Ocean acidification affects the benthic nitrogen cycle in coastal sediments: evidence from the Belgian Part of the North Sea

Vanaverbeke Jan[1], Ulrike Braeckman[1], Carl Van Colen[1], Katja Guilini[1], Dirk Van Gansbeke[1], Karline Soeteaert[2] and Magda Vincx[1]

[1] Marine Biology Research Group, Ghent University, Krijgslaan 281/S8, B-9000 Gent, Belgium
E-mail: jan.vanaverbeke@ugent.be

[2] Department of Ecosystem Studies, Netherlands Institute for Sea Research, PO Box 140, 4400 AC Yerseke, the Netherlands

Research so far provided little evidence that benthic ecosystem functioning is affected by ocean acidification under realistic climate scenarios (pH decrease of 0.3). Therefore, ocean acidification is considered a process acting in the water column, with little to no direct effect on benthic ecosystem functioning. However, most of these investigations did not cover different sediment types and possible seasonal effects. The scarce information is available from relatively fine-grained sediments, while the effect of ocean acidification on permeable coarse sediments, covering the bulk of coastal sediments, remain virtually unexplored. We investigated whether a pH decrease of 0.3 affects sediment community oxygen consumption (SCOC), nutrient exchange, estimated nitrification rates and alkalinity fluxes in coastal permeable and fine sandy sediments. As benthic ecosystem functioning is largely affected by the timing of phytoplankton bloom deposition, we repeated our incubations before, during and after bloom deposition. We observed a lower SCOC in both sediment types with a decreased pH compared to ambient pH in February and April. This suggests that benthic oxygen consuming processes (such as nitrification) might be hampered at lower pH, which is indeed corroborated by lower estimated nitrification rates in these treatments. In addition, acidified sediments displayed more erratic (zero and negative) estimated nitrification rates. This suggests that the acidified benthic ecosystem is out of steady state, and highlights the need for long-term (> 14 days) experiments to measure the effect of ocean acidification on benthic nitrogen cycling. Structural and functional characteristics of macrofauna were not affected by pH. Whereas drastic changes in pH affect benthic nitrogen cycling through altered macrofauna activity, we hypothesize that a realistic decrease in pH (-0.3) affects benthic nitrogen cycling through small changes in the microbial community.