

Interactive comment on “Influence of temperature and CO₂ on the strontium and magnesium composition of coccolithophore calcite” by M. N. Müller et al.

A. D. Wanamaker Jr. (Referee)

adw@iastate.edu

Received and published: 9 December 2013

This is a robust and elegant study. The results are surprising, rather interesting and they will provide important clues regarding the biomineralization processes in these coccolithophores. The manuscript is very well written and the results are compelling and likely reach beyond the study of coccolithophores.

The data presented support the conclusions that Sr/Ca or Mg/Ca ratios as environmental proxies (SST, productivity) derived from these coccolithophores must be used with caution under high pCO₂ conditions. Specifically, a strong interaction/relationship was noted between the strontium partition coefficient (DSr) and temperature and be-

C6177

tween DSr and pCO₂. As in many other studies on biocarbonates, Sr/Ca ratios are also strongly related to growth effects. Hence, the authors conclude that multiple parameters are important during calcification and must be considered when Sr/Ca ratios are used as an environmental proxy.

The implications of these results are huge (and not likely limited to the species studied here) and need to be discussed more strongly in the discussion and conclusion sections. In other words, are the interpretations from previous studies during high pCO₂ conditions (e.g., Paleocene-Eocene thermal maximum) using Sr/Ca ratios from these calcitic coccolithophores as an environmental proxy remotely valid? Please consider this question in a broad sense.

This study also reveals that caution might be in order for researchers who use Sr/Ca or Mg/Ca ratios in other biominerals as a proxy for seawater temperature or productivity. This is especially important/true under the increasing pCO₂ conditions that are being experienced in the atmosphere and oceans.

The differing uptake of Sr and Mg during biomineralization is fascinating- and very likely (as the authors state) represent unique pathways of incorporation. The authors caution that Mg/Ca ratios in coccolithophore tests likely do not represent oceanic Mg/Ca ratios of seawater due to the different calcification pathways between Mg, Sr, and Ca. I think this statement should also be included in the conclusion section.

Are Mg/Ca ratios under the pCO₂ conditions a valid proxy for productivity? If so, what potential problems exist with this interpretation?

Multiple impacts on element/Ca ratios:

Although I do not think it is absolutely necessary in this study, might the authors consider multiple linear regression techniques to model the concurrent effects of pCO₂, growth rates, and temperature on DSr? This may provide some additional insight on the relative importance of each of these parameters on Sr/Ca ratios for each of the

C6178

coccolithophore species.

Potential formatting issue:

On page 12, there are five equations listed for DSr but none noted for DMg. Was this intentional? My suggestion is that you be consistent- either include/exclude both Sr and Mg partition equations.

Interactive comment on Biogeosciences Discuss., 10, 15559, 2013.