How did orbital cycles influence coccolith size fluctuations? An example from the Early Pliensbachien (Early Jurassic) of Peniche (Portugal)

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Though climate and environmental changes influence coccolithophorid (unicellular photoautotrophic algae) diversity, the relationships between fluctuation of size of coccoliths (small calcite plates produced by coccolithophorids) and environmental parameters remain unclear. In order to understand possible interactions between coccolith size variations and climate, a high-resolution (every 5 cm) biometric study of *Crepidolithus crassus* coccoliths has been performed in the Early Pliensbachian (Early Jurassic) hemipelagic deposits of Peniche (Portugal). Four of the six measured parameters have cyclic patterns that appear to be in phase opposition with calcium carbonate contents of the sediments. Spectral analyses performed on both size measurements and calcium carbonate contents show that the size variations of *C. crassus* coccoliths are related to Earth's eccentricity and precession orbital cycles. A closer analysis of morphologic disparity within the measured specimens through 'mixture analysis' reveals the existence of two distinct groups: a group called here 'small *crassus*' with a mean size of ~6.5 μm, and a group called 'large *crassus*' that averages a size of ~8.5 μm and dominates the assemblages during the studied interval.

C. crassus is generally interpreted as a deep-dweller (living in the lower photic zone) and its development could have been greatly dependant on light supply. Accordingly, the two morphotypes could have lived at different water-depths due to differential buoyancy capacities. To test this hypothesis, a geometrical coccosphere reconstruction model, based on coccolith biometry, was built and reveals a linear relationship between coccolith size and coccosphere mass, thus confirming that smaller coccoliths may have had overall higher buoyancies than larger ones. Consequently, it is suggested that changes in the water-column transparency may have been an important controlling factor on replacement between the two groups, and hence the resulting coccolith mean size. This transparency may have been mainly controlled by both carbonate platform input and storm recycled particulates in the photic zone, which could thus explain the inverse relationship between calcium carbonate contents and *C. crassus* size. Though, the 'small *crassus*' group appears to be more abundant in organic matter-rich levels, suggesting a preference for nutrient-rich water bodies.