

1 We appreciate the detailed and thorough reviews from Referee 1, 2 and 3. Between the three  
2 reviews, there are common themes, which we group together and respond to at once when  
3 appropriate. Below are responses to 1) their general comments, and 2) line-by-line comments.  
4 We also include our response to the editor's comment on our initial revision.

5 The reviewer comments are unbolded and marked as Referee 1 (*R1*), Referee 2 (*R2*), and  
6 Referee 3 (*R3*). The author's responses are marked as *AR* and **bolded**. This same document is  
7 included in all three replies and responds to all referee and editorial comments. The line  
8 numbers refer to the manuscript with tracked changes and are stated below the comment they  
9 address.

10

### 11 *Presentation and discussion of the Allerød Re-advance Hypothesis*

12 *Referee 1 (R1):* 2) The "controversial" hypothesis should be presented in more detail in the  
13 introduction or geological setting. Now it is only briefly mentioned in the introduction and again  
14 in the discussion. It is very relevant to describe in detail how Young et al concluded that a  
15 readvance took place at 13 ka.

16 **Author Response (AR):** We will update the introduction to include the following text in  
17 **red:**

18 "However, Young et al. (2020) recently interpreted new **and existing** radiocarbon ages  
19 from western New York to support a significant re-advance of the LIS at ~13 ka that  
20 overtopped the Lake Escarpment Moraine and nearly reached the Kent Moraine (Fig.  
21 1). **The evidence includes the re-interpretation of several unrelated sites throughout**  
22 **western New York, but largely hinges on new trenched sections near the Kent Moraine**  
23 **revealing logs in clayey diamicton, which Young et al. (2020) suggest requires glacial**  
24 **overriding of a forest ~13.3 to ~13.0 ka.** In contrast to Young et al.'s (2020) reconstruction,  
25 most literature places the LIS margin north of Lake Ontario at this time (Dalton et al.,  
26 2020; Muller and Calkin, 1993; Terasmae, 1980; and references therein), with the drainage  
27 of Glacial Lake Iroquois occurring at ~13 ka (Fig. 1; Cronin et al., 2012; Lewis and  
28 Anderson, 2019; Rayburn et al., 2005). **To reconcile the disagreement in timing between**  
29 **the hypothesized Allerød re-advance and existing chronologies, Young et al. (2020)**  
30 **invoke a largely floating ice mass that left minimal traces of its existence in most areas.** If  
31 a re-advance of the scale hypothesized by Young et al. (2020) occurred (henceforth  
32 referred to as the 'Allerød re-advance hypothesis'), we would need to revisit many  
33 regional deglaciation chronologies.

34 **Please see lines 56 - 67 with this updated text.**

35

### 36 *Presentation, organization, and discussion of the stratigraphy:*

37 *R2:* Section 4.1. It's easy to get lost in the stratigraphic descriptions for each core in Section 4.1.  
38 It could be helpful for the reader to explicitly discuss each core based on the associated  
39 moraine, so it becomes easier to follow when the stratigraphy of a Lake Escarpment moraine  
40 core is being described versus a Kent moraine core.

41 *R3*: The *stratigraphy* and *sediment core chronology* sections need some deep reworking.  
42 Indeed, I found these sections poorly organized, making it difficult to read and understand the  
43 results. The different cores are mixed in the text and the different units are not well defined. A  
44 better presentation of the data is important, as the position of the samples within the units is  
45 subsequently used extensively to correlate ages. Suggestions for improvement are included in  
46 my comments line by line in the “specific comments”.

47 **AR**: These two comments suggest a reformatting of the results section to group the  
48 stratigraphy and radiocarbon results by sediment core and moraine. We will format the  
49 results sections to discuss each site in order by moraine, describing each sediment core  
50 individually. This individual description will include 1) descriptions of the core  
51 stratigraphy by Unit, 2) radiocarbon ages with information about the unit they come from  
52 and 3) the age-depth relationship.

53 Please see lines 248 - 307 for the updated text.

54

55 *Presentation, organization, and discussion of the radiocarbon*:

56 *Associate editor*: Concerning the table 2 and reporting all calibrated intervals associated to the  
57 relative probability. I'll stick on the recommendations of the 14C community (e.g. Millard 2014).  
58 By reporting the interval that encompasses all calibrated intervals, you miss important  
59 information: the time periods that are unlikely and you no longer report a 95% confidence  
60 probability but something higher, between 0.95 and 1 since you include part of the remaining  
61 5%. This is not mathematically correct. I would also draw your attention to the fact that the  
62 median makes no sense in the context of a multiinterval calibration. You may even end up with a  
63 median in a non-probable interval. You'll save space by eliminating this column. Furthermore, as  
64 the  $\delta^{13}\text{C}$  are reported with uncertainty of 0.1‰, a single digit will sufficient to report this value.  
65 The spare room can be used to report 14C lab code. I understand your desire for an elegant  
66 table. My recommendation is to play with the thickness and color of the lines.

