We thank the anonymous reviewer for their constructive comments and thorough review of this manuscript. Below are the reviewer's comments and author responses in blue italics.

Stable isotope measurements (d18O and d13C) from deep-sea corals provide valuable paleotemperature reconstructions through the water column at all latitudes (unlike shallow-water corals, geographically constrained). Yet, deep-sea scleractinian and bamboo corals have shown complications derived from "vital effects" that deviate the environmental signal in the isotopic records. A new coral taxon (Stylasteridae) has been considered as an alternative archive, as "vital effects" in these specimens have been reported to be lower than those in other deep-sea coral taxa. This study, however, shows that "vital effects" and their impact on the skeletal isotopic composition of stylasterid corals might not be as straightforward as previous studies have shown.

This study carries out fine stable isotopic (d18O and d13C) mapping on several cross-sections of two specimens of Errina fissurata. Results show that sections closer to the growing tip of the colony present more depleted d18O and d13C than sections further down the branch. Equally, those samples located near the centre of each cross-section (branch) showed values that were closer to equilibrium than those samples from the outer areas of the cross-section. Importantly, these results contradict observations from previous papers. The authors present a growth model where an initial skeletal framework form the main structure of the branch (quick biomineralization) followed by slow mineralization of the inner sections for structural strength and argue that this is the source of isotopic differentiation across all cross-sections. This work points towards the need of a deep understanding of the growth mechanisms of Stylasterid corals (or Errina sp. in particular) in order to obtain more precise paleoreconstructions and introduces an strategy (isotopic mapping) to locate the skeletal area closest to equilibrium, and therefore the areas to sub-sample for the aforementioned reconstructions.

This is an interesting piece of work that deepens our knowledge of a newly explored paleo archive (Stylasterid corals), focuses on the need for further research regarding skeletal growth and geochemical composition and presents new information on the stable isotopic composition of skeletal material. The data presented by this manuscript is of importance for communities in the fields of paleoclimate, and marine biomineralization and calcification and as such, it should be published. However, a more thorough discussion, including data from previous publications and expanding on concepts like the role of mineralogy on the reported results should be considered and included. See below for some points that can improve the strength of the manuscript.
We noticed similar themes between both reviewers (e.g., incorporation of coral mineralogy, clarification of methods, and incorporation of previously published data) and agree that these areas need the most attention during our revisions.

1. Introduction

A more extensive literature review on stylasterid corals, and more specifically previous geochemical publications of this taxon and its positive results for reconstructions, would help making a stronger case on why keep focusing efforts on these specimens. This can be included either towards the end of the third paragraph or in the fourth.
We agree and will add this section.

2. Methods

L. 96: It is unclear from which specific dredging the two samples come from, or whether dredging D05 to D09 was done consecutively and there is no possible way to know the exact depth of the sample. This needs to be specified.
Yes, as written, it is not clear. The dredges were consecutive, but it is unclear to us where exactly the corals were collected (from dredge D05, D06, D07, D08, or D09). This is because we performed the geochemical analyses after receiving the corals from a now deceased collaborator and we have not been able to locate sample collection information recorded during that cruise. We will clarify the methods.

3. Results

A table in results summarising average d18O and d13C from each sample (or section as described by the text) coupled to the average environmental data used for both samples (Temperature, d18Osw and d13Csw) would help the reader to quickly grasp variability (or lack of) of the data between samples and the environmental conditions. I might be wrong, but I think seawater temperature is not specified before Figure 9 (the very end of the MS) and would help contextualise the environment and the discussion later on when comparing with work in the literature if included in the results.
We agree that adding a table would be an easy way for potential readers to make those comparisons and will include one. The data are compiled in the supplemental information, but we will provide averages as suggested by the reviewer. This reviewer is also correct in that the seawater temperature is not mentioned before Figure 9 and we will be sure to include that in the section about sample collection as well.

4. Discussion

4.1. Isotopic disequilibrium

This is a nice section that sets the argument for consecutive discussion on growth models and paleo reconstructions. However, I feel that a deeper comparison of the data of this manuscript with published d18O and d13C from stylasterid corals needs to be addressed (beyond the minimum offsets from equilibrium and d13C–d18O slopes). Samples here show a wider range of both d18O and d13C than those in Samperiz et al. (2020) and Wisshak et al. (2009) for aragonitic specimens. Importantly, the d13C here reach levels similar to those of calcitic samples. Whether this is an effect of much finer sampling, mixed mineralogy, or other potential artifacts, it needs to be discussed more deeply in this section.
We agree and will be enhancing the discussion section as per this reviewer's and the first reviewer's comments. We plan to include previously published data (from both Samperiz et al. (2020) and Wisshak et al. (2009)) into Figure 4 and Figure 5. In addition to this we will be incorporating a discussion on mineralogy as well.

