**Review EGUSPHERE manuscript 2023-941**

**Title:** Building your own mountain: The effects, limits, and drawbacks of cold-water coral ecosystem engineering

**Author:** Anna-Selma van der Kaaden et al.

**General remarks:**

The manuscript went already through a review process with suggested major revisions and the present revised version improved a lot. However, I still have some concerns, which I would like the authors to consider:

- I think the authors should better differentiate between short and long-term processes in their discussion, please see detailed comment for lines 388–398;
- The authors could better discuss the relationship of mound height to increasing hydrodynamic variables (see more detailed comment to Lines 181 and 281 below). I miss the discussion on mounds reaching a maximum height at the boundary (perm. thermocline, water mass, density) and their behavior/control at the maximum height, or mounds occurring at much shallower water depths (e.g., Norway);
- Figures and tables could be improved, see comment to Fig. 1, Table 1, Lines 214 and following, Fig. 4 and Fig. 8 below;

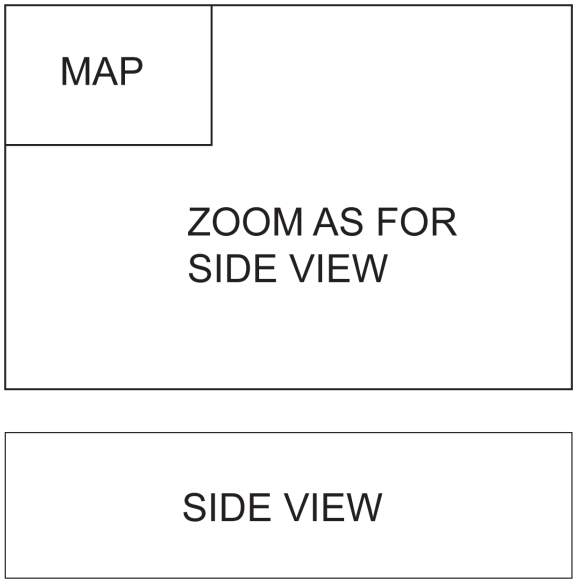
In the end, I suggest moderate revisions to address these points, but also to publish this article after revisions, as the data and conclusions bring some new aspects to the general discussion of coral carbonate mounds and environmental drivers.

I hope, these comments help the authors to improve their manuscript.
Kind regrads.

**Detailed remarks:**

Line 56: …develop into mounds, where coral growth and sediment infill… add a “comma” and “where”, otherwise the sentence does not make sense.

Fig. 1: The color coding for the transects are not well chosen as they are hardly to be identified. Wouldn’t it be better to simply use black and white including numbers? The authors could also zoom into the area as for the side view – then the transects are larger and better visible (see sketch to the right).



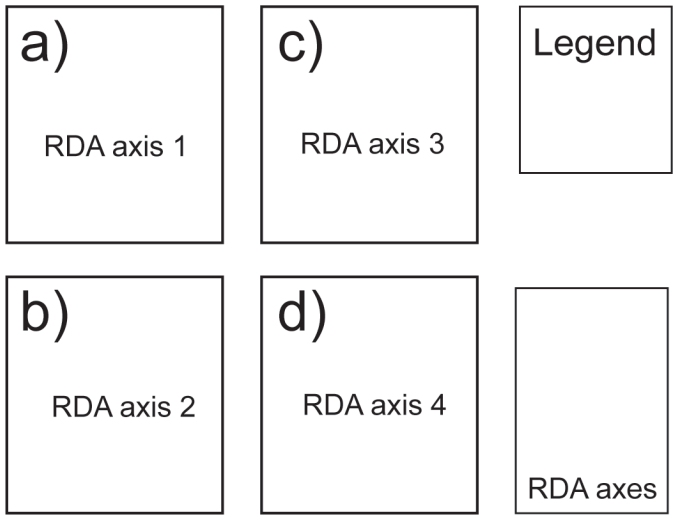

Line 140: space between 140 and m

Table 1: To better structure the table and compare the data, I would recommend to add columns to min, mean, max values instead of separation by comma. For downward velocities, numbers are in opposite order (max, mean, min).
Furthermore, the authors present the hydrodynamic variables for the “mound-and-corals setting” only – however, it would be helpful for the reader to compare the data with the “no-mound setting” of the smoothed seafloor – even, if they had been published earlier. For example, in Lines 176-179, the authors mention “We calculated the coral mound engineering effect by subtracting … (hydrodynamic variables) … of the simulation with smoothed bathymetry (…) from simulations with unmodified bathymetry (…).” or in the caption of Fig.6 – it would be helpful showing these data to better grasp the difference and the impact CWC reefs and mounds do have.

Line 180-181: quite confusing sentence – better rephrase.

Line 181: “hydrodynamic variables will increase if mound height increases” – this is a positive feedback mechanism – just for curiosity, do there also exist negative feedback mechanisms?
What about the situation, if mound height reaches the level of deep thermocline or water mass boundaries or change in density level – then the mounds would grow more towards the sides then further increasing the height of the mounds. In this situation, the mound height would also limit the engineering effect and influence the environmental factors supportive for the corals. It would be nice to see a discussion on this issue as well.

