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Peaking at the past controls on the production of pelagic carbonate - *N. Shackleton Science Innovation Medal Lecture*

ROSALIND E. M. RICKABY[1], CRAIG DEDMAN[1], XIAOXU MA[1], NISHANT CHAUHAN[1], ALBA GONZALEZ-LANCHAS[1] AND EL MAHDI BENDIF[2]

[1]University of Oxford

[2]University of Quebec at Rimouski

Presenting Author: rosalind.rickaby@earth.ox.ac.uk

The production of calcium carbonate in the surface ocean by biomineralisers is an important component of the carbon cycle. It contributes to export of organic matter from the mixed layer, forming sediments on the deep seafloor, a dominant sink of carbon from the atmosphere over geological timescales, plays a role in Earth's thermostat and acts as a buffer for seawater chemistry. Estimates suggest that globally pelagic calcification consumes 3-4 times the alkalinity supplied to the ocean from rivers but it remains unclear what controls this production rate of pelagic calcium carbonate. Much work has focussed on the impact of declining carbonate saturation state on calcifier mineralisation. However, the modern ocean is up to four times supersaturated with respect to calcite, so it is clear that saturation state alone cannot limit the rate of calcification in the surface ocean.

Coccolithophores, single celled photosynthetic algae are responsible for up to 50% of pelagic carbonate productivity. They produce intricate calcium carbonate liths within their cells, fuelled by photosynthesis and unite the organic and inorganic carbon pump of the ocean within one organism. Here, we will explore the isotopic geological record of calcification during the Cenozoic together with laboratory derived biological controls on how the calcium carbonate and organic carbon cycles may be directly coupled, via the PIC/POC of coccolithophore production rates. The aim is to understand the role of coccolithophore productivity in driving the past carbon cycle and particularly the concept of biological compensation i.e. when coccolithophore productivity decouples the saturation state of the ocean from weathering inputs.