L. 205: What is the lifespan of stylasterid corals? This information can be added either here or in the introduction. For reference, observed axial growth rates from King et al. (2018), Miller et al. (2004), and/or Wisshak et al. (2009) would extrapolate to lifespans of >100yr (and up to 400yr) for Errina sp. colonies. Despite this method presenting several caveats, it is useful for the reader to understand that these colonies can be long-lived.
We agree and will add that information.

L. 225: Maybe I misunderstood. 0.68‰ and 3.95‰ are offset values from calcite or aragonite equilibrium? It doesn't change the observation but would be good to specify. Especially since the comparisons with other data (Samperiz et al. (2020) and Wisshak et al. (2009)) are made for aragonite equilibrium, and they show that calcitic samples show a larger offset from equilibrium for d13C.
The offset values are from calcite equilibrium. We agree that this should be clarified and will adjust the text to be sure the proper comparisons are made.

L.226: The minimum offset from Samperiz et al. (2020) is from bulk sampling or cross-section analysis within one specimen (similar to this study?). Worth being specific here.
These values were compared to the cross-section analysis, but we will specify.

L. 231: Authors comment that they have evidence for mixed mineralogy of these specimens. What is this evidence? This needs to be expanded. Work by Samperiz et al. (2020) and Stewart et al. (2020, 2022) have shown how sample mineralogy have a great impact on elemental and isotopic composition. This sentence is the only mention to mineralogy in the manuscript; however, it is known how sample mineralogy is one of the main caveats to the use of stylasterid specimens. A more thorough discussion needs to be included on the potential effects of mineralogy on these results, especially if mixed CaCO3 polymorphs have been observed. This is an interesting point that needs to be considered and will enrich the manuscript.
We completely agree here. We have some mineralogical data, but it was not generated from the specimens that were analyzed for stable isotopes, so it was excluded. However, the samples analyzed for mineralogy were from the same cruise and dredge(s). After reading these comments, and similar comments from another reviewer, we feel comfortable including the data we have. We will edit the discussion to include the mineralogical data and discuss how that affects stable isotopes. We do have evidence for a mineralogical change in percentage of calcite-to-aragonite from the outer portion to the center. In adding to the discussion, we are going to include an additional author, Dr. Noel P. James (Queen's University), who conducted these analyses. We have also done some preliminary calculations based on the small change in percent calcite-to-aragonite by region (~3% more aragonite in the interior compared to outer samples of coral slices). This change in mineralogy could only explain the isotope values we observe if the oxygen isotope ratio of the new calcite was ~-32.5‰. This seems unrealistic. Therefore, with the caveat that the mineralogical data are from a different specimen, we will discuss that mineralogy is an important consideration, however, not the main forcing of the trends we observe. Only a small amount more of new calcite would have to be precipitated to bring isotope values to within our observed skeletal variability, but such proportions would not be parsimonious with our mineralogic data.

4.2. Isotopic trends and calcification models

I enjoyed reading through this section. It is clear that new research needs to be directed towards modelling of stylasterid growth to clarify vital effects patterns. The addition of a simplified model with three scenarios (regular growth, ontogenic decrease and increase of radial growth) is helpful for the reader.
Thank you!

L. 256: The authors use published radial growth rates from Bamboo corals in their models, justified by the lack of data on growth rates from Errina sp. (or even any Stylasteridae coral). Assuming the authors still have access to the samples dated in King et al. 2018, would it be possible to roughly extrapolate radial growth across two dated points within a branch and differences in diameter? This data, although rough, could shed light on whether growth rates of Stylasteridae are similar to those employed here.

This information, coupled to lifespan of the colonies (see above, L. 205) will be useful and interesting for future research.
This is a great suggestion to get a radial growth rate for these corals. We will include a calculation of radial growth based on the distance between radiocarbon dates and the radius of the branch.

L. 274-275 "…as the available literature supports slowing growth with time.": Can you specify the literature (add references)? Is this referring to Stylasteridae or marine calcifiers in general?
Yes, we will add those references. The statement was referring to marine calcifiers in general.