67 **AR**: In Table 2 we will report the discrete solutions within the 95% confidence interval (as  
68 shown in your example table) instead of the min and max of this range (as it is reported  
69 now). We will truncate the  $\delta^{13}\text{C}$  to one decimal point.

70 Please see line 361 for the updated Table 2.

71

72 *R1*: 1) The radiocarbon ages a given as ranges (min-max) throughout the text. Although this is  
73 the most correct way of reporting radiocarbon ages it makes the text less readable. I suggest  
74 that the min-max ranges are provided in the table and calibrated ages (in kiloyears) are used in  
75 the manuscript.

76 **AR**: If the editor agrees, we would change the age presentation in the text and figures to  
77 median ages reported from Calib and uncertainties as the larger difference between the  
78 median and the maximum and minimum age, like this: “X.X ± X.X cal ka BP”. Table 2 will  
79 still list ages in min-max form including discrete intervals as described above. Otherwise  
80 we will keep the age presentation in the text as the full 2-sigma range, as it is now, and  
81 refer to the table for more detailed information.

82 **As advised from the associate editor, we report the 95% interval in the text as a**  
83 **range of ages in cal BP.**

84

85 *R1:* 3) It would be worthwhile to consider making age-depth models for the records where there  
86 are many radiocarbon ages. This would allow a better assessment of the potential outliers  
87 mentioned in the text and also plot the proxy data on an age scale.

88 *R3:* Radiocarbon ages should be placed in a chronological framework using chronostratigraphic  
89 models (in figure 5 or in the appendix) instead of just reported ages in a stratigraphic column as  
90 discussed in the main text. This should be easily done with Oxcal for example (using sequence  
91 or phase command...). Then we may have access to probability spectra, for individually  
92 calibrated and modelled ages. This would make it possible to better justify/approve the choices  
93 made by the authors to conclude that the ages are not those expected. This also allows them to  
94 better constrain the ages between the bottom and the top of the different cores. Maybe the  
95 radiocarbon ages will perhaps also be less rejected by the authors...

96 **AR:** These two comments both suggest making age-depth models for the cores where we  
97 have sufficient radiocarbon constraints, so we will address their comments together. We  
98 agree that the age-depth plots provide a nice framework for discussing the radiocarbon  
99 results. We will add a supplemental file to our paper that contains age-depth plots so  
100 readers can visualize the sample distribution. We find the data shown as age-depth plots  
101 is most useful because we can symbolize the data by single terrestrial radiocarbon  
102 sample vs combined macrofossils with aquatic influence, etc., whereas an age-depth  
103 model created from rBacon or OxCal cannot. The  $2\sigma$  age range is typically smaller than  
104 the symbol to show the sample age when viewing all the dates on a single plot, and the  
105 probability spectra for each age can be created with the raw data should a reader want to  
106 access this. Finally, our interpretation that Unit 2 records the collapse of ice-cored  
107 moraines and the creation of kettles in an unstable environment makes us hesitant to  
108 create an age-depth model through these sediments.

109 **Please see the new Supplemental File for these age-depth plots. They are**  
110 **referenced in the text throughout the new results section (lines 248 - 307)**

111

112 *R2:* Section 4.2. It could be helpful to declare the stratigraphic unit in which each basal age is  
113 found since that is not consistent across all cores. As an example, starting on line 264 the basal  
114 ages for the Kent moraine are described, yet the 15,050-15,550 cal yr BP ages from 20VIN1 are  
115 in Unit 2 just above the boundary with Unit 1, whereas the 13,00-14,050 cal yr BP ages from  
116 15ABB7 are found in Unit 3. Clarifying this for all radiocarbon data in Section 4.2 will strengthen  
117 your argument and allow the reader to immediately associate the ages with their stratigraphic  
118 unit, at the same time setting up the stratigraphic discordance with older ages higher up the  
119 core.

120 **AR:** This will be clarified in the new structure of the results section.

