Title	**Investigation of flow and transport in the vicinity of uprising bubbles near the interface of permeable sediments using 3D PLIF and PIV**
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Abstract	The transport of methane from marine sediments into the seawater and then into the atmosphere is important in the context of its role as a greenhouse gas. In the present work, we use an artificial laboratory setup in order to investigate the mechanisms of flow and transport induced by rising gas in a permeable sediment We use a combination of the experimental techniques Particle Image Velocimetry (PIV), 3D Planar Laser-induced Fluorescence (3D PLIF) and refractive-index matching for the visualization and quantification of different aspects of this multiphase flow phenomenon. The gas injected continuously into the sediment leads to a cone-shaped structure of trapped gas and to a spatially and temporally fluctuating escape of bubbles at the upper interface. The temporal variability of the total volume of trapped gas results in fluctuations of liquid velocities in the sediment pores and therefore leads to an enhanced mixing of solutes in the sediment. Furthermore, the highly resolved 3D PLIF data visualizes and quantifies the existence of a reverse, i.e. downward directed flow of liquid into the sediment induced by the rising gas. The presence of this downward flow in marine sediments may have important implications for the understanding and modeling of nutrient cycles and microbial life at the seafloor in the vicinity of methane seeps.
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