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Bacterial activities and community structure interactions with organic matter dynamics at dial scale and during seasonal stratification in the NW Mediterranean

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While it is now clear that bacteria are important for determining the fate and loss of organic carbon exported to the mesopelagic layer and the deep ocean, the rates at which bacterial processes occur in natural environments, how they vary in response to small or larger spatio-temporal scale events and how does this impact biogeochemistry is still under question. Thus, an outstanding goal of marine microbial ecology is to better understand interactions between the organic matter characteristics (quantitative as well as qualitative) and the bacterial compartment, at a microbiogeochemical scale as well as at the scale of ecosystem functioning. Within this context, the objectives of the PROPECHE observations (PROOF-PECHE project, **P**roduction and **E**xportation of **C**arbon : Control by **HE**terotroph at small temporal scale) were to study the dynamics of POM and DOM at daily and seasonal scale within contrasted ecosystem trophic conditions (spring and summer), and to relate variations to bacterial community activities and structure in the surface and twilight zone. Observations were done at a fixed station in the central zone of the Ligurian Sea (Dyfamed, NW Mediterranean),

during day and night, in March and June 2003, along a 0-1000 m water column. The hydrological structure of the ecosystem, the mineral and organic stocks (labile and refractory), the phytoplankton biomass, the structure of heterotrophic communities and their trophic behavior were studied. We focused our biogeochemical and microbiological approach on the study of lipid dynamics coupled to bacterial lipase activity as well as on the fine description of bacterial community structure, using recent methodological developments in lipid biogeochemistry (Bourguet et al. 2004) and community structure analysis (Ghiglione et al. 2004).

In spring, day and night succession had a major effect on the bacterial community structure, in relation with particles formation through zooplankton grazing and aggregation during the night. Ressources were abundant and bacteria were particularly active on particle at night (Ghiglione et al. in prep). Production of C-lipid monomers through hydrolysis of C-lipid polymers, and assimilation of monomers by bacteria were balanced within a period of 8 days. The evolution of the system from mesotrophy to oligotrophy was accompanied by a drastic diminution of total bacterial numbers and activity. The structure of the bacterial community changed and followed the stratification layers. DOM was enriched whereas POM was depleted. Bacteria actively hydrolyzed DOM to overcome the depletion of the very labile material (exudation products). Hydrolysis activity per cells was high in the surface layer, suggesting that communities were adapted to conditions at the surface. A decoupling between hydrolysis and assimilation was observed. C-lipid monomers residence time increased up to more than 30 days, leading to a significant increase of labile lipid stocks. Accumulation of refractory lipids (humic acids) was observed simultaneously. Opposite day/night variation of labile and refractory lipids suggests that a refractorisation of labile lipids likely occured under the effect of light intensity during the day. In conclusion, results demonstrate how both biotic (bacterial community structure and activities) and abiotic processes (light effect on refractorisation of labile molecules) contributed to DOC accumulation observed in North Western Mediterranean during evolution of the system from mesotrophy to summer oligotrophy.