L. 300 and below: Building the growth of Errina sp. on growth models from scleractinian corals (or Acroporids) can be problematic. Scleractinians have shown to calcify from centres of calcification/amorphous crystals/ fusiform crystals, from where aragonite needle-like bundles grow (e.g., Gladfeiter 1982). In Scleractinia, these calcification areas show distinct isotopic signature (e.g., Adkins et al. 2003). However, these centres of calcification or growth framework has not been observed in Stylasteridae corals and therefore is hard to argue they are the cause for isotopic differentiation.
Whereas the calcification described by Adkins et al. (2003) applies to the solitary coral Desmophyllum cristagalli, the calcification described by Gladfelter (1982) is for a branching scleractinian coral. From our understanding, the centers of calcification in the D. cristagalli are different from those of the A. cervicornus. We don't argue that there is the exact same calcification mechanisms, only that there is a change in calcification rate: faster near the outer edges and slower near the center. We can adjust the wording to be clearer in this section.

Wisshak et al. (2009) discussed skeletal architecture and skeletal reorganisation and it is an important source to cite and consider when studying structural growth of Errina sp. This work needs to be included in this section. Wisshak et al. (2009) explain structural growth of Errina dabneyi based on a 2-step model also, with the coenosarc canal network in the middle area of branches being simultaneously dissolved (wider-canals) and infilled (secondary precipitation) as the skeleton thickens. Although several questions remain on the nature of this secondary material, this growth model needs to be considered in this section of the discussion.
We agree and will incorporate this into the section.

Is there imaging showing the two-step infilling process described in this manuscript? SEM images similar to those in Figure 6 from Wisshak et al. (2009) would be helpful to discern the two-step growth. Maybe observations made during the SEM analysis. But white-light images could be useful too. Wisshak et al. (2009) describe how ampullae are more common in the outer layers, while old ampullae towards the centres of branches could be seen infilled. By the pictures of Figure 3 it would seem like that is the case (no ampullae in the inner sections), but a closer inspection could be beneficial. Just a few sentences signalling whether any of the observations made by Wisshak et al. (2009) are visible on these specimens (or not at all) will be valuable information contributing to the understanding of Errina fissurata growth.
We agree with this too and have made arrangements to take some SEM images looking for such features. There are a few coral slices that appear to have more ampullae in the outer layers, but we will take more comprehensive images and incorporate these results into the updated manuscript.

L. 304 "We posit that this model accurately described the stylasterid coral growth…". Disagree. This growth (outer framework and later infilling of the centre) does not explain observations by Samperiz et al. (2020) and Wisshak et al. (2009), therefore stylasterid coral growth is still largely unknown (L. 311).

We will reword this section to clarify that we posit the growth model could apply to the specimens in this study specifically.

An expanded discussion of sample mineralogy (as specified above, L. 231) coupled to the two-step growth model will be beneficial in here (as a paragraph or a new section within the discussion by itself). While Samperiz et al. (2020) and Wisshak et al. (2009) confirm their Errina antarctica and Errina dabneyi samples are 100% aragonite, authors hint at a mixed mineralogy here. I appreciate mineralogical mapping (e.g., Raman) or even bulk XRD might not be possible for these specimens of Errina fissurata in this manuscript. However, the possibility of the centre infilling to be mineralogically distinct from the initial framework needs to be considered as a source of discrepancies between results in this study and others published, gaining a more thorough discussion on the growth of Errina sp. Both Samperiz et al. (2020) and Stewart et al. (2020 and 2022) noted geochemical differences among calcitic and aragonitic Stylasteridae.
We agree. As mentioned above, we have mineralogical data that we will incorporate. This consists of some XRD measurements in the center and outer region of the corals. We will include these data and expand the discussion to include the mineralogy and SEM discussions. See replies for L. 231 above for more details.

4.3. Considerations for paleoceanographic reconstructions

L. 314: Please, specify that the white centre is the ideal region to sample for paleotemperature reconstructions "in the samples of this study". Other samples in the literature show the opposite behaviour, and therefore this cannot be extrapolated to every Errina sp. specimen. This might be species specific effect, or site-specific, or even specimen-specific.
Yes, we will do this. This comment echoes those from another reviewer on the common theme that we need to specify this study.

L. 338: "If finer-scale samples were informed with CT scanning methods…". Maybe I have missed it, but it is not clear to me what finer structures I should look for in the CT images to improve reconstructions. Is this denser or lighter skeleton because it would be an indication or more or less secondary infilling of the initial framework? A sentence here clarifying would be useful to guide future work.
The CT scanning methods could illuminate structures like growth rings that are invisible to the naked eye or microscope. Additionally, the density differences between calcite and aragonite could be determined spatially. We will mention this and discuss it within the context of the mineralogy work that will be incorporated into the updated manuscript.

