Pore-water advection and solute fluxes in permeable marine sediments (I): Calibration and performance of the novel benthic chamber system Sandy

Janssen, F., P. Faerber, M. Huettel, V. Meyer, U. Witte

Limnol. Oceanogr., 50(3), 2005, 768-778 | DOI: 10.4319/lo.2005.50.3.0768

ABSTRACT: This contribution introduces the benthic chamber system *Sandy* that was developed for studying in situ solute fluxes in permeable sandy sediments where advective pore-water transport can dominate solute exchange across the sediment-water interface. The *Sandy* system can be deployed at the seafloor, where it autonomously performs measurements of sediment-water solute fluxes. The innovative features include an insertion mechanism that permits gentle and deep penetration of the chamber into hard consolidated sands with minimum disturbance, and an adjustable stirrer that generates a rotationally symmetric pressure gradient between the center and the circumference of the enclosed sediment surface. In contrast to similar systems, *Sandy* takes advective pore-water exchange into account. Through adjustment of the stirring rate, defined pressure gradients can be established that are similar in shape and magnitude to natural pressure gradients that develop at topographical structures of current-exposed sediment surfaces. Solute fluxes measured in the chamber at a specific [advective] stirrer setting can be compared with those obtained at reduced stirring, where pressure gradients are absent and solute exchange therefore is restricted to diffusion and bioirrigation. Rates of pore-water exchange that were determined by means of tracer experiments at different stirrer settings in natural coarse-grained North Sea deposits demonstrate the feasibility of this approach. This permits, for the first time, an evaluation of the contribution of advective exchange to the total interfacial solute flux in situ and makes *Sandy* a valuable tool to study advection-related processes in permeable shelf sediments.