A Mother Lode of Log Accumulation During Rapid Climate Change Younger Dryas to Middle Holocene

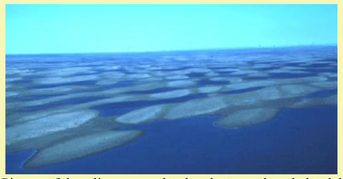
A mother lode of logs accumulated in the Bell Creek Valley in north central New York State from 12.1 to 11.2 ka cal BP. Over this time period the site evolved from being part of Lake Iroquois, to an flat lowland with flow between drumlins and log accumulation, to a site of sediment accumulation which preserved the logs. Over this period, preserved flora indicate the climate evolved from boreal open forest, to a moist cool climate, and then to the moist warm climate of today. Samples we will collect from this site could give a unique view of how climate changed at the end of the last ice age.

Carol Griggs[1], Todd Grote[2], Samuel Kachuck[3], Lawrence Cathles[3]

[1]Cornell Tree-Ring Laboratory, Cornell University, Ithaca, NY; cbg4@cornell.edu
[2]Geography and Geology, Eastern Michigan University, Ypsilanti, MI; tgrote@emich.edu
[3]Earth & Atmospheric Science, Cornell University, Ithaca, NY; sbk83@cornell.edu, lmc19@cornell.edu

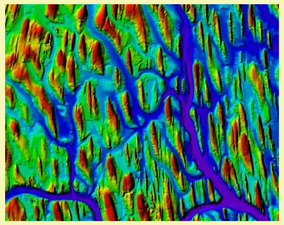
Illustrations of the landscape evolution of the site from before the Younger Dryas to the Middle Holocene.

Glacial Lake Iroquois, ca. 13.5 ka cal BP, when drainage was into Lake Albany. Red dot indicates Bell Creek site.



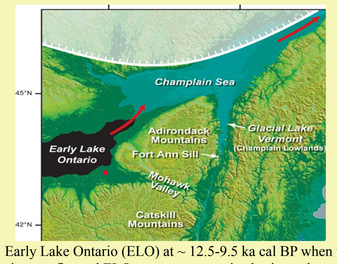
Picture of drumlins exposed today that were beveled to lake level in the past. Shore lines were cut into sides and bases of drumlins as the lake level continued to drop. Suggests the region as Lake Iroquois drained ~ 13.5-13.0 ka cal BP.

Picture show shoreline incisions.



Example of rivers flow through a drumlin field suggesting the pattern of river flow at the site before and during log accumulation, ca 13.0 to 11.0 ka cal BP.

Meandering river in a boreal setting with a constriction just before the lake that we think is similar to the situation in YD-EH time (ca 12.1 – 11.2 ka cal BP) when the logs accumulated.



Early Lake Ontario (ELO) at ~ 12.5-9.5 ka cal BP when the site was flat and ELO was an evaporative basin, and trees from local drumlins accumulated at the Bell Creek site.

Wetlands and drumlin, illustrating the period after log deposition, ~ 9.0 - 6.6 ka cal BP.

A 1994 aerial photo of site showing floodplain, current and abandoned channels, and wood collection sites to date. Today, opposite to when the logs accumulated, stream flow is to the south but eventually drains into the Oswego River which flows north into Lake Ontario.

Bell Creek Valley lies in a drumlin field in the lowlands south of Lake Ontario (Figure 1 to the right) that was covered by proglacial Lake Iroquois before the Younger Dryas (YD) and was gradually exposed starting ca 13,500 cal BP at which time a boreal-type terrestrial environment was established dominated by spruce. Quantities of logs were deposited along with sediments in the floodplain with the most log accumulation into the Early Holocene as fir became established in the floodplain. Spruce persisted later into the EH at this site than at sites to the south and east of the Lake Ontario basin.

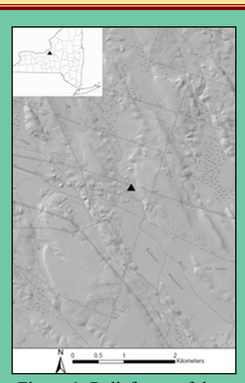


Figure 1. Relief map of the site and surrounding region.

Timeframe	Depositional Environment	Paleoecology	Paleohydrology
12-12.5 ka +	Shallow glaciolacustrine: shoreface/nearshore	Aquatic: gastropods, bivalves, etc.	Lacustrine
~ 12-9 ka	High energy fluvial system (braided?)	Boreal-type open forest with *Picea spp, Larix laricina, Abies balsamea* and *Pinus spp.*	Cold and dry transitioning to cool and moist
~9-6.6 ka	Poorly drained floodplain wetland with seasonally high water table	*Tsuga canadensis, Fagus grandifolia, Ulmus sp,* and other deciduous species in vicinity, but wetland with *Typha spp* and *Larex spp*	Warm and wet
post 6.6 ka	Better-drained floodplain dominated by overbank deposition	Deciduous-dominated forest	Warm and dry transitioning to cool and moist about 3 ka

Table 1. The timing of log depositions and the environmental and hydrologic conditions at the Bell Creek site in the timeframe of calibrated years BP.

