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Modeling the strontium to calcium ratios in coccoliths of *Emiliania huxley*

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Although calcite precipitation in coccolith vesicles proceeds under tight cellular control, the incorporation of trace metals (Me=Sr, Ba) into coccolith calcite has been found to record characteristics of ambient seawater. Therefore, Me:Ca ratios of coccoliths have been proposed as a proxy for changes in ocean chemistry. We used a combined experimental and modeling approach to develop a better understanding of strontium incorporation into coccolith calcite of *Emiliania huxleyi*. Determination of strontium exchange coefficients for coccoliths is nontrivial, since the chemistry of seawater differs from that of the coccolith vesicle solution. Exchange coefficients of coccolith calcite presented in our study and in the literature are high compared to values of inorganically precipitated calcite. Although kinetic effects can explain part of this offset, the origin of this discrepancy is yet not fully understood. Coccolith Sr:Ca ratio was shown to be linearly related to seawater Sr:Ca ratio (with a slope of 0.39). We developed a model for strontium partitioning during calcification in *E. huxleyi* which is based on the channel/carrier mediated transport of calcium and strontium ions inside the cell. The model is solely based on thermodynamical constraints and does not assume a relationship between the exchange coefficient and either the crystal growth rate or pumping rate of transport ATPases. Based on the model the high strontium exchange coefficient values for coccolith calcite and the linear relationship between

coccolith and seawater Sr:Ca ratio could be explained. For *E. huxleyi*, the model for Sr partitioning suggests that barium displays a behaviour which is similar to that of strontium if the Ba/Ca ratio in the seawater is altered.

References

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