Atomic Force Microscopy reveals marine *Synechococcus*-heterotrophic bacteria interactions at individual cell level: implications for oceanic carbon biogeochemical cycle

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Marine bacteria are important in oceanic biogeochemical cycles. Since they exert their biological influence at the individual cell level it is important to study their ecology at the microscale at high resolution. We found, by Atomic Force Microscopy, that a large fraction of marine *Synechococcus* cells, important unicellular primary producers, were associated with "free-living" heterotrophic bacteria (Malfatti and Azam 2009). We have picked single cells and amplified single genome from the natural marine sample thus we have identified some heterotrophic bacteria associated with the *Synechococcus cells*. We have measured at the individual cell level the primary production of natural assemblages of *Synechococcus* by ^{14}C microautoradiography. The rate of carbon fixation is significantly higher in the associated *Synechococcus*. We addressed the interaction specificity in model systems--using cultures of isolated marine heterotrophic bacteria (*Vibrionales*: SWAT3; *Pseudoalteromonadales: Pseudoalteromonas flavipulchra*) and *Synechococcus* isolates (WH8102, CC9311). We found that *Synechococcus* cell growth was inhibited by the presence of heterotrophic bacteria, thus suggesting an antagonistic interaction. *Synechococcus* growth was inhibited by SWAT3 and *P. flavipulchra*. Our findings at individual cell level can have biogeochemical consequences on the regulation of primary productivity and carbon flow in the ocean.