal and vertical variation in ecological characteristics (such as abundance, number of species observed and diversity) of mega-benthic invertebrates and habitats in the deep-sea. Furthermore, it will greatly contribute to establish ecosystem approach and adaptive management frameworks by identifying areas that may constitute ecosystem reference sites to assess GES. Many ecosystems have experienced a long history of exploitation (e.g. fisheries) making it difficult, if not impossible, to know what the reference (a.k.a. baseline) conditions were. Vertical walls may thus constitute one of the few areas where pristine ecosystems may be found.

On each sampling location we suggest to collect multibeam data for mapping and ROV dive planning, ROV transects from the bottom to the top of the wall for a general characterization of the communities, with a subsequent fine-scale mapping based on video mosaicking construction on selected parts of the walls Water masses properties could also be characterized by sampling seawater and measuring physical-chemical parameters.

RELEVANT PARTNERSHIPS

This white paper is presented under IMAR plans for an improved mapping of vulnerable deep-sea benthic communities in the Azores. This line of research has been developed under relevant partnerships with H2020 international research project ATLAS, SPONGES and MERCES, and Azores funded research projects MapGES. Exploration of the areas proposed here may contribute to the Atlantic project currently submitted to the H2020 program. This white paper was also developed in close collaboration with papers being developed in the context of ATLAS and SPONGES projects and to Deep Ocean Observing Strategy (DOOS) initiative to integrate physical, biogeochemical, and biological/ecosystem-based investigations.

References: [1] Braga-Henriques et al. (2013) Biogeo. Disc. 10; 529–590; [2] Omira et al. (2016) Plate Boundaries and Natural Hazards 219: 271-287; [3] Huvenne et al. (2011) PloS one, 6(12): e28755; [4] Robert et al. (2015) Mar. Ecol 36: 1256-1276; [5] Puig et al. (2014) Ann. Rev Mar Sci 6: 5.1–5.25; [6] Wisshak, et al (2009) Palaeogeol, Palaeoclim, Palaeoecol, 271(1-2), pp.77-83; [7] Carreiro-Silva et al (2013). Mar Ecol Progr Ser, 473, pp.189-199.