The role of Phaeocystis globosa in the carbon cycle through photosynthetic activity and marine gel synthesis: A biomolecular field study

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Marine ecosystems support complex biochemical processes that play a critical role in the global carbon cycle. One key process is the production of particulate organic carbon (POC), which facilitates the transfer of carbon from the photic zone to the deep ocean (Alderkamp *et al.* 2007). During the descent, the organic particles are also an important food source for microscopic live in the meso- and bathypelagic zones. A vital component of POC flocs, acting as both "glue" and medium, are marine gels, which are produced in large amounts during algal blooms (Engel 2004). This study focuses on *Phaeocystis globosa*, a globally distributed bloom-forming alga renowned for its foam and gel production (Lancelot *et al.* 2007). Under optimal conditions, *Phaeocystis* releases excess energy in the form of glucans and mucopolysaccharides, which contribute to the formation of a gel matrix (Solomon *et al.* 2003). This matrix facilitates colony formation and attracts specific bacterial communities. Post-bloom, the lysis of *Phaeocystis* colonies releases large amounts of carbohydrate-rich dissolved organic matter (DOM) into the water (Chin *et al.* 2004). This DOM acts as a precursor for marine gels, such as transparent exopolymer particles (TEP), which promote foam formation and potentially enhance the sedimentation of POC flocs (Chin *et al.* 2004).

We investigate the metabolism of *P. globosa* alongside TEP concentrations and biogeochemical ecosystem characteristics over diel cycles. We aimed to evaluate the contribution of *Phaeocystis* to the drawdown of dissolved inorganic carbon (DIC) and the resulting oxygen production during a bloom. We integrated metatranscriptomics with measurements of ecosystem properties to describe the biogeochemical dynamics of a *Phaeocystis globosa* bloom and to further unravel the drivers involved in carbohydrate production and metabolic pathways active in *Phaeocystis*. With the R/V *Simon Stevin,* a sampling campaign was completed in the spring of 2023, targeting two distinct ecosystems over a diel cycle: a *Phaeocystis globosa* bloom and a plankton community in post-bloom state. We deliver some first estimates on the amount of DIC that is processed by blooming *Phaeocystis* and the resulting biomass that is stored as TEP to maintain their colonies. We further demonstrate diel compartmentalization of photosynthetic activity and growth in *Phaeocystis globosa* over a 24-hour period in a coastal sea.

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Marine Gels; Phaeocystis; Carbon Cycle; Diel Cycles; Metatranscriptomics; Ecosystem Dynamics; Algal Blooms