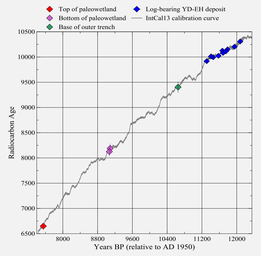


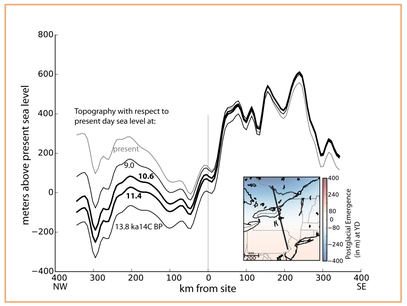
Figure 2. The IntCal13 calibration curve with the ^{14}C dates of the samples listed in Table 2.

AnaNr	Species	^{14}C Age	^{14}C Error	Location
Wetlands				
Hd-26256	*Fagus grandifolia*	6649	36	top
Hd-26286	*Abies balsamea*	8191	28	base
WW-9390	*Tsuga canadensis*	8125	35	base
Interface				
Hd-30279	*Picea*	9403	35	interface
Active Fluvial System				
WW-8906	*Picea*	9995	30	outer bank
Hd-28655	*Picea*	9918	37	
Hd-30270	*Picea*	10011	44	
Hd-30278	*Picea*	10112	40	Increasing distance from outer bank
Hd-30268	*Picea*	10024	52	
Hd-28656	*Picea*	10125	38	
Hd-28653	*Picea*	10082	38	
Hd-30269	*Picea*	10098	36	
Hd-30253	*Picea*	10152	34	
Hd-30271	*Picea*	10204	34	
Hd-30251	*Picea*	10308	32	inner oxbow

Table 2. ^{14}C ages of wood samples collected from the Bell River site. Note the persistence of spruce (Picea) well into the EH (post-10 ka 14C BP).

Figure 3. The emergence of topography near and at the Bell Creek site (at 0 km) from 13.8 ka ^{14}C BP to the present. The site sits just north of a location where the uplift increases strongly to the north. The insert shows the location of the transect and also indicates the pattern of emergence (present elevation of past surfaces) since 10.8 ka ^{14}C BP (YD time). Note the emergence flattens the topography at the site.

Conversion from ^{14}C to cal BP:
13.8 ka ^{14}C = 16.5 ka cal BP
11.4 ka ^{14}C = 13.3 ka cal BP
10.6 ka ^{14}C = 12.5 ka cal BP
9.0 ka ^{14}C = 10.0 ka cal BP



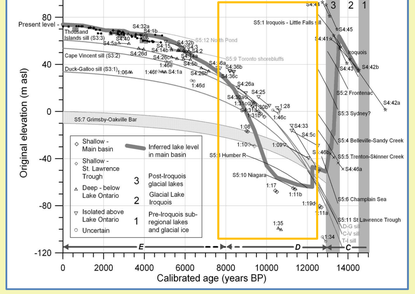


Figure 4. The elevation of the water surface of Lake Ontario (relative to present sea level) as a function if time. The lake level dropped abruptly at ~13.5 to 13.0 ka cal yr BP and the logs at the Bell Creek site accumulated when the lake level was at its lowest level. Starting about 10.3 ka cal BP the Lake level started to rise. Also shown by light lines and a grey band are the elevation of spill points that controlled flow into and out of the lake. The spill points changed with erosion and glacial emergence.

The logs were buried and preserved by silt deposition as glacial rebound flattened the site (Figure 3), and the site became a wetland starting around 9.0 ka cal BP. The organic-rich wetland sediment contain only small fragments of wood that increase in size upwards through the cover. The wood fragments indicate that a temperate forest surrounded the wetland, and that the climate was moist and relatively cool. Hemlock, elm, and beech indicate that occasional flood events transported fallen and decomposing logs across parts of the wetlands. The anatomical features of the fragments indicate a normal environment with little of the growth stress found in trees in a higher-energy riparian environment.

During this period isostatic adjustment plus erosion/deposition reversed the direction of the streamflow. During this reversal conditions were particularly stagnant.

By about 6.6 ka cal BP, continuing isostatic uplift ended wetland deposition and meandering streams, with overbank erosion and shifting channels, were established in a drier environment.

CONCLUSIONS: The Bell Creek site described above is surely a case of the **right site at the right time**. The site was right because it was at the hinge line of isostatic uplift where hydrological changes allowed the logs to be accumulated and then preserved. The time was right because it was during the rapid climate warming that ended the last ice age. This site provides a mother lode of tree ring data for the most interesting period of recent geological time.

References:
Anderson, T.W. and Lewis, C.F.M., 2012. A new water-level history for Lake Ontario basin: Evidence for a climate-driven early Holocene lowstand. Journal of Paleolimnology 47 (3): 513-530.
C. Griggs and T. Grote (2015). Evidence of climate change in the Lake Ontario region, North America, at the end of the Younger Dryas. (to be submitted to *CJES*, April 2015)
Grote, T., 2015. Late Quaternary Stratigraphy and Soils of the Bell Creek Floodplain research site near Ingalls Crossing, Oswego County, New York. Unpublished report.

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