Biogeosciences Discuss., 6, C2533–C2535, 2009
www.biogeosciences-discuss.net/6/C2533/2009/

Biogeosciences Discussions

Interactive comment on "Review: the effects of secular variation in seawater Mg/Ca on marine biocalcification" *by* J. B. Ries

Anonymous Referee #2

Received and published: 14 October 2009

General comments: This article is well written, interesting, and contain a wealth of data on the response of marine biocalcification for a number of marine calcifiers to changes in seawater Mg/Ca ratios observed under experimental incubations. However, rather than a comprehensive review on the topic I think this paper is better classified as a summary of the previous work by Ries and his colleagues (i.e., Ries et al., Stanley et al.). Most of the data have already been published elsewhere and as far as I can tell the present article does not add any revolutionary new ideas or interpretation of these data. Nevertheless, the experimental work and results of Ries and colleagues is very impressive and a summary of their results will serve as a very useful reference. However, in my opinion there are two problems with the current version of this manuscript that I suggest being addressed. First, I think the current version omits a number of important and highly relevant references pertaining to the factors controlling the min-

eralogy of carbonate minerals during nucleation (especially kinetic controls), previous work on the controls of Mg composition of Mg-calcite minerals, and early and recent work on changes in Phanerozoic seawater composition including the seawater carbonic acid system on this time scale. Thus, I think the literature review and reporting in the current version of this manuscript is somewhat inadequate and could be improved. Second, although I think the immense work conducted by Ries and colleagues is highly commendable, the big missing link of their work and in their interpretation of their results is the failure to not consider the kinetic controls of mineral nucleation as well as the importance of the availability/activity of reactants including Mg2+, Ca2+, AND CO32- (and consequently seawater saturation state) in controlling the composition and mineralogy of both abiotic and biotic carbonate precipitates. The Mg/Ca ratio only represents one part of the story and does not by itself fundamentally explain the observed mineral compositions.

Specific comments: In several places throughout the manuscript (e.g. pages 7331, 7365, 7367, 7368) Ries refers to Chave's (1954) observation that Mg content of Mg-calcite secreting organisms varies as a function of ambient seawater temperature. It is important to recognize that these observations also varied as a function of seawater carbonate ion concentration and carbonate saturation with changing latitude. Later work by for example Moberly (1968) and Mackenzie et al. (1983) interpreted this variability in Mg content as a function of growth rate which is a function of both temperature and seawater carbonate saturation state. Furthermore, more recent experimental work by Agegian (Agegian 1985; Mackenzie and Agegian, 1989) has shown that the Mg content of coralline algae varies as a function of growth rate, carbonate saturation state and temperature.

P7335, line 19-26: Reference to e.g., Morse et al., 1997.

P7341, line 7-10: Is this statement based on a completely qualitative assessment?

P7342, line 8: I suggest removing "Reducing [CO32-] via. . ." and just say "Calcification

has the net effect of shifting the aqueous carbonate system towards elevated [CO2] and [H+]." It is not only the removal of [CO32-] per se that is causing the increase in [CO2] and [H+], but also the relative decrease in TA (owing to removal of Ca2+) to DIC caused by this process.

P7364, line 11-16: See for example Mackenzie et al., 1983, Tribble et al. 1995.

P7367, line 7-11. Why would Stanley and Hardie hypothesize that the Mg content of Mg calcite secreting organisms has varied with seawater Mg/Ca based on Chave's observation that the Mg content of such organisms varied as a function of temperature? Please clarify.

P7370, line 26-29: Yes, exactly! This needs to be emphasized stronger and considered in other parts of the manuscripts (especially growth rates and kinetic controls).

P7384, line 15: The statement that regions of the world ocean will become undersaturated with respect to Mg-calcite minerals by year 2150 does not make sense. Many regions are already undersaturated with respect to high Mg-calcite phases. See for example Andersson et al., 2008.

Interactive comment on Biogeosciences Discuss., 6, 7325, 2009.