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Spatial patterns and drivers of benthic O_2 demand in the West Gironde Mud Patch (Bay of Biscay, NE Atlantic)

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Benthic remineralization of organic matter in river-dominated continental margins plays an important role in coastal carbon cycling. However, the respective contributions of surface sediment properties and benthic biological activity to its spatial variability remain poorly understood. The West Gironde Mud Patch (WGMP) is a mid-shelf silty clay depocenter in the Bay of Biscay (Northeast Atlantic), where sedimentary processes are influenced by Gironde estuarine inputs, autochthonous bloom-derived organic matter, hydrodynamic forcing, and bioturbation. The WGMP thus provides a natural laboratory to investigate the drivers of benthic remineralization, as assessed by sediment oxygen (O_2) consumption, a well-established proxy.

Surface sediment characteristics (median grain size, specific surface area, organic carbon and total nitrogen contents, chloropigments and their degradation products, total and enzymatically hydrolysable amino acids, ∂^{13}OC, recent sedimentation) were measured in sediment cores collected in June 2022 at 13 stations along a 35 and 75 m depth gradient. Diffusive O_2 uptake (DOU) was estimated by modelling *in situ* microprofiles measured with a benthic station, whereas total O_2 uptake (TOU) was measured from *ex situ* incubations of four sediment cores maintained under *in situ* conditions. Benthic macrofauna was identified to the lowest taxonomic level and counted after sieving (1 mm mesh) the incubated sediment cores, and its activity was quantified from sediment profile images collected with an Ocean Imaging Systems® profiler.

Results indicate a clear depth gradient of sediment O_2 demand, supporting the division of the WGMP into two zones. TOU decreased from 20.2±3.8 mmol m^{-2} d^{-1} in the shallow proximal area to 5.3±0.4 mmol m^{-2} d^{-1} in the deeper distal zone. In contrast, DOU increased along the same inshore-offshore gradient from 3.4±1.4 to 8.1±2.3 mmol m^{-2} d^{-1}. Accordingly, the DOU/TOU ratio increased from 0.2 in the proximal zone to 0.8-1.0 offshore, indicating that O_2 consumption in distal sediments was mainly driven by diffusive processes, with minor contributions (<20%) from macrofaunal respiration and bioturbation activities. These spatial patterns will be examined in relation to surface sediment properties, macrofaunal community compositions, and sediment profile images descriptors to identify the key factors controlling the spatial variability of benthic O_2 demand within the WGMP.