Tracing the impact of uncultivated diazotrophs on the oceanic N and C cycles

M. M. M. KUYPERS[1]

[1]MPI for Marine Microbiology, Bremen, Germany (mkuypers@mpi-bremen.de)

Microbial fixation of N_2 gas into biologically available ammonium is the main source of DIN in the open Ocean. The majority of N_2 fixation is attributed to larger colonial and heterocystous (heterocysts are specialized cells for N_2 fixation) cyanobacteria populations. There are other N_2 fixing microorganisms, which are grouped into "the smaller size fraction" (< 10 μm), and which contain unicellular cyanobacterial, bacterial and archaeal lineages. It is thought that the activity of these other N_2 fixing populations may help balance the N budget; however we know little about their distribution and activity.

Recent results from isotope labelling experiments using a new incubation method indicate that N_2 fixation by the smaller size fraction can exceed N_2 fixation by large cyanobacteria in the surface waters from the Atlantic Ocean. We used single cell techniques to identify the responsible organisms. A combination of in situ hybridization and nanoSIMS shows that a widespread small (<1 μm) uncultivated novel N_2 fixing cyanobacterium (UCYN-A) lives in association with another equally small algal partner cell. Moreover, we show that fixed N is provided by UCYN-A in exchange for fixed C from the host algal cell which we identified as a picoeukaryote. New results show that at least three different picoeukaryotes, two Haptophyta and an unknown organism, can act as a host. Furthermore, nanoSIMS analysis of samples incubated with $^{15}N_2$ and different nutrients show that Saharan Dust, iron and phosphorus stimulate N_2 fixation by this uncultivated symbionts. These results reveal a direct linkage between the marine carbon and nitrogen cycles that is fuelled by the atmospheric deposition of dust.

Currently a combination of light isotope tracers is used to get the first quantitative information on the contribution of this widespread and abundant diazotroph to the oceanic N and C cycles.