Oxygen as a control on sea floor biological communities and their roles in sedimentary carbon cycling

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ABSTRACT: ^{13}C tracer experiments were conducted at sites spanning the steep oxygen, organic matter, and biological community gradients across the Arabian Sea oxygen minimum zone, in order to quantify the role that benthic fauna play in the short-term processing of organic matter (OM) and to determine how this varies among different environments. Metazoan macrofauna and macrofauna-sized foraminiferans took up as much as 56 $\pm$ 13 mg of added C m^{-2} (685 mg C m^{-2} added) over 2-5 d, and at some sites this uptake was similar in magnitude to bacterial uptake and/or total respiration. Bottom-water dissolved oxygen concentrations exerted a strong control over metazoan macrofaunal OM processing. At oxygen concentrations <7 μmol L^{-1} (0.16 ml L^{-1}), metazoan macrofauna were able to take advantage of abundant OM and to dominate OM uptake, while OM processing at O_2 concentrations of 5.0 μmol L^{-1} (0.11 ml L^{-1}) was dominated instead by (macrofaunal) foraminiferans. This led us to propose the hypothesis that oxygen controls the relative dominance of metazoan macrofauna and foraminifera in a threshold manner, with the threshold lying between 5 and 7 μmol L^{-1} (0.11 to 0.16 ml L^{-1}). Large metazoan macrofaunal biomass and high natural concentrations of OM were also associated with rapid processing of fresh OM by the benthic community. Where they were present, the polychaete *Linopherus* sp. and the calcareous foraminiferan *Uvigerina* ex gr. *semiornata*, dominated the uptake of OM above and below, respectively, the proposed threshold concentrations of bottom-water oxygen.