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Oxygen dynamics at sediment-water interface in Arabian Sea continental margin: results from planar oxygen optode experiments in situ

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Arabian Sea intermediate water is known as typical oxygen (O_2) depleted environment due to higher primary productivity. Between 200 to 800 m in the water column of western Indian continental margin, O_2 minimum zone (OMZ) is extensively developed and the O_2 concentration decreases to 0.2$\sim$1.5 μM at the depth. To investigate processes of O_2 penetration into sediment and interactions between O_2 and benthic activities at sediment-water interface (SWI) in OMZ, we newly developed an ultra-high sensitive planar O_2 optode to measure two dimensional O_2 profiles and their time series changes at SWI. This system consisted of a palladium porphyrin-based transparent sensor foil and a high speed modulation camera, and it was designed to obtain both O_2 profiles and the corresponding grayscale images at SWI at a same time. In the YK08-11 Arabian Sea cruise by R/V Yokosuka, the planar O_2 optode system installed in an autonomous lander system was deployed at 801 m and 1160 m depth in western Indian continental margin, respectively. At 801 m depth, O_2 concentration in the bottom water was changed from 1.5 to 4.0 μM during one day deployment, and the change was synchronized to the tidal cycle. O_2 penetration depth into the sediment was at most 2 mm by molecular diffusion, but O_2 penetration was partly enhanced by hydrodynamic flow. At 1160 m depth, O_2 concentration in the bottom water was fluctuated from 17.5 to 25 μM, and the depth of O_2 penetration into the sediment was 4 to 6 mm. In each site, no meiobenthic activities were observed as to see the grayscale profile images. However, large benthic organism tabulated sediment surface at 801 m depth, suggesting that even in sediment in OMZ, biological mixing plays a significant role on O_2 supply at SWI.