

Prince et al. (2024) – Peer review

Geochronology

The submitted manuscript by Prince et al. presents new geochronologic data in the form of basal radiocarbon ages from kettle lakes and optically-stimulated luminescence (OSL) ages from glacial deltaic deposits to constrain the timing of the Kent and Lake Escarpment moraines – a Last Glacial Maximum (LGM) and recessional moraine, respectively. Results from these data are used to refine the timing of Laurentide Ice Sheet (LIS) deglaciation in western New York (NY) and address the proposed Allerød re-advance hypothesis (Young et al., 2020) which proposes re-advance of the LIS ~13 ka beyond the Lake Escarpment moraine.

The authors proposed a landscape evolution of kettle formation thousands of years after retreat of the LIS from the respective margins leading to a lag response in radiocarbon ages relative to the onset of deglaciation. The mechanism for the observed lag is attributed to the persistence of ice-cored moraines and permafrost across the Heinrich Stadial 1 cold interval followed by melting of the ice features during the abrupt Bølling warming leading to kettle lake formation. Interbedded coarse sediments amongst silt-dominated lake deposits are interpreted as periodic slumps of till during moraine stabilization.

The authors find no evidence to support re-advance of the LIS across the Lake Escarpment moraine and propose their new interpretation of landscape/kettle stabilization to explain the alternating coarse-fine sediments within the cores.

Overall, Prince et al. present compelling evidence to support their interpretations and conclusions. The results of this manuscript will advance the community's understanding of western NY deglaciation and the mechanisms driving ice-sheet deglaciation. There is room for improvement within the manuscript itself including some organizational changes and clarification of certain arguments related to radiocarbon interpretation. However, should these issues be addressed by the authors it is my opinion that the submitted manuscript should be accepted for publication.

My comments for improvement are listed below as broad, sections-specific, and finer, line-specific comments.

Section-specific comments:

Section 3. There are no issues with the content of this section. However, many of the sentences start with the word “we” (e.g., “We collected...”, “We determined...”, “We returned...”, etc.) often in sequential sentences. I recognize that there is debate within the scientific community about the use of active or passive voice in writing, but for now the Methods section would read more fluidly if many of these sentences were changed to “Samples collected were analyzed for...” or “OSL analysis was conducted at...”.

Section 4.1. It's easy to get lost in the stratigraphic descriptions for each core in Section 4.1. It could be helpful for the reader to explicitly discuss each core based on the associated moraine, so it becomes easier to follow when the stratigraphy of a Lake Escarpment moraine core is being described versus a Kent moraine core.

Section 4.2. It could be helpful to declare the stratigraphic unit in which each basal age is found since that is not consistent across all cores. As an example, starting on line 264 the basal ages for the Kent moraine are described, yet the 15,050-15,550 cal yr BP ages from 20VIN1 are in Unit 2 just above the boundary with Unit 1, whereas the 13,00-14,050 cal yr BP ages from 15ABB7 are found in Unit 3. Clarifying this for all radiocarbon data in Section 4.2 will strengthen your argument and allow the reader to immediately

associate the ages with their stratigraphic unit, at the same time setting up the stratigraphic discordance with older ages higher up the core.

Section 5.2. The second paragraph of Section 5.2 discusses the basal radiocarbon ages in relation to the timing of LIS retreat from the Kent moraine. It would be helpful to clarify you are referring to the ages from 20VIN1 located in Unit 2 just above Unit 1 which is interpreted as the glacial till. The description of “shortly before ~15 ka” needs to be changed to “prior to ~15 ka” as these are minimum-limiting ages on deglaciation and the duration between deglacial onset, as indicated as the stratigraphic change from Unit 1 to Unit 2, and the radiocarbon ages cannot be determined from these data alone. As such, there is not necessarily a contradiction between the young basal radiocarbon ages and regional correlations with the Lake Escarpment moraine ~17 ka. These results simply state that abandonment of the Kent moraine happened prior to ~15 ka and must have occurred prior to deposition of the Lake Escarpment moraine ~17 ka. Additionally, this interpretation of the basal radiocarbon age lends support to the eventual age-lag conclusion due to persistent ice and permafrost within the moraine.

Line specific comments:

Line 36: Consider revising. “Well constrained ice sheet chronologies...constrain”. Refine?

Line 93: Consider revising. “...dated to...by radiocarbon dating” is redundant.

Line 116: Define “significant” if you plan to describe the re-advance in this way.

Line 154: Was sediment bulk density only measured on the Little Protection cores? If so, why not on the others?

Line 283: Missing an end parenthesis after Olley et al. (1999).

Line 290: Consider using consistent terminology when discussing cores. Here you describe Vincent-1 when previously these cores were described as “20VIN1”. You could also include the associated cores in parentheses after “Vincent-1” for clarity.

Line 300: Careful with the word “probably”. This is an interpretation based on stratigraphy alone. A safer word to use here is “potentially”.

Line 301: Reiterate that core 21LPB1 is associated with the Lake Escarpment moraine.

Line 330: Clarify that “These samples...” refers to the macrofossils.

Line 336: Greater description is needed for how samples were assumed to be terrestrial origin. What visual cues were looked for to identify terrestrial vs. aquatic samples.

Line 348: Consider revising. The basal radiocarbon ages are trustworthy, but the up-core ages exhibit stratigraphic discordance and therefore do not reflect an accurate age of sediment deposition.

Line 364: The radiocarbon ages are from sediments stratigraphically above the glacial deposits therefore would not reflect moraine deposition. Do you mean “do not record deglacial onset”? A more accurate conclusion is reached on Line 425 “...radiocarbon dates can be extreme minimum age constraints on deglaciation.”

Line 366: Consider revising. “Ice cored moraines remained *as such...*” or “Moraines can remain ice cored for...”

References

Young, R. A., Gordon, L. M., Owen, L. A., Huot, S., and Zerfas, T. D.: Evidence for a late glacial advance near the beginning of the Younger Dryas in western New York State: An event postdating the record for local Laurentide ice sheet recession, *Geosphere*, <https://doi.org/10.1130/GES02257.1> , 2020.