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Enhanced alkalinity and dissolved inorganic carbon release in intertidal sands from the Oosterschelde (The Netherlands) induced by a natural macrofaunal community

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The influence of bioturbation and bioirrigation in intertidal sandflat sediments from the Oosterschelde (The Netherlands) on the rates and sources of benthic alkalinity (TA) and dissolved inorganic carbon (DIC) generation was examined using measurements of sediment-water fluxes of bromide, oxygen, nutrients, TA and DIC. Sediments from the Oosterschelde typically contain the deep-burrowing polychaete Arenicola marina, the sub-surface bioturbator Macoma balthica and the surface bioturbator Cerastoderma edule. Measurements were carried out in six tanks (106 cm x 87 cm x 20 cm). The sediment was collected in November 2012. Measurements were started in June 2013. Each tank was sampled twice for benthic fluxes over the course of one month. Prior measurements three tanks were defaunated by covering the sediment surface with a black plastic sheet. Benthic flux measurements were carried out in closed plastic chambers (diameter 66 cm). These chambers typically contained about 10 cm sediment and 20 cm overlying water. The tank was completely covered with opaque a black plastic sheet during measurements. The incubation time ranged from 6 to 8 hours.
Here we present preliminary results from both experimental runs. High benthic fluxes of TA (10 - 70 mmol m-2 d-1) and DIC (35 - 150 mmol m-2 d-1) were observed in all tanks. Whereas benthic TA and DIC fluxes were significantly higher in faunated tanks, total oxygen uptake (TOU: 30 - 75 mmol m-2 d-1) did not show any meaningful trend between the two treatments. Therefore, the apparent community respiratory quotient (CRQ = DIC/TOU) varied between 0.9 and 3.3, with significant higher values in faunated tanks, suggesting enhanced flushing of DIC produced in deeper layers and released by bioirrigation. This DIC was either produced by anaerobic respiration or carbonate dissolution. To unravel the contribution of carbonate dissolution and anaerobic respiration on the observed TA and DIC fluxes, we further present estimations for relevant reaction rates based on a mass balance approach.