

Interactive comment on “Impact of seawater carbonate chemistry on the calcification of marine bivalves” by J. Thomsen et al.

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Other research on calcification in reef corals (Jokiel 2011a, b) supports your statements (page 2555, lines 21-25) that “lowered seawater pH diminishes the H⁺ gradient between the calcifying epithelia and the ambient water which needs to be counterbalanced by up regulation of active H⁺ extrusion mechanisms. If the regulatory capacities cannot fully compensate for the adverse ambient conditions calcification rates remain reduced.” In the case of corals, the diffusion of protons through the boundary layer is not under biological control and limits calcification rate (Jokiel et al. 2014). Therefore, calcification is reduced as the ocean becomes more acidified because as [H⁺] is increased there is an increase in the strength of the diffusion barrier. Furthermore, your observation (page 1556 lines 1-5) that “the combination of both parameters, carbon

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availability and H⁺ gradient, expressed as the ratio [HCO₃⁻] / [H⁺] which is linearly correlated to [CO₃²⁻] predicts the calcification response best” is supported by analysis of data on corals and crustose coralline algae (Jokiel 2013). However, the ratio of total dissolved inorganic carbon (DIC) to proton concentration ([DIC]/[H⁺]) may be a better descriptor than [HCO₃⁻] / [H⁺] because the different forms of DIC shift with changing pH over the gradient. Most of the DIC will be in the form of HCO₃⁻, so both are acceptable. I agree that the reduction in calcification rate in marine organisms in response to reduced [CO₃²⁻] is a misinterpretation of the complex chemical speciation of the carbonate system, leading to the widespread erroneous belief that aragonite saturation state of bulk water controls coral and coral reef calcification (Jokiel et al. 2014). Correlation does not prove cause and effect.

Jokiel PL (2011a) Ocean acidification and control of reef coral calcification by boundary layer limitation of proton flux. Bull Mar Sci. 87639–657 [doi:10.5343/bms.2010.1107]

Jokiel PL (2011b) The reef coral two compartment proton flux model: A new approach relating tissue-level physiological processes to gross corallum morphology. J Exp Mar Biol Ecol 409:1–12 [doi:10.1016/j.jembe.2011.10.008]

Jokiel PL (2013) Coral reef calcification: carbonate, bicarbonate and proton flux under conditions of increasing ocean acidification. Proc R Soc Lond B 20130031 [doi:10.1098/rspb.2013.0031]

Jokiel PL, Jury CP, Rodgers KS (2014) Coral-algae metabolism and diurnal changes in the CO₂-carbonate system of bulk sea water. PeerJ 2:e378 [doi:10.7717/peerj.378]

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