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Distribution of tunnel valleys along the southern margin of the former Laurentide Ice Sheet

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The formation of tunnel valleys remains enigmatic, having variously been attributed to: (i) gradual formation by subglacial sediment deformation into channels under steady-state conditions; (ii) time-transgressive formation close to the ice margin by drainage of supraglacial meltwater to the bed or of meltwater temporarily impounded behind a permafrost wedge; and (iii) by catastrophic subglacial meltwater floods.

We present comprehensive mapping of the distribution of tunnel valleys and their relation to moraines and outwash fans along the southern sector of the former Laurentide Ice Sheet. The results permit a detailed morphometric and spatial analysis of tunnel valleys, and are compared against potential subglacial lake locations derived from a simple diagnostic approach that applies the Shreve equation to modelled ice and bed elevation data. A comparison of the two allows us to decipher the possible contribution of subglacial lake drainage events to tunnel valley formation. A relative age of the tunnel valleys, based on their association with moraines (i.e. whether they are incised through or overlain by them), is used to resolve when individual tunnel valleys and networks were eroded.