L. 342: "We recommend sampling of the white centre using more spatially precise micro-milling methods…". As mentioned above, sampling the white centre would work for these specimens, but not for other published data. In addition, the white centre limits the application of this technique to specimens showing distinct coloration on its cross-section. As an example, the coenostum of Errina dabneyi sampled by Wisshak et al. (2009) was pure white, potentially not showing a distinct branch centre. I would be very precise specifying that this technique cannot be universally applied to every Errina sp. However, a fine spatial analysis on a cross-section will be useful to inform on isotopic distribution of new samples, regardless of skeletal coloration. In my opinion this is a very important point that this manuscript raises.
We agree and will improve the section so that we are very specific about applying this technique to this species of coral and our recommended sampling scheme is not universal.

L. 355: I would also suggest including literature of CT imaging of stylasterid corals (Stylaster sp.) showing skeletal structures (e.g., Puce et al. 2011). We know that these are structurally very different from Corallum sp., and it is not certain they follow the same growth pattern. Furthermore, skeletal structure seems to differ even between Stylasteridae genera. CT imaging will be very useful to discern growth patterns before reconstructing temperatures indeed.
Thank you for this recommendation, we will incorporate this into the discussion.

L. 356: would improve "and?" allow an even closer approach…
Great catch, we will fix this line.

5. Conclusions

L. 380: Please, change "we recommend sampling along the centre, white region where the infilling has allowed for calcification closest to seawater equilibrium…". In my opinion the evident recommendation emanating from this study is the need for spatial sampling to localise the skeletal region closest to equilibrium, in contrast to what was proposed for example in Samperiz et al. (2020) or Stewart et al. (2020) (i.e., bulk or surface sampling).
We agree and will adjust the text.

Figure 4: Add circles and squares for data from each specimen of this study (similar to Figure 5 and 9). This will help quickly localise differences across samples (or lack of thereof). Equally, including in this figure data from Samperiz et al. (2020) and Wisshak et al. (2009) would be beneficial to framework what is discussed in this section (i.e., the offset from equilibrium, differences in isotopic signal across literature sources and what might be caused by).
We agree and will add the data and make the adjustments to the figure.

Adkins JF, Boyle EA, Curry WB, Lutringer A (2003) Stable isotopes in deep-sea corals and a new mechanism for "vital effects." Geochim Cosmochim Acta 67:1129–1143

Gladfeiter EH (1982) Skeletal development in Acropora cervicornis: I. Patterns of calcium carbonate accretion in the axial corallite. Coral Reefs 1:45–51

Miller K, Mundy CN, Lindsay Chadderton W (2004) Ecological and genetic evidence of the vulnerability of shallow-water populations of the stylasterid hydrocoral Errina novaezelandiae in New Zealand's fiords. Aquat Conserv Mar Freshw Ecosyst 14:75–94

King TM, Rosenheim BE, Post AL, Gabris T, Burt T, Domack EW (2018) Large-Scale Intrusion of Circumpolar Deep Water on Antarctic Margin Recorded by Stylasterid Corals. Paleoceanogr Paleoclimatology 33:1306–1321

Puce S, Pica D, Mancini L, Brun F, Peverelli A, Bavestrello G (2011) Three-dimensional analysis of the canal network of an Indonesian Stylaster (Cnidaria, Hydrozoa, Stylasteridae) by means of X-ray computed microtomography. Zoomorphology 130:85–95

Samperiz A, Robinson LF, Stewart JA, Strawson I, Leng MJ, Rosenheim BE, Ciscato ER, Hendry KR, Santodomingo N (2020) Stylasterid corals: A new paleotemperature archive. Earth Planet Sci Lett 545:116407

Stewart JA, Robinson LF, Day RD, Strawson I, Burke A, Rae JWB, Spooner PT, Samperiz A, Etnoyer PJ, Williams B, Paytan A, Leng MJ, Häussermann V, Wickes LN, Bratt R, Pryer H (2020) Refining trace metal temperature proxies in cold-water scleractinian and stylasterid corals. Earth Planet Sci Lett 545:116412

Stewart JA, Strawson I, Kershaw J, Robinson LF (2022) Stylasterid corals build aragonite skeletons in undersaturated water despite low pH at the site of calcification. Sci Rep 12:13105