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The nearshore conveyor belt: Th-234 tracking of sediment transport in southern Lake Michigan

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U-238/Th-234 disequilibria have been used frequently to determine vertical particle settling rates in the ocean. Here we apply this pair in estimating horizontal transport in a nearshore, coastal environment. Episodic, storm induced sediment resuspension in the shallow nearshore zone of southern Lake Michigan remobilizes large masses of material within a matter of days to weeks. These episodic events, visible in satellite imagery, spin up quickly and are capable of resuspending as much or more material than is permanently deposited in the lake on an annual basis. Circulation and particle transport models developed by Schwab and others indicate transport of this material within the nearshore occurs in a counter-clockwise fashion, consistent with observations of the long-term sediment accumulation patterns in the southern basin. While this long term burial operates over decades, the aggregate time scale of the processes by which these particles move from source in river inputs and shoreline erosion to depositional sink is not well quantified.

An ROV deployed sampling system was developed for the quantitative collection of inventories of transient sediments on non-depositional hard bottoms. Comparison of these inventories with the supported production of excess Th-234 ($^1/_2$ life, 24 d) from U-238 decay in the water column follows a counter-clockwise trend from Th-234 depletion ($\sim$20%) along the western boundary of the basin to Th-234 excess ($\sim$30%) on the eastern side, implying a relatively rapid transport of active particles from west to east over distances of 100-200 km. Particle transport is accomplished via repeated resuspension into the overlying water where particles are conveyed by shore parallel coastal currents. Inventories and radionuclide disequilibria within this actively resus-

pended and transported sediment pool provide unique, empirical measurements of the residence time of particles in the nearshore water column, the frequency and duration of particle resuspension, the rate of horizontal transport of fine-grained sediments within this coastal plume zone, the absolute mass transport, and the relative focusing of material along this coastal conveyor system.