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The last North American ice sheet and mantle viscosity from glacial rebound analyses.

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This abstract presents new results for both earth (E-6) and ice-sheet (LW-6) parameters from the inversion of North American geological evidence for relative sea-level change (rsl) and tilting of palaeo-lake shorelines, complemented with loose constraints from observations of present-day radial crustal displacement across North America. The resulting earth response function is representative of the sub-continental mantle conditions with 3-layer effective mantle parameters (lithospheric thickness H and upper- and lower-mantle viscosities ηum and ηum) of H=102 (85–120) km, ηum =5.1x1020 (3.5–7.5)x1020, ηlm=1.3x1022 (0.8–2.8)x1022 (95% limits). The difference between ηum and the comparable estimate of for ocean mantle is statistically significant. An important new constraint on the interior of the ice model is provided by shoreline gradient information from Glacial Lakes McConnell, Agassiz, Algonquin and Ojibway and require multiple ice domes from at least ∼17-18 ka onwards with principal domes are over southern Nunavut (the Keewatin Dome) and over Québec-Labrador, both of ∼3500 m thickness, separated by an ice ridge across Ontario and northern Manitoba some 1500 m lower than the domes. The North American ice sheet volume before ∼17 ka remains poorly constrained from the North American analyses alone. Reconstructions of the glacial lakes are consistent with the locations and timing of the observational evidence for the four major lake systems with the likely drainage routes identified. The evolution of the LW-6 ice-volume function, expressed as equivalent sea level, is characterized by a rapid decrease in ice volume from ∼15–14.5 ka, corresponding to the Bølling-Allerød period, in the main from rapid ice retreat along the southern margin, with further contributions from drainage through the St Lawrence River valley and the major northern straits and gulfs, but not Hudson Strait where the rsl data point to late removal of ice (after 10 ka). The contribution of the drainage of the palaeo-lakes to global sea level rise is small, < 1m at the end of 9 ka, with final drainage of the Agassiz, Algonquin and Ojibway lakes occurring through Hudson Strait. The comparison of model predictions based on the above model parameters are, with one exception, consistent with observed GPS rates but do indicate a differential offset between the origins of the geodetic and geophysical reference frames, with the geodetic frame moving relative to the geophysical frame in direction approximately parallel to the earth's rotation axis. The full paper 'The North American Late Wisconsin ice sheet and mantle viscosity from glacial rebound analyses' is in press in J. Quaternary Science Reviews