Non-Redfield C:N ratio of transparent exopolymeric particles in the northwestern Mediterranean Sea

Mari, Xavier, Sophie Beauvais, Rodolphe Lemée, Maria Luiza Pedrotti

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ABSTRACT: The stoichiometric model of Redfield, which describes the elemental composition of marine organic matter, is generally used to link the production of new organic matter to the uptake of nitrate. The Redfield C:N molar ratio of 6.6 is a well-established value for particulate organic matter produced in surface waters. Yet recent studies have shown that the inorganic C:N uptake ratio during nitrate-limiting conditions is >14. This non-Redfield behavior during the production of new organic matter suggests that a large standing stock of organic matter, rich in carbon, should accumulate in the euphotic zone from the spring bloom to late summer. This hypothetical pool of carbon-rich organic matter and the pool of transparent exopolymeric particles (TEP) exhibit similar seasonal distributions, which suggests that TEP may indeed be this carbon-rich pool. For this scheme to work, TEP should have a high C:N ratio. TEP distribution from an open-ocean site in the northwestern Mediterranean Sea (DYFAMED) was monitored, and TEP C:N ratio was measured from TEP produced in the laboratory by bubbling dissolved organic matter collected in the field. We found that the TEP pool increases during the summer season and that the C:N ratio of TEP produced from naturally occurring dissolved organic matter, is well in excess of the Redfield ratio with an overall average C:N molar ratio of ~20. As a result, the production of TEP could be the main pathway of carbon overconsumption required of oligotrophic, nitratelimiting waters, and, thus, TEP may represent an important intermediary pool in the ocean carbon cycle.

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