Evidence of synchronous mass transport deposits from sub-bottom profiling at Lac de l'Argile, Quebec

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Abstract
A sub-bottom acoustic profiling survey was undertaken at Lac de l’Argile (6.5 km²), southwestern Quebec, consisting of 39 profiles totaling 36.6 line-km. Mapping revealed 24 sub-aqueous, mass transport deposits (MTDs) occurring at ten stratigraphic levels (or event horizons) within the sub-bottom. Deeper mass transport deposits are present, but were not mapped because of signal degradation with depth. Eight of the ten event horizons are interbedded within an acoustic facies exhibiting multiple, decimeter-scale, parallel reflectors that is interpreted to be Champlain Sea glaciomarine deposits. The ninth event horizon is situated at the interface between the glaciomarine deposits and a massive to weakly-bedded acoustic facies interpreted to be post-glacial lacustrine deposits. Ten of the 24 mapped MTDs are located within event horizon 8, where the deposits are up to 12 m thick and form a continuous bed over ~4.1 km² of the sub-bottom. The spatial pattern of erosive and conformable contact underneath the bed reveals that the MTDs originated from multiple locations around the lake and coalesced within the basin. Because of the lack of differentiation between adjacent deposits, the MTDs are inferred to have happened synchronously. Event horizon 9 consists of four isolated MTDs of which two are relatively large (0.1 and 0.3 km²) and thick (up to 11.5 m). The other eight event horizons consist of one or two MTDs, which are mostly small (<0.2 km²) and thin (<3 m). The laterally extensive, multiple MTD character of horizon 8 contrasts markedly relative to the other horizons. It evidently was the product of a mechanism that triggered multiple, synchronous, sub-aqueous failures within the Champlain Sea. We hypothesize that the geomorphic signature of horizon 8 is best explained by a significant paleoearthquake within the Western Quebec Seismic Zone that occurred between 11 and 11.5 yr cal BP.