Comparison of recalcitrant dissolved organic matter produced by three model marine bacterial strains

*Goto Shuji[1], Yuya Tada[2], Koji Suzuki[1,3], Youhei Yamashita[1,3]

1. Graduate School of Environmental Science, Hokkaido University, 2. Japan Agency for Marine-Earth Science and Technology, 3. Faculty of Environmental Earth Science, Hokkaido University

Marine dissolved organic matter (DOM) constitutes one of the largest reduced organic carbon pools on the earth’ s surface. The recalcitrant DOM (RDOM) has been considered to be major fraction of marine DOM and play an important role as a slow cycling carbon reservoir. However, source and production mechanism of marine RDOM have not been fully understood. Bacterial production of RDOM has recently been proposed as a carbon sequestration process. The concept of this process called microbial carbon pump (MCP) was derived from the previous studies of in vitro culture experiments in particular using natural microbial community. Since specific species who contribute MCP cannot identify from incubation experiments with microbial community, it is still unclear whether difference in bacterial species can affect RDOM production. In this study, to clarify similarity/dissimilarity of production efficiencies and composition of DOM derived from different bacterial species, we conducted batch culture experiments using three model marine bacterial strains, namely *Alteromonas macleodii* (*A. macleodii*) and *Vibrio splendidus* (*V. splendidus*) affiliated with ubiquitous Gammaproteobacteria, and *Phaeobacter gallaeciensis* (*P. gallaeciensis*) belonging to Alphaproteobacteia. Incubations were conducted in the dark at 25˚C for 1–2 weeks with glucose (1 mmol C L^{-1}) as the sole carbon source in addition to inorganic nitrogen and phosphate. Bacterial numbers, dissolved organic carbon (DOC) concentrations, and excitation-emission matrices (EEMs) of DOM were monitored during incubations. Subsamples were taken from triplicate bottles at 8 points of time. DOC concentrations were drastically decreased during the exponential growth phases and relatively stable during the stationary phases, irrespective of differences in bacterial strains. While, bacterially derived DOM from glucose, namely residual DOC concentration in experiment was considerably high for *V. splendidus* (205 ±11 μmol C L^{-1}) compared with other two strains (51 ±4 μmol C L^{-1} for *A. macleodii*, 75 ±3 μmol C L^{-1} for *P. gallaeciensis*), suggesting that efficiencies of RDOM production were possibly different among bacterial species. EEMs during/after incubations showed the bacterial production of fluorescent DOM. Interestingly, fluorescent peak positions and number of peaks, including refractory humic-like fluorophores, were different among three strains. For example, two strains belonging to Gammaproteobacteria produced humic-like fluorophore emitted at >500 nm wavelength, while these fluorophores were not produced by the strain of Alphaproteobacteria. These in vitro culture results with different model bacterial strains imply that production efficiency and composition of RDOM are different among bacterial species or class levels.

Keywords: Marine carbon cycle, Dissolved organic matter, Microbial carbon pump, Marine bacterial isolate

