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A 210Pb sediment budget and granulometric proxy record of discharge variations for a sub-Arctic deltaic system: the Great Whale River in Hudson Bay, Canada

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To place recently observed discharge variations in Hudson Bays watersheds in a larger climatological context, a modern (<200 yr) sediment budget for the Great Whale River in southeastern Hudson Bay has been developed, based on ^{210}Pb/^{137}Cs geochronology from sediment cores. Seven box and gravity cores were recovered offshore the Great Whale River mouth. Coring locations were carefully chosen based on detailed bathymetrical and sub-bottom surveys. Sediment and mass accumulation rates (SAR, MAR) were calculated by measuring ^{210}Pb$_{XS}$ and ^{137}Cs activities. Sediment properties and sedimentary structures were analyzed via x-radiography and down-core patterns in ^{210}Pb$_{XS}$ activities and grain diameter distributions. To elucidate the fate of discharged sediment, ^{210}Pb$_{XS}$ apparent mass accumulation rates have been compared to measured modern river-sediment load. To hindcast on Late Holocene discharge patterns, modern mass accumulation rates then have been compared with the total sediment mass deposited in the study area as inferred from strata thickness in subbottom profiles. Minimum temporal resolutions were estimated from apparent bioturbation depth (inferred from x-radiographs and ^{210}Pb$_{XS}$ profiles) and sediment accumulation rates and range from 20 to 40 yr. However, patterns evident in granulometric data suggest that even higher frequency (<20 yr) environmental signals are preserved in the sedimentary record, despite biological homogenization of most sedimentary structures. Downcore variations in granulometric mass-frequency distributions further suggest a primary mode of sediment delivery of suspension settling from the river plume with a 15-20 yr cyclic pattern in plume intensity during the past 200 yr. Comparing ^{210}Pb$_{XS}$ derived mass accumulation rates with modern river sediment load shows that 20 % of the discharged sediment get deposited within 7 km of the river mouth (within our array of cores). The remaining 80 % are either deposited further off-shore or dispersed in the Hudson Bay system. In contrast, mass accumulation estimates from subbottom profiles suggest that since onset of fluviodeltaic sedimentation ($\sim$2800 yr BP) up to five times more sediment has been deposited annually offshore of the river mouth, than is being discharged by the Great Whale River today. This implies that either sediment discharge has been decreasing during the Late Holocene or that large amounts of sediment are being advected from elsewhere. One potential explanation (among several options under evaluation) is that continued isostatic rebound is decreasing local water depth, and increasing wave-associated sediment resuspension, winnowing, and bypass, thus decreasing local sediment retention offshore of the river mouth.