Importance of coccolithophores in the ocean deep biomass

Amos Winter, Josué G. Millán
Indiana State University, Terre Haute, IN 47809 USA; amos.winter@indstate.edu, jmillan1@sycamores.indstate.edu
Diana P. Ruiz-Pino
Sorbonne University, P&M Curie Campus, LOCEAN, 75005 Paris, France; Diana.Ruiz-Pino@locean-ipsl.upmc.fr
Luc Beaufort
CEREGE, CNRS/Aix-Marseille University/IRD/College of France/INRA, 13545 Aix-en-Provence, France; beaufort@cerege.fr
Ian Probert
Sorbonne University, Roscoff Marine Station, CNRS, 29680 Roscoff, France; probert@sb-roscoff.fr

The deep biomass (DB), which is located in the lowest part of the euphotic zone (approximately 80–300 m deep) and occurs primarily in the subtropical gyres, is an unexplored part of primary production (PP). It is one of the largest biomes on our planet, considering that subtropical regions occupy 60% of the total ocean. Observations indicate that the major oceanic gyres have expanded recently by 15%, a phenomenon attributed to global warming. As the gyres expand and warm, they become more stratified, which could be expected to favour coccolithophores. The biological community in the DB, however, is not well known, and their contribution to export production has never been quantified. Productivity estimates for oceanic net primary production show that regions with oligotrophic surface-waters contribute significantly to global productivity due to their deep phytoplankton communities. Some model estimates indicate that there has been a recent increase in net oceanic primary production in oligotrophic ocean gyres. If we consider: 1) the total area covered by the DB; 2) the expansion of the ocean gyres; 3) the PP that occurs throughout the year; and 4) the global depth-integrated NPP of the mixed layer in the tropics and subtropical gyres that displays very small seasonal variability, it is reasonable to assume that the DB ecosystem is likely to be as important for productivity and chemical recycling as seasonally-active upwelling areas. The role in PP of this enigmatic biome cannot be easily determined using chlorophyll because organisms in the deep photic zone, particularly coccolithophores, do not possess much chlorophyll per biomass. It is thus probable that carbon export from the DB is underestimated in models. With the upper euphotic zone of the oceans already impacted by acidification, the DB can arguably be considered to be the last refuge for marine organisms. We need to determine how anthropogenic activity is affecting the phytoplankton that comprise the DBM and the ensuing biogeochemical cycling of carbon.