Response to Reviewer 2, Justin Ries

1. *These observations, in their own right, are worthy of publication. However, the authors' extrapolation of these results to solution of the 'dolomite problem' (i.e., Title: 'a biological solution to the geological dolomite problem')appear a bit overstated. My main concern with their extrapolation stems from the fact that dolomite is found in a wide range of fossils throughout the geologic record, including echinoids, receptaculitids, stromatoporoids, stromatolites, etc, not simply in the fossils of coralline red algae. Thus, invocation of a biological origin for the 'geological dolomite problem' would require that the authors demonstrate that each of these additional taxa also biomineralize dolomite. Although this may be the case, the authors would need to demonstrate this for additional taxa (and also for additional species of coralline red algae) in order to make this assertion with the force that they have in their present manuscript. Furthermore, kilometer-thick units of dolomite and interlaminated dolomite/calcite are widespread in Precambrian (and some Phanerozoic) bulk limestones around the world, and these formations appear to lack a biogenic origin. To claim that coralline algal biomineralization is responsible for these massive dolomite deposits, to which the 'dolomite problem' also pertains, is obviously problematic.*

Suggestion adopted. As both reviewers have interpreted our claim as being that coralline algae are responsible for dolomite formations beyond the reef environment (which was not our intention), we have edited the ms to clarify our claim. We are not suggesting all dolomite was formed by coralline algae but instead that the discovery of biologically induced dolomite in coralline algae shows that dolomitisation can be biological rather than an abiotic diagenetic process .

We have edited the ms, including the title, as follows.

Changed title

Dolomite and magnesite discovered in living tropical coralline algae: could there be a biological solution to the Dolomite Problem?

Abstract … 'biomineralization that can account for the massive formations seen in the geologic record' which refers to the previous sentence on fossil reefs. Changed to - …biomineralization that can account for the *fossil reef dolomite* formations seen in the geologic record.

Line 1, p 5886, added in …. that we limit our discussion to marine sedimentary dolomite, *particularly fossil coral algal reefs,….*

P5894 Conclusion has been edited to reduce the force of the claim.

Noting also the concerns of Reviewer 1 regarding our comparisons beyond the cretaceous, we have changed discussion at 4.2 'Applying results to interpret fossil dolomite formation' to limit the comparison using coralline algae to the Cenozoic and give other examples of biological dolomite, echinoderm and microbial to support our proposal for a biological driver.

2. *The manuscript would also benefit from a more rigorous statistical treatment of the data. The authors should state clearly in the text the number of specimens that were analyzed, from where they were obtained, how many analyses were made per specimen, and standard deviations for all repetitive measurements (hopefully there were some)-(* There were many). *Many of these factors could be calculated from data presented in the supplementary materials, but this should really be summarized in the main manuscript, preferably in the form of a table.* The methods section would benefit from a quantitative estimate *of the precision of the analytical approaches used (e.g., EDS, XRD, ICPAES, etc*),

Suggestion adopted.

Table with this information added to XRD results

Added to manuscript- SEM and ICP methods- precision of measurements for SEM is +/- 0.05 mol. %, ICP relative standard deviation is 0.2%. XRD methods- Precision of measurements was +/- 0.25 mol. %. Fifteen samples were analysed and 4 sub-samples. All samples were taken as a bulk slice down the sample.

3. *more detailed description of how %-abundances of calcite, aragonite, dolomite, and magnesite were determined, and how the XRD was calibrated for these analyses.*

Abundances of mineral phases were not included in the manuscript.

4. *Detailed information about the source of all specimens should also be provided, including geographical coordinates, water depth, and water temperature/salinity at time of collection. Specimen IDs should be decoded so that the reader knows if different IDs refer to different species, individuals, branches of an individual, etc.*

Suggestion adopted. Specimen decoding added to supp. I

Water depth and coordinates are already in the ms in the sample collection and preparation paragraph (line 11, p 5886).

Added to text in 2.1 sample collection and preparation – Temperature was 26.1 degrees and salinity 34.5‰ measured using an Orion hand held meter.

5. *And finally, one minor correction: the authors state that 'Dolomite formation is thought to control the history of Mg/Ca ratio in the ocean throughout the Phanerozoic (Holland,2005; Wilkinson and Algeo, 1989)'. However, other work suggests that the hydrothermal lalteration of oceanic crust also plays an important role in the evolution of seawater Mg/Ca ratios throughout Phanerozoic time (e.g., Hardie, 1996, Geology).There is a large body of literature, as well as strong empirical support, for this alternative/complementary hypothesis (for Review, see: Ries, J.B., 2010, Geological and experimental evidence for secular variation in seawater Mg/Ca (calcite-aragonite seas)and its effects on marine biological calcification. Biogeosciences 7: 2795–2849)*

Suggestion adopted.

We recognise the role of hydrothermal alternation, however the referenced papers demonstrated that the role of dolomitisation in controlling the Mg:Ca ratio is likely greater than that of hydrothermal alteration.

Manuscript edited to include role of hydrothermal alteration

6. *Overall, the authors' discovery that coralline red algae biomineralize magnesite and protodolomite are key observations with important implications for the fields of carbonate sedimentology, paleoceanography, and biomineralization. The extrapolation of these results to 'solution of the dolomite problem' are not needed to justify publication of the fundamental and novel observation that coralline red algae biomineralize magnesite and dolomite; indeed, this extrapolation may even detract from the authors' discovery.*

We thank the reviewer for these comments. As geoscientists we are very aware of the long history of the search for Holocene dolomite, and feel we would be remiss if we did not make this connection.