Sediment oxygen demand and nutrient fluxes during an experimentally induced hypoxia

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Enhanced productivity coupled with water column stratification induce a removal of oxygen that often exceeds its inputs, and generate oxygen levels lower than the saturation concentrations. Aquatic organisms start to be affected when dissolved oxygen concentration drops below 63 µM (defined as hypoxia) but can go up to aquatic organisms mass mortality if oxygen almost completely disappears (i.e., anoxia) leading to "dead zones" formation, with large ecological and socioeconomic impacts.

Berre lagoon, an eutrophicated mediterranean lagoon is periodically submitted to hypoxia events in the water column. Baseline studies were carried out ex-situ using 40 sediment cores collected from the study site, stabilised at in situ salinity temperature conditions and submitted during 4 weeks to 0, 15, 30 and 100% oxygen saturation content. Microelectrode measurements of O_2, pH, and hydrogen sulphide were carried out in addition to flux measurement of O_2 and nutrients through core incubations at 6 occasions during the 25 days lab experiment.

Benthic oxygen fluxes stabilized rapidely in a few days and remained almost constant during the course of the experiment. The reduction from 100 % to 30 and 15 % saturation showed a decrease of the Total Oxygen Uptake by half (from 3000 to 1500 $\mu mol.m^{-2}.h^{-1}$ TOU) for both oxygen conditions. At around 0% saturation, stabilizing of the cores tooks a few days more. Dissolved Oxygen Uptake (DOU) estimated from microprofiles agreed well with TOU.

Results clearely demonstrate that Benthic respiration is controled by water column oxygen content, that TOU/DOU ratios were around 3-4, representing the effect of benthic fauna on sediment respiration and fall to 1 under anoxia. The effect on nutrient fluxes and the overall impact on water column biogeochemistry will be discussed.