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Biogeosciences
Discussions

Interactive comment on "Response of the temperate coral *Cladocora caespitosa* to mid- and long-term exposure to *p*CO_2 and temperature levels projected in 2100" *by* R. Rodolfo-Metalpa et al.

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In acidic water calciumcarbonates dissolve easier, because the carbonate concentrations decrease. Due to the current increase in atmospheric CO2 the oceanic pH will decrease with approximately 0.2 units in the coming century. In the last decade several studies have shown that this may strongly reduce calcification and growth of marine calcifying organisms, like coccolithophores and corals. It is generally thought that this is linked to the decrease in calciumcarbonate supersaturation of the oceans: the shift in the carbonate system makes it more difficult for organisms to precipitate calciumcarbonate. The central message of this paper is that it is not that simple, as the calcification of temperate corals is not influenced by pH decrease as predicted by 2100. The results are different than those on coccolithophores and tropical corals, where strong calcification reductions were observed. The experiments are carefully performed, with incubations over a year. The data and the conclusion that pCO2 has no effects are reliable. In a more general way, it was argued that corals adapted to lower temperatures are less sensitive to increasing pCO2. It is hypothesized that the slower calcification by temperate corals is protecting them from carbonate transport limitation.

This hypothesis seems debatable. It is of course odd that organisms, living at the edge of the climate zone where coral calcification is possible, because of the seawater temperature and concomittant reduced aragonite saturation, have more resistance against acidification. It is thought that carbonate is generated in or near the calcification sites, at the skeleton. By Ca2+-H+-ATPases the pH is locally increased, leading to a shift in the carbonate system and thus enhanced carbonate. Thus the calcification is rather limited by energy than transport, and at higher temperature more energy is available as the respiration rates are higher. A more detailed mechanistic explanation is needed. It would be good if the authors embed their hypothesis in a general model for calcification, that explains why a slower calcification due to energy or saturation conditions is more resistant against decreased calcite/aragonite saturation. Also the authors should design tests for their hypothesis. As it is now, we seem to have a circular reasoning: the low temperatures lead to lower oversaturation (lower carbonate concentrations), thus to lower calcification rates, and when we have lower calcification rates the carbonate supply is less critical. But exactly the carbonate concentration limits the calcification at low pH, so further decrease of carbonate by low pH should further limit the calcification rate. It might be of interest to study pCO2 effects on Lophelia, to go further into the extreme.

Even if no fully satisfying mechanistic explanation can be produced, the paper is a valuable scientific contribution and should be accepted, after the points are addressed.

Some detailed comments: p7104 Calcification is also controlled by energy (see Anthony) p7105 I appreciate the notion that acidification will change ecosystems, but that adaptation of organisms should be considered in predictive attempts. p7118 It would be good to explicitly state why the different methods to manipulate the aragonite saturation state lead to different conclusions.

This central sentence is not clear: This would explain why Reynaud et al. (2003) did not find a significant increase in growth rates of Stylophora pistillata maintained at 734 ppm and 25.1_C but only when the corals were exposed to the 28.3_C, i.e. when calcification rates were faster under normal pCO2 conditions. Better is: This explains why Reynaud et al did not find an effect of enhanced pCO2 at 25 C, but only when the corals were exposed to 28 C, i.e. when calcifications rates were higher.

Interactive comment on Biogeosciences Discuss., 6, 7103, 2009.

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