

***Interactive comment on* “Cold-water corals and hydrocarbon-rich seepage in the Pompeia Province (Gulf of Cádiz) – living on the edge” by Blanca Rincón-Tomás et al.**

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Authors response to Referee n° 2

We are thankful for your constructive feedback and the helpful comments. We have considered and addressed your suggestions carefully, and almost all have been followed in the revised manuscript.

Detail Comments from Referee n° 2

1) Line 1. Title. The text after the hyphen: ‘living on the edge’ is unnecessary and adds nothing to the title. What edge? I suggest removing this.

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Response: we would like to keep the text “living on the edge” to emphasize that hydrocarbon-rich seepage has both advantages and disadvantages for cold-water corals growth.

2) Lines 26-27. Abstract Delta C13 values of the coral skeletons (see below)

Response: see discussion on reviewer comment n° 19 below.

3) Line 31. Abstract. Suggest ‘seeping’ rather than ‘seeped’ fluids.

Response: done.

4) Line 61. Suggest ‘In addition’ to replace ‘On the other hand’, as this is not a contrasting observation.

Response: done.

5) Line 76. ‘Englobes’ is not an English word. Seems like a transliteration of ‘encompasses’.

Response: done.

6) Line 128. Don’t start sentence with a number – spell it out.

Response: done.

7) Line 152. Can the authors give a little more detail of the nature of the samples used for the DNA work. Are these MDACs?

Response: done. We now provide more information on the nature of the samples (lines 155–158 in the revised manuscript).

8) Lines 192-195. The background information about the Gulf of Cadiz isn’t really results and would go better at the start of section 2.

Response: we agree that the background information of the Gulf of Cádiz is not part of results. However, the Pompeia Province region, which our study is focused on, has

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not been described in detail so far. We here provide the first description of geological structures in this area (Southern and Northern Pompeia Coral ridges, Cold-water Coral Mounds Fields), including novel data (e.g., bathymetry, seismics). For this reason, we consider it appropriate to report these findings in the results sections.

9) Line 241 and other places. It's quite difficult at the moment to correlate the isotopic data in Table 2 with the sample points in Figure 7, because the specimen images in Figure 7 are not quite large enough to distinguish samples of authigenic carbonates from embedded coral skeletons. Therefore, could the authors add a column into Table 2 that makes it clear what the samples are for each of the isotopic data points, e.g. authigenic carbonate or coral skeleton.

Response: done. One more column has been added in Table 2 as proposed, indicating the type of samples from which stable isotopic analyses are.

10) Line 253. Replace 'stems' with 'comes'.

Response: done.

11) Line 254. In the figure the 'worms' look like serpulid worm tubes. Is this so? In which case please add this information.

Response: done.

12) Line 291. Replace 'On the contrary' with 'In contrast'.

Response: done.

13) Line 296. Spell out '2D' at start of sentence.

Response: done.

14) Line 305 and elsewhere. What is 'dripping-like' seepage? This isn't a description I recognize, so it would be helpful if the authors specify what this means.

Response: done. "Dripping-like refers to intermittent bubbling fluids" (lines 308–309 in

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the revised manuscript).

15) Line 317. Suggest 'data', rather than 'evidences'.

Response: done.

16) Line 330. I'm unclear where is being referred to here.

Response: removed.

17) Line 332. 'appear', not 'appears', as preceding diapiers is plural.

Response: done.

18) Line 339. Typo. Angle not angel.

Response: done.

19) Lines 346-354. The authors here suggest that the seawater-like values of the delta C13 from the dead scleractinian skeletons and those embedded in the MDAC show that the corals do not use methane as a food source, either directly or through symbionts. The authors need to be careful here, because some seep organisms that demonstrably do use methane (and sulfide) from seep fluids for food via endosymbionts produce carbonate skeletons that also have seawater-like delta C13 signatures. I am referring here to vesicomid and bathymodiolin bivalves, that sequester seawater bi-carbonate ions to produce their shells. Using this model, having seawater-like delta C13 values in the coral skeletons does not prove that these animals do not use chemosynthetic food sources at the site. Really, to be able to settle this conclusively, authors would have to do isotopic, histological and DNA work on living corals from their site, not just on skeletal material and MDAC. In addition, it would be worth noting that scleractinian corals are found embedded in ancient seep carbonates too (see Goedert and Peckmann 2005); there may be some useful comparative isotopic data in that paper.

Response: We included the paper by Goedert and Peckmann, 2005. We fully agree that analyses of coral tissues ($\delta^{13}\text{C}$, DNA) would add important information on their nu-

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trition and metabolic relationships. However, we still regard $\delta^{13}\text{C}$ values of their skeletons as valuable proxy for the possible uptake of CH_4 . Corals utilize HCO_3^- deriving from both the environment and the internal production of CO_2 for skeleton biomineralization (Swart, 1983; Zoccola et al., 2015; Nakamura et al., 2018). Therefore, if they uptake CH_4 as a carbon source, the CO_2 produced from CH_4 metabolism would be used, and consequently parts of the HCO_3^- utilized for biomineralization would be isotopically depleted. This “mixing effect” would result in at least partially depleted $\delta^{13}\text{C}$ values of the skeletons, similar to some chemosynthetic vesicomid and lucinid bivalves (Hein et al., 2006). The skeletons of the corals analyzed herein, however, exhibit significantly higher $\delta^{13}\text{C}$ values than the co-occurring AOM-derived carbonates. Thus, they are not indicative for CH_4 as important carbon source.

20) Lines 364-367. The entombment of coral skeletons by MDAC may have no consequence to corals, if they are already dead. It's not entirely clear from the text if the corals associated with the MDAC are dead or alive. If they are alive then this argument is stronger. Also, in most seep environments MDACs form in the subsurface where AOM reactions are occurring. Is this the case at this site? What proof is there of active MDAC formation at the sediment-water interface, as indicated in Figure 12? This is pertinent to the arguments in section 4.3.

Response: We cannot determine if the scleractinian corals embedded in AOM-derived carbonates (samples D10-R3 and D11-R8) were alive or dead when they were buried. However, we observed living corals in areas that are currently affected by seepage (e.g. the Northern Pompeia Coral Ridge, lines 235–236 in the revised manuscript; Fig. 6, C). Furthermore, we observed living octocorals growing on surfaces of currently formed AOM-derived carbonates (e.g., in an active pockmark in the Al Gacel MV, sample D10-R7; Fig. 5, C). These observations imply that corals in these regions are directly affected by methane seepage and the microbially mediated formation of carbonates due to AOM.

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