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Early diagenetic processes in an eutrophic estuarine system: indices of sediment contribution to summer hypoxia of the Loire?

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Despite the decrease of nutrient loads from catchment area due to environmental regulation, the Loire is the last wide estuarine system in France where hypoxia persists. Increase of low-flow summer episodes due to climate change is suspected to be the cause. The OXYMORE project aims at examining the role of benthic exchanges in the occurrence and intensity of such hypoxic events inducing fish mortality and lowering the score of Loire estuary in the European Water Framework. During the low-flow period, physical conditions are suspected to favour a significant destocking of phosphorus and reduced species from sediments towards the water column via the dissolution of metal oxides which would contribute to trigger or maintain oxygen depleted condition. Series of interface cores were sampled in the upstream Loire estuary (Le Pellerin) and processed during contrasted hydrological situations. First results obtained during a severe hypoxia event in August 2020 (below 30% saturation in bottom waters) showed limited iron oxides stocks in uppermost sediments indicating an advanced degradation state of previous large flood deposits. Consequently, sulphate reduction was observed few millimetres below bottom surface and seemed to dominate dissimilatory reduction processes despite a relatively low salinity. In the absence of macrofauna, total oxygen uptake was about twice higher than diffusive indicating importance of other non-diffusive transport processes. However, these fluxes were relatively low (22-27 and 6-10 O_2 mmol.m^{-2}.d^{-1}) and concomitant to low alkalinity influx and no quantifiable phosphate diffusion. First results from February 2021 showed an inversion of alkalinity flux towards water column. These results confirm the relatively low benthic exchanges during hypoxia. Comparison with flood period will permit to depict the initial state of sediment freshly deposited in terms of organic matter content, lability and origin and iron oxides and adsorbed phosphorous stocks allowing mass balance approaches to evaluate significance of benthic processes as triggers or magnifiers of estuarine seasonal hypoxia. Our first results underline the importance to pursue analytical research in pelagic and benthic coupling in such a complex system and for stakeholders to take into consideration the benthic compartment and benthic/pelagic coupling in water quality management modelling and policy.