Early Holocene mass-movements in southeastern Hudson Bay and their possible triggering by postglacial seismicity

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Abstract

Glacio-isostatically induced seismic activity is recognized to play a major role in triggering submarine mass-movements along formerly glaciated continental margins. Ice load removal is known to cause fault instability and generate many earthquakes in these regions immediately after deglaciation. With rates of forced regression of ~7 m/100 yr at time of deglaciation (8-7 ka BP), southeastern Hudson Bay stands out as the region of the world with the highest recorded glacio-isostatic rebound. Although no evidence for past high magnitude earthquakes has been reported so far in the region, it is probable that such high rates of postglacial rebound generated seismicity shortly after ice retreat. Here we report on deglacial marine sediments traced over an extensive area of southeastern Hudson Bay that have been largely affected by submarine mass-movements during and shortly after their deposition. Exposures of ice-contact submarine fans today found on land show widespread occurrence of sliding and slumping, debris flow, liquefaction and dewatering structures. On the seafloor, a finer-grained deglacial sediment unit (i.e., more distally deposited) observed on subbottom acoustic profiler data show faults, slumps, debris flow lenses and abrupt discontinuities that pre-date the deposition of overlying postglacial sediments. High sedimentation rates during deglaciation generated excess pore pressure that preconditioned failure. However, high magnitude earthquakes possibly triggered mass-movements in southeastern Hudson Bay following deglaciation, as indicated by (1) the continuity of sediment deformation over a large area, (2) the presence of deformation in both submarine fans and distally deposited sediments, (3) similarities between the observed deformation structures with other earthquake-induced structures (seismites), (4) the fact that the deglacial sediments were deformed prior to the deposition of postglacial sediments that show only minor and superficial mass-movements features, and (5) the timing of their deposition, i.e. during a period of rapid glacio-isostatic rebound that had the potential of causing fault instability.