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Thermal and chemical evidence for rapid water exchange across the sediment-water interface by bioirrigation in the Indian River Lagoon, Florida

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ABSTRACT: Time-series measurements of chloride (Cl⁻) concentrations in lagoon and pore waters of an estuary on the east coast of Florida (Indian River Lagoon) demonstrate exchange of lagoon surface water to depths of ~40 cm in the sediment in less than 46 h. The exchange rate may be as fast as 150 cm d., based on models of the decay in the amplitude of diurnal temperature variations and the time lag of maxima and minima of the temperature variations at depths of 15 and 30 cm below the sediment-water interface. These flow rates indicate a minimum residence time of 0.33 d for the pore water. Considering the small tides and waves, rate of the exchange, and large number of bioturbating organisms in the Indian River Lagoon, the exchange of water is driven largely by bioirrigation. The exchange provides a greater flux of excess radon-222 from the sediment to the lagoon than would occur from diffusion alone. The exchange also pumps oxygenated water into the sediments, thereby enhancing organic carbon remineralization and the flux of nitrogen from sediments to the lagoon water. High rates of exchange across the sediment-water interface indicate that marine sources are volumetrically more important than terrestrial sources to submarine groundwater discharge in the permeable sediments of this estuary.

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