Collapse of coccolith calcification after 1940 recorded in a 500-years long time series (core MD05-2917 - Western Pacific) with a yearly resolution

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Résumé

Coccolithophores are the main pelagic calcifiers. Because of their minute size, it is very difficult to asses the amount of calcite they secrete. We present here a new method which permits to measure the thickness, and hence estimate their mass. It is based on the birefringence properties of the calcite. Rotating polarizer and analyzer permit to grab numerical images in 3 different polarizing planes. The combination of these images allows to eliminate the typical "black-cross" that appear on coccolith observed in crossed nichols. The measurement of the light is converted into thickness using the measured retardation and the known birefringence of the calcite. The multiplication of thickness, surface, and calcite density equals the mass of the coccoliths. We use this method on sediments retrieved north of Papua in 2005. 14C chronology of Core MD05-2917 indicates regular sedimentation rate in the order of 6mm/1000years. We sampled the top 6m of the core every centimeters. We prepared a smear slide for each sample on which a 2mm continuous transect was scanned by at 1000X resolution with an automated Leica DMR6000N microscope and a DiaFlex digital camera. Coccolith photographs of Emiliania huxleyi and of 2 species of Gephyrocapsa were selected by an artificial neural network using the combined "3 angles polarized" digital images of the field of views. The high sedimentation rates in this core implies important dilution of coccoliths in the sediments, but with the help of the automated technic it was possible to get a sufficient number of coccoliths to obtain robust statistics. We produced a high resolution (1 years) record of coccolith mass for the last 500 years (≈1998-≈1580 year C.E.). The mass of Emiliania huxleyi remain constant between 1580 and 1940 and then decreased by half since then. The only explanation of this calcification collapse is recent ocean acidification.

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