

## ***Interactive comment on “Significant long-term increase of fossil fuel CO<sub>2</sub> uptake from reduced marine calcification” by A. Ridgwell et al.***

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This is not a review; I would just like to provide some comments that Andy Ridgwell and colleagues may find useful for revising their very interesting contribution.

### **General comments**

1. The introduction would greatly benefit from a clear description of the processes at work. It currently describes well the fact that decreased calcification increases the capacity of the surface ocean to absorb CO<sub>2</sub> (that is because calcification generates CO<sub>2</sub>). There is, however, another process, antagonistic of the first one: the amount of CO<sub>2</sub> generated by calcification for each mole of CaCO<sub>3</sub> precipitated ( $\Psi$  ratio; Frankignoulle et al., 1994) increases as a function of increasing pCO<sub>2</sub>.

Both processes must be taken into account to investigate the response of the surface ocean to elevated  $p\text{CO}_2$  (Gattuso et al., 1999). I am quite sure that the response of  $\Psi$  is embedded in the model via the equations of the carbonate system; it would just be useful to mention these antagonistic mechanisms in the introduction.

## 2. I have several comments on Table 1:

- An additional column for  $\Omega_{aragonite}$  would be less confusing than having  $\Omega_{aragonite}$  given in the  $\Omega_{calcite}$  column with a footnote mentioning that it is in fact  $\Omega_{aragonite}$ .
- Are coral communities also included under “Corals”? Some coral and coral community data were published after the review of Langdon and Atkinson (2005), for example Yates and Halley (2006a and 2006b) and Schneider (2006). Are other benthic calcifiers, such as coralline algae, considered?
- I am not sure that the data for *Orbulina universa* can be used. The reason is that Bijma et al. (1999) reported the response of shell weights, not rates of calcification, to changes in  $[\text{CO}_3^{2-}]$ . The two may not be correlated as an individual with a small shell weight may exhibit a rate of calcification higher than an individual with a larger shell weight if its mass was precipitated over a much shorter time interval. The generation time is indeed required to convert shell weight into calcification rates.
- I would like to stress that the legend of Fig. 8 in Bijma et al. (1999) mentions that experiments with *G. bulloides* were inconclusive. This may mean that shell weight was not affected by changes in  $[\text{CO}_3^{2-}]$ . Although this may suggest that a large interspecific variability exists in Foraminifera, as outlined above, no conclusion on calcification can be drawn.
- This table is not comprehensive for pelagic calcifiers: the results of Scian-dra et al. (2003) and Langer et al. (2006) are missing. Sciandra et al.

(2003) provided data for nutrient-limited cultures of *Emiliana*, an experimental setting closer to natural conditions than nutrient-replete batch cultures. Langer et al. (2006) provided new data on several coccolithophores, some of which exhibit a bell-shaped response to elevated pCO<sub>2</sub>, unlike all previous response curves and also unlike the response curves used by Ridgwell et al. I think that it is essential to consider these data in any modeling exercise.

- Perhaps the rows should be sorted by species (or chronologically).
3. Ridgwell et al. point out that "because our Earth system model includes a climate component ... we were able to take into account the impact of changes in climate". I think that this sentence may be misleading because it seems that only the response of calcification to changes of the carbonate chemistry was parametrized. None of the responses to other variables, such as temperature, concentration of nutrients and light, were considered. Admittedly, there is likely not enough experimental data available to include these variables in a model but this limits the predictive capabilities and should be made clear for the readership. As a result, I wonder about the value of running the model until the year 3000.
  4. It would be useful to provide the input parameters of 54-member ensemble and any other useful information as supplementary material.

## Typos

- p. 1770 l. 5: a word missing?
- p. 1770 l. 15: "Heinze"

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