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The C, O and S isotope distribution under different bed-forms of permeable sediment: A pumping and streamline segregation model

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Pressure gradients created by the interaction between sediment topography and bottom water currents transport reactive solutes and organic matter into marine surface sediments. The isotope distribution in the pore water reveals the effect of advection on the biogeochemical processes, transformation rates, fluxes of dissolved species across the sediment-water interface, and the development of isotope geochemical signatures in dissolved and authigenic solid phases. Based on the pumping and streamline segregation model, we calculated two-dimensional distribution of DI13C, 34SO4 and S18O4 in the pore waters of marine surface sediments. The isotope partitioning is dependent on the pore flushing rate, residence time, oxic mineralization rate, sulphate reduction and sulphide reoxidation rate. Comparing with a one-dimensional model, in which the effective diffusion coefficient is commonly used to represent the advection, our model gives a more accurate evaluation of the filter effect by permeable sediment. The model can be extended to other questions of benthic element transfer and biogeochemical cycling.

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