

Cyanobacterial and non-cyanobacterial nitrogen fixation play a different role on marine primary production

SHIOZAKI, Takuhei^{1*} ; KODAMA, Taketoshi² ; HASHIHAMA, Fuminori³ ; HAMASAKI, Koji¹ ; FURUYA, Ken²

¹The University of Tokyo, Atmosphere and Ocean Research Institute, ²The University of Tokyo, Graduate School of Agricultural and Life Sciences, ³Tokyo University of Marine Science and Technology, Department of Ocean Sciences

Marine primary production is limited by nitrogen availability, and it generally increases with new nitrogen input. The new nitrogen sources in the open ocean are nitrogen fixation and nitrate supplied from deep water. Due to the well-stratified condition in the tropical and subtropical oligotrophic region, nitrate input from deep water is little, and nitrogen fixation becomes important as new nitrogen source. Therefore, in theory, primary production would increase when nitrogen fixation becomes active in the oligotrophic region. In the South Pacific subtropical ocean, active nitrogen fixation occurs in both eastern and western region (Dekazemacker et al. 2013; Shiozaki et al., 2014). Meanwhile, satellite observations demonstrate that primary production is higher in the western region than in the eastern, suggesting that the contribution of nitrogen fixation to primary production would be different between the two regions.

In the present study, we examined primary production, nitrate-based production, and nitrogen fixation with accompanying measurements of nutrients and the diazotroph community in the eastern and western South Pacific subtropical ocean. In both regions, surface nitrate was depleted and nitrate-based production was similar. On the other hand, nitrogen fixation tended to be higher in the eastern region than in the western. Although primary production was elevated in the middle of western subtropical region where active nitrogen fixation occurred, it was not in the eastern region. These results indicated that nitrogen fixation did not enhance primary production in the eastern region. We quantified the *nifH* gene of three representative cyanobacterial diazotrophs, UCYN-A, UCYN-B, and *Trichodesmium* using a qPCR technique in both regions. In the western region, the three diazotrophs were widely distributed and abundant, that is, these three cyanobacterial diazotrophs played a key role in the nitrogen fixation. However, those abundances were nearly the detection limit of the analysis in the eastern region except some stations where abundance of UCYN-A was high, suggesting that non-cyanobacteria dominated the diazotrophs community in the eastern region. Therefore, the different contribution of nitrogen fixation to primary production was attributable to the diazotrophs community structure.

Keywords: nitrogen fixation, primary production, *nifH* gene, oligotrophic ocean