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Diffusion-limited settling of porous particles in a stratified fluid KOLJA KINDLER, BO LIU, Max Planck Institute for Marine Microbiology, ROMAN STOCKER, Massachusetts Institute of Technology, ARZHANG KHALILI, Max Planck Institute for Marine Microbiology — Marine particles settle at low Reynolds numbers, are often highly porous, and are frequently observed to accumulate at pycnoclines. We present the first study of the settling of porous particles in a stratified fluid, by combining laboratory experiments and Lattice-Boltzmann simulations. We find that porosity markedly affects settling by causing retention of particles at pycnoclines. The excess density of highly porous particles is largely determined by the density of the interstitial fluid. The latter is adaptive in a stratified ambient, through exchange with the surrounding fluid. For low-permeability particles at sharp density interfaces, we observed the retention time to scale quadratically with particle size, as predicted based on a purely diffusive exchange of interstitial fluid. The simulations reveal that the interstitial fluid exchange, and thus the settling velocity, is modulated by a wake of lighter fluid that the particle entrains from upper layers. Both porosity and wake entrainment contribute to increase drag. These findings will affect estimates of carbon export rates from the upper ocean to the deep sea.

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