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Impact of a river system on carbon sedimentation and sequestration in Cook's Bay of Lake Simcoe, Ontario

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The influence of sedimentation rates and organic matter quality on carbon sequestration and mineralization at the land-water interface of lakes is not well understood. To study this issue we investigated shallow Cook's Bay of temperate Lake Simcoe in southern Ontario. The elongated bay provides gradients in morphometry, trophic level, and distance to a major tributary as a potential point source of nutrients and terrestrial organic carbon. At five sampling sites of increasing distance to the river outlet the water column was examined during stratification regarding physio-chemical parameters, dissolved organic matter (DOM) characteristics, sedimentation rates and mineralization of settling material and sediments. To quantify actual organic carbon burial, sedimentation rates and mineralization were determined in situ and by diffusive flux modeling. Long-term carbon burial and sedimentation rates were determined using 210Pb dated sediment cores. Organic carbon quality and origin were analyzed in water samples via fluorescence spectroscopy, solid DOM and settling particles via elemental analysis and 13C isotopic data. Results showed that actual and long-term carbon burial were highest at the central sites of the transect (52-63%) and lowest at the profundal sites (0-25%). Current organic carbon deposition was highest near the river outlet (max. 0.3 g C m-2 d-1) and there the settling material reaching the sediments and in the sediments was also most highly decomposable. Total sedimentation rates and organic carbon burial were closely related. Compared to the outer sites, the DOM quality was significantly different at the site closest to the river outlet but already strongly influenced by lacustrine carbon cycling. Permanent organic carbon burial was mainly influenced by sedimentation related to lake morphometry and dependent parameters. The relation between sedimentation and carbon burial rates underlined the importance of oxygen exposure time and burial for preservation of organic matter.