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Effects of sulfate concentration on *Emiliania huxleyi* growth in current and past ocean

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Changes in sulfur concentration in the ocean produced by both volcanoes and anthropogenic inputs, may produce different impacts on pelagic calcifies tests according to seawater chemistry (aragonite vs calcite seas, whose boundary is defined as Mg/Ca ratio = 2[1]).

This work tests in *in-vitro* laboratory experiments the effects of 2 chemical changes, Mg/Ca and Sulfur [sulfate] on the calcification and growth of the greatest calcite producing organisms in the ocean, the coccolithophores. Original Batch cultures were used to reproduce the growth of clones of *Emiliania huxleyi* in artificial seawater conditions reproducing the modern configuration (high Mg/Ca ratio 5.2, low Ca of 10.5mM) and two different Cretaceous-like ocean configurations (calcite-sea period): K1 with Mg/Ca = 1 and Mg and Ca concentration as 25mM; K3 with Mg/Ca = 1 but low Mg and Ca concentration (= 10.5mM). The 3 Mg/Ca conditions are submitted to increasing sulfates concentration from 5mM to 180mM, to simulate the functioning of Cretaceous and modern oceans facing the highest input of sulfur.

Modern conditions resulted to be more favorable to calcification and larger cells than those of K3 sea but provided smaller and less calcified cells than those of K1 sea. At low sulfates, K1 is more favorable for the precipitation of calcite than modern conditions. Calcification was strong in the Cretaceous calcite sea's conditions when sulfates were also low (5mM and 17mM) and has only decreased in modern Mg/Ca ratio.

K3 experimental results suggest that low Mg/Ca ratio with low Ca concentration in the past, when associated with high sulfur inputs, could have played a role in driving one of the greatest biocalcification crises (Cretaceous crisis, 66.04Ma) in past ocean. On the opposite, K1 could reproduce conditions of flourishing of high diversity and high calcification rate during the Cretaceous. The result of our experiment opens the question whether different coccolith species would have similar behavior to chemical changes in ocean as modern *Emiliania huxelyi* and if all known biocalcification crises in the past were linked to changes in both sulfate and Mg/Ca.

[1] Goldschmidt, Stanley & Hardie (1999), *GSA today*, *9*(2), 1-7.