Deep-Sea Research II 57 (2010) 431–440

Contents lists available at ScienceDirect

Deep-Sea Research II

journal homepage: www.elsevier.com/locate/dsr2

Deep-sea survey for the detection of methane at the "Santa Maria di Leuca" cold-water coral mounds (Ionian Sea, South Italy)

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ARTICLE INFO

Available online 31 August 2009

Keywords:
Methane
Corals
Seepage
Marine geology

ABSTRACT

The "Santa Maria di Leuca" Cold-Water Coral (CWC) province (northern Ionian Sea) was investigated for the first time to detect eventual occurrence of methane anomalies as a possible indication of hydrocarbon seepage stimulating the coral growth. Most coral mounds have developed in correspondence with tectonic scarps and faults, orthogonal to the southern margin and trending NW-SE, which could be potential sites of gas escape. A visual and instrumental inspection was performed by using a new deep-sea probe equipped with video-cameras, sonar, CTD, methane sensors, and a water sampler. Eight areas were explored by 10 surveys, depths ranging from 380 to 1100 m, for a total of more than 26 h of continuous video and instrumental recording. Sediments were also sampled by gravity corers and analysed in laboratory.

The images allowed to assess distribution, abundance and geometry of the colonies, most of which are developed on morphological highs often characterised by tectonic scarps. All data indicate however the lack of a significant occurrence of methane, both in seawater and sediments. No direct or indirect expressions of gas seepage were recognised on the seabed. Weak methane anomalies were detected only in seawater at the base of some fault-linked scarps, where more reducing conditions and bacterial methanogenesis are possibly enhanced by less water circulation. The faults are not fluid-bearing as previously suggested by high-resolution geophysical signatures. The development of the coral colonies thus cannot be attributed to seeping fluids, but to a favourable physiographic position with exposure to nutrient-rich currents.

1. Introduction

The occurrence of deep-sea Cold-Water Corals (CWC) is generally linked to the migration and concentration of nutrients carried by oceanic currents (e.g., Freiwald, 2002). It also has been reported that, in hydrocarbon-prone basins, coral banks can develop in correspondence with methane seeps, representing a local source of nutrients (Hovland and Risk, 2003; Hovland, 2005).

CWC are often found on sea-floor elevations called carbonate mounds (Freiwald, 2002). On and around these structures there is often a complex interaction of geological, biological and hydro-geological processes (Kenyon et al., 2003; Huvenne et al., 2005; De Mol et al., 2007; Wheeler et al., 2007).

The "Santa Maria di Leuca" (SML) CWC province (Apulian Plateau, Ionian Sea–Fig. 1) hosts living coral colonies of *Madrepora oculata* and *Lophelia pertusa,* within different geomorphological settings (Savini and Corselli, 2010), and their growth is considered to be stimulated only by oceanographic currents (Taviani et al., 2005). Previous seismic surveys showed that the offshore Apulian Plateau is characterised by important tectonic dislocations (Auroux et al., 1983, 1985; Merlini et al., 2000; Fusi et al., 2006; Fig. 1). The Apulian margin belongs to the Apulian swell, a NW–SE trending narrow ridge of continental crust, running from central Italy to offshore Greece, which represents the foreland for both the Calabrian and the Hellenic Arc. The Apulian swell is a large anticline that involves about 100 km of lithosphere (Ricchetti and Mongelli, 1980) and is segmented by several parallel normal faults. In its western sector, a system of regularly spaced conjugate normal faults (WNW-ESE oriented) with intervals of 1–2 km and with seafloor displacements of up to 200–300 m (Merlini et al., 2000). These active or subrecent faults might have determined also the high seismicity recognised in the Puglia-Salento region and the adjacent offshore area (Argnani et al., 2001).

The seismic data available in the literature (Auroux et al., 1985; Argnani et al., 2001) were combined with the geomorphological data and with high-resolution seismic-stratigraphic data acquired during the first oceanographic cruise of the APLABES project (Savini and Corselli, 2010), allowing to recognise the close correspondence of the mounds hosting living corals with the fault lines. Since fault planes are often main hydrocarbon

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doi:10.1016/j.dsr2.2009.08.020