# Calcification of the *Gephyrocapsa* complex during the Mid-Brunhes


## Alba González-Lanchas

Department of Geology, University of Salamanca (Spain); *now at* Department of Earth Sciences, University of Oxford, Oxford (UK).
alba.gonzalez-lanchas@earth.ox.ac.uk

## José-Abel Flores

Department of Geology, University of Salamanca (Spain)

## Rosalind E. M. Rickaby

Department of Earth Sciences, University of Oxford, Oxford (UK)

## Andrés Rigual-Hernández

Department of Geology, University of Salamanca (Spain)

## El Mahdi Bendif

Department of Earth Sciences, University of Oxford, Oxford (UK)

## Odysseas A. Archontikis

Department of Earth Sciences, University of Oxford, Oxford (UK)

## Francisco J. Sierro, Montserrat Alonso-Garcia

Department of Geology, University of Salamanca (Spain)



Noelaerhabdaceae coccolithophores contributed to modulating the global carbon cycle by increasing carbonate export and burial rates due to recurrent enhanced production at low eccentricity scenarios with an ~ 400 kyr cyclicity during the Pleistocene. Whether this variability also entailed a change in the degree of coccolithophore calcification is unknown, but plausible since regulation in the carbon cycle at this scale necessarily involve deep changes in the state of ocean carbonate chemistry.

We analyzed the morphometries (size and mass) of the dominant *Gephyrocapsa* complex during the last eccentricity minimum episode 400 kyr ago, encompassing the Mid-Brunhes event, at a wide range of latitudinal environments across the North Atlantic Ocean region and the Mediterranean Sea. We capture an enhancement in *Gephyrocapsa* calcification coeval to high coccolithophore production led by mid-sized *Gephyrocapsa* specimens. Analysis of diversity on the *Gephyrocapsa* complex allows us to determine an increased calcification expressed by an array of morphotypes at the different sites. Such widespread enhanced calcification across the *Gephyrocapsa* complex supports the existence of a common trigger for a higher degree of calcification of a range of *Gephyrocapsa* during the Mid-Brunhes. This feature is plausibly related to changes in seawater chemistry, e.g., $HCO_3^-$ increase, that could explain the common response of *Gephyrocapsa* calcification observed at all sites.

This perspective critically underscores that the nature of the stimulus mediating orbital forcing and long-term phytoplankton evolution or adaptation could be embellished by changes in seawater carbonate chemistry as a critical component.