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Sediment megaripples as biocatalytical filters

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Megaripples are common marine bedforms in areas with strong bottom currents. Similar to their smaller counterparts, the sand ripples, megaripples influence physical, chemical and biological processes at the seafloor, but little is known about their role in the benthic ecosystem. We use a megaripple field in a tidal inlet in the northeastern Gulf of Mexico as in-situ laboratory to investigate the biogeochemical and ecological functioning of the megaripples. Acoustic Doppler current profiler data linked to sediment temperature profiles reveal that the tidal flows generate substantial water flows through the sediment that transport solutes and particles into and through the megaripples. These pore water flows produce a characteristic 3-dimensional geochemical zonation with well-separated oxic and anoxic reaction zones. These zones oscillate in tidal rhythmicity, promoting the sedimentary decomposition process and nutrient remobilization. Tracer applications allow estimates of the water volume that is filtered within each tidal cycle through the megaripple field, underlining the role of the bedforms as large benthic filtration system. Since this megaripple field is located within a tidal inlet, it can function as a filter at the entrance to the adjacent bay, modulating organic carbon, nutrient and pollutant exchange.