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Biogeosciences Discussions

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

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General comments:

This is a well written, concise summary of previously published data about the response of modern calcifying biota to changes in the Mg/Ca of seawater. The figures are excellent and nicely support the text. Principally, the paper appears to be a summary of previous publications by the author and as I understand, there are no new data presented. While this is acceptable for a review paper, it should be made clear, what aspects of the broader topic are new, i.e. considered here for the first time.

Specific comments:

p. 7329, last paragraph and page 7330, first paragraph; also p. 7333, first paragraph;

page 7351, line 16; p. 7356, line 6; p. 7389, line 15: The Early Cretaceous is, in fact, considered to be the time of a calcite sea (Hardie, 1996, Fig. 1 of this manuscript), and the late Early Cretaceous recorded the lowest Mg/Ca ratio after the Cambrian. The statement on p. 7329 is therefore not correct. Also, the first rudists that evolved during the Early Cretaceous were aragonite-dominated and developed calcite-dominated shells in the Late Cretaceous, when the seawater Mg/Ca was rising sharply (Steube, 2002). Consequently, there seems to be a delay in the response of major carbonate producers to a changing seawater compositions (that seems to be well constrained for that time period). Also, rudists should not be considered as reef builders (see Gili, E., Masse, J.-P. & Skelton, P.W. 1995. Rudists as gregarious sediment-dwellers, not reef-builders, on Cretaceous carbonate platforms. Palaeogeography, Palaeoclimatology, Palaeoecology, 118: 245-267, 15 figs.; Amsterdam) but rather important or even dominant carbonate producers.

p. 7333, line 15: How does modern pelagic carbonate sedimentation fit into the picture?

p. 7335, chapter 2.2.1: This is a well written review of the evolution of ideas about potential controlling factors of marine carbonate mineralogy that provides convincing lines of evidence that Mg/Ca is the major driver. The author may consider to refer to Steuber, T., and Veizer, J. 2002. Phanerozoic record of plate tectonic control of seawater chemistry and carbonate sedimentation. Geology, 30: 1123-1126, for independent, geochemical evidence for secular changes in marine carbonate mineralogy.

p. 7335, line 25: When discussing the saturation state of (surface) sea water, it would be important to briefly discuss regional variations (temperature, upwelling).

p. 7339, chapter 3: Are there records of fossil Bryopsidales that had a different mineralogy than the modern ones?

p. 7348, chapter 4: Again, there is a problem with timing of events. While coccolithophores evolved during the Jurassic-mid-Cretaceous, the chalk was deposited later, i.e. when the seawater Mg/Ca began to rise. Chalk deposition was not coeval with minimum in the Mg/Ca ratio of seawater.

p. 7351, line 4: This conclusions implies that modern coccoliths should consist of high Mg calcite (see also page 7350, line 6). Some clarification about the mineralogy of modern coccoliths is necessary here.

p. 7363, chapter 6.2: According to my knowledge, coralline red algae precipitate carbonate with their cell walls. This is different to calcification e.g. in green algae. In this context, the results are surprising. The author may consider to discuss different modes of calcification in the algae studied.

p. 7371, line 3: Here, it is stated with reference to Fig. 1 that the values reported by Dickson have been re-calculated. If this is correct, this should also be mentioned in the caption of Fig. 1.

Chapter 8.5 seems to be a rather long summary of research about Precambrian seawater chemistry and the relevance of this chapter for the paper is not clear.

Chapter 8.6: Potential excursions of up to two per mil will be largely obliterated by diagenesis and, more importantly, by secular variations in the oxygen and carbon isotopic composition of seawater.

Chapter 9.2 and caption of Fig. 29: This discussion misses an important aspect of modern (and possibly ancient) acidification events, i.e. carbonate compensation by fluctuations of the CCD. During ancient times of high CO2, presumably there was sufficient time for ocean circulation to buffer seawater by dissolution of deep-water carbonates. The impact of the modern rise of CO2 is related to the rapid (compared to ocean circulation) increase of atmospheric CO2 that reduces pH of sea surface water that cannot be buffered by carbonate compensation, i.e, rising of the CCD. Similar acidification events may have occurred during the Phanerozoic but require a rapid injection of large volumes of CO2 in the ocean atmosphere systems (events). The long episodes

of calcite seas, coinciding with high pCO2 should not be considered as acidification events.

Caption Fig. 15: The molar Mg/Ca of Cretaceous is given as 0.5. here, although there is no evidence that it dropped significantly below 1.0.

Fig. 29: In view of the discussion in chapter 9.2, it would be more straightforward to compare Ca concentration instead of Mg/Ca with pCO2.

Technical comments:

p. 7337, line 3: . . .and Folk (1974) has shown. . .

p. 7343, line 3: . . .inverse changes. . . This is not clear in this context. Please rephrase.

p. 7355, line 23: Reference to Hardie (1996) seems to be a mistake here.

p. 7365, line 17: Petrographic conditions. . .. Replace by Diagenetic conditions. . .

p. 7374, line 14: Delete ‘And’ at beginning of sentence.

p. 7376, line 19: Should be ‘mm-to-cm thick’?

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