From Line 214 onwards you describe data of RDA Axes 3 and 4, which are not shown. I would recommend to show these data as well in Fig. 4, which could be arranged like this sketch (or put a) and B9 on top and c) and d) at the bottom):




Or dependent on the proportion explained by RDA axis, skip axes 4 and 5 (also in the description, as both have values below 1%) and only show axes 1–3 (also in the figure 4).

Fig. 7: in a) y-axis: add space between “Absolute” and “bigdelta”

Lines 281–283 (and in general): This conclusion may be true for the investigated Logachev mound province. However, mounds which have reached the permanent thermocline/water mass boundary/density gradient like the upper Belgica Mound chain in the Porcupine Seabight may not provide this supportive, engineering conditions to positively affect coral/mound growth. Here and elsewhere like the Norwegian reefs, the mound height may not directly affect the coral reef growth as at the (bigger) Logachev mounds. I would recommend to tone done conclusion and/or link them to the study site instead of too much generalization.

Line 326: add space between 600 and m

Line 351: replace the second “3)” with “5)”

Line 354–356: there exist earlier studies and from different disciplines showing this pattern of coral settlement and sedimentary facies on carbonate mounds, for example:

Freiwald, A., Hühnerbach, V., Lindberg, B., Wilson, J. B., and Campbell, J., 2002, The Sula Reef Complex, Norwegian Shelf: Facies, v. 47, p. 179–200.

Foubert, A., Beck, T., Wheeler, A. J., Opderbecke, J., Grehan, A., Klages, M., Thiede, J., Henriet, J.-P., and The Polarstern ARK-XIX/3A Shipboard Party, 2005, New view of the Belgica Mounds, Porcupine Seabight, NE Atlantic: preliminary results from the Polarstern ARK-XIX/3a ROV cruise, in: Freiwald, A., and Roberts, J. M. (eds.), Cold-Water Corals and Ecosystems: Springer-Verlag, Berlin, p. 403–415.

Dorschel, B., Hebbeln, D., Rüggeberg, A., And Dullo, C., 2007, Carbonate budget of a deep water coral mound: Propeller Mound, Porcupine Seabight: International Journal of Earth Sciences, v. 96, p. 73–83.

Mortensen, P. B., Hovland, M. T., Fossa, J. H., and Furevik, D. M., 2001, Distribution, abundance and size of Lophelia pertusa coral-reefs in mid-Norway in relation to seabed characteristics: Journal of the Marine Biological Association of the UK, v. 81, p. 581–597.

Wheeler, A. J., Kozachenko, M., Henry, L.-A. Foubert, A., De Haas, H., Huvenne, V. A. I., Masson, D. G., and Olu, K., 2011a, The Moira Mounds, small cold-water coral banks in the Porcupine Seabight, NE Atlantic: Part A—an early stage growth phase for future coral carbonate mounds?: Marine Geology, v. 282, p. 53–64.

Foubert, A., Huvenne, V.A.I., Wheeler, A., Kozachenko, M., Opderbecke, J., Henriet, J.P., 2011. The Moira Mounds, small cold-water coral mounds in the Porcupine Seabight, NE Atlantic: Part B - Evaluating the impact of sediment dynamics through high-re- solution ROV-borne bathymetric mapping. Mar. Geol. 282 (1–2), 65–78.

An overview:

Vertino, A., Spezzaferri, S., Rüggeberg, A., Stalder, C., Wheeler, A., and the EUROFLEETS CWC-MOIRA Cruise Scientific Party (2015) An overview on cold-water coral ecosystems and facies. Cushman Foundation Special Publication No. 44, p. 12–19.

Line 378–380 and line 384: here you should refer to mountain instead of mound. It should read: “These zones vary with relative altitude on the mountain, but not with the absolute height above the ground, because of feedbacks between the size of the mountain and the environment (…)” and “…feedbacks between the mountain and the environment, …”.

Lines 388–390: I think that the authors make it a bit too simple. They should clearly differentiate between the short-term processes related to different times with long-term processes. For example, the deep winter mixing occurs during February, which correlates with the higher downward velocities (indicate in Fig. 8 the timing of the processes, especially in 8b Side view – here it looks like all processes happens at once), while the upward velocities occur during August supporting the nutrient upwelling.
The latter was also reported by Findlay et al. (2014) but only to the depths of the coral mounds. Soetart et al. (2016) then shows that the upwelling occurs also to shallow areas, but together with the February downwelling they are clearly tidally influence with strong velocities (interesting for the engineering process) during spring tides only.
In Lines 393–398 the upwelling processes are related to nutrients transported to the sea surface, where strictly speaking the reference to Findlay et al. (2014) is not supporting this. Further in the text, the authors compare that the primary productivity is stimulated by these upward water motion bringing nutrients to the surface with processes on millennial time scales (glacial-interglacial) and refer to Eisele et al. (2011), which compare coral age data with TOC mass accumulation data from a close-by ODP core offshore Mauritania indicating a possible relationship at millennial time scales, or to Wienberg et al. (2020) and (2022), which do not present any nutrient- or primary productivity-related data to compare (2020), or they compare the western Mediterranean Sea coral mound record with an eastern Mediterranean ODP core showing Monsoon-related variability of Nile river discharge (far away from the coral site) for the former study (2022). I would recommend clear separation of processes on short- and long-term and discuss it properly.