Modelling the mechanisms controlling $\delta^{88/86}$Sr variations in coccolithophores

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Coccolithophores are key contributors to marine calcium carbonate export to the deep ocean. During coccolith calcification, Sr substitutes to some extent for Ca. Culture studies suggested that growth rates modulated by temperature may be driving variations in the Sr isotopic composition ($\delta^{88/86}$Sr) of coccolithophores (Stevenson et al., 2014), implying a kinetic effect in Sr isotopic fractionation. However, to date there is no available quantitative approach to identify the mechanisms controlling coccolith Sr isotopic fractionation during Sr uptake and transport within the cell.

In this study we will further develop the CaSri-Co cellular model proposed for coccolith $\delta^{44/40}$Ca and Sr/Ca (Mejía et al., in review EPSL) to apply it to coccolith $\delta^{88/86}$Sr, so as to identify quantitatively the mechanisms controlling $\delta^{88/86}$Sr in coccolithophores. We will apply this model to published and new $\delta^{88/86}$Sr data from cultured coccolithophores of varying growth rates but grown under constant temperatures, so as to differentiate the effects of both parameters. The model will be also applied to new $\delta^{88/86}$Sr data from sedimentary coccoliths (8-10 μm size fraction) from ODP Site 905 located offshore New Jersey, where surface temperatures were relatively constant for the last 30000 years but coccolith Sr/Ca suggest important variations in coccolithophore's growth rates.

The application of the model to our new dataset will allow a better understanding of the cellular processes involved in determining Sr isotopic fractionation, while at the same time giving insights of the mechanism linking Sr/Ca ratios to productivity variations and/or Ca retention efficiency. Finally, if coccolith $\delta^{88/86}$Sr was indeed found to be predominantly affected by coccolithophore's growth rates, we suggest coccolith $\delta^{88/86}$Sr could be used as a growth rate proxy, a required parameter to reliably reconstruct CO_2 from alkenone and diatom-bound organic matter δ^{13}C records.