121 **Please see lines 248 - 307 for the updated text.**

122

123 R2: Section 5.2. The second paragraph of Section 5.2 discusses the basal radiocarbon ages in  
124 relation to the timing of LIS retreat from the Kent moraine. It would be helpful to clarify you are  
125 referring to the ages from 20VIN1 located in Unit 2 just above Unit 1 which is interpreted as the  
126 glacial till. The description of “shortly before ~15 ka” needs to be changed to “prior to ~15 ka” as  
127 these are minimum-limiting ages on deglaciation and the duration between deglacial onset, as  
128 indicated as the stratigraphic change from Unit 1 to Unit 2, and the radiocarbon ages cannot be  
129 determined from these data alone. As such, there is not necessarily a contradiction between the  
130 young basal radiocarbon ages and regional correlations with the Lake Escarpment moraine ~17  
131 ka. These results simply state that abandonment of the Kent moraine happened prior to ~15 ka  
132 and must have occurred prior to deposition of the Lake Escarpment moraine ~17 ka.  
133 Additionally, this interpretation of the basal radiocarbon age lends support to the eventual  
134 age-lag conclusion due to persistent ice and permafrost within the moraine.

135 **AR: We agree that the nature of minimum-limiting radiocarbon ages means the ages are**  
136 **not contradictory to any of the correlations or the OSL ages. We will clarify wording**  
137 **according to this suggestion. A couple of line-by-line comments from R3 also suggest**  
138 **clarifying our discussion section that we address in more detail below.**

139 **We removed this paragraph and replaced the information in lines 439 - 457. We**  
140 **find this new text a more straightforward way of discussing the minimum-limiting**  
141 **nature of each Unit. We also changed the wording in the abstract (Lines 22 - 29).**

142

143 *Methods section:*

144 R2: Section 3. There are no issues with the content of this section. However, many of the  
145 sentences start with the word “we” (e.g., “We collected...”, “We determined...”, “We returned...”,  
146 etc.) often in sequential sentences. I recognize that there is debate within the scientific  
147 community about the use of active or passive voice in writing, but for now the Methods section  
148 would read more fluidly if many of these sentences were changed to “Samples collected were  
149 analyzed for...” or “OSL analysis was conducted at...”.

150 **AR: We appreciate this comment aimed at streamlining our writing. That said, this**  
151 **comment is a bit subjective (first vs. third person a matter of writers’ preference) and**  
152 **would like this in active voice.**

153

154 *Line-by-line comments:*

155 **R1:**

156 Line 15: consider using another word than "provocative" - it gives the wrong impression. Maybe  
157 use an alternative instead of provocative.

158 **AR: We agree to change the adverb provocative, perhaps to ‘controversial’, as described**  
159 **above.**

160 **We chose to remove the adverb altogether (Line 15).**

161 Line 19: ..luminescence ages..."of what?

162 **AR: We will include that these ages are from topset beds in an ice-contact delta.**

163 **This information is included on Line 19.**

164 Line 29: see the first comment about "provocative"

165 **AR: See above reply.**

166 Line 50: More information is needed about how Young interpreted the radiocarbon ages (see  
167 general comment)

168 **AR: See above reply.**

169 Line 69 (Fig. 1): Nice figure. Maybe add the existing chronological constraints mentioned in the  
170 text.

171 **AR: We will add in data discussed in the text as points along the moraines.**

172 **Figure 1 has been updated with the dates discussed in the text (Line 80) and the**  
173 **caption includes the citations (Lines 90-95).**

174 Line 173 (Fig 3): Nice figure but consider changing the yellow colour or increasing the line  
175 thickness.

176 **AR: We will increase the line thickness.**

177 **Please see updated figure on Line 191 with increased line thickness.**

178 Line 214 (Fig. 4): Overall good figure but panel A could be improved. The dimensions seem off  
179 and I wonder what the light brown colour below (a) represents.

180 **AR: R3 also has comments on how to improve this figure. We will sub-out the image in**  
181 **Figure 4, check the alignments and dimensions, and provide in the figure that the light**  
182 **brown is also bedrock.**

183 **Please see updated figure on Line 234 with fixed dimensions and bedrock labeled.**

184 Line 224: Ok descriptions, but it would be good to include the proxy data more in the description  
185 of the 3 units. In particular, MS, CaCO<sub>3</sub> and water content could be better incorporated in the  
186 text.

187 **AR: We believe these data are best shown in the figures – we will refer to the graphs in**  
188 **the beginning of the results sections to guide readers.**

189 **We refer to the graphs and broadly describe the downcore data on Lines 257 - 260.**

190 Line 249 (Fig. 5): Good summary figure with proxy data from the sediment cores. In 15ABB7  
191 MS is 0 - is that a mistake? Also, some LOI and water content data are missing in 20VIN4.

192 **AR: Yes ABB7 has MS values of zero for the entire core. We did not measure LOI and**  
193 **water content in 20VIN4 because it was a diamicton and difficult to sample, and we will**  
194 **add that information into the figure.**

195 **Please see updated figure on Line 332.**

196 Line 317-321: Consider starting with summarizing new data before stating it supports the  
197 existing data.

198 **AR: This was also mentioned by R3 – we will move this sentence to the end of the**  
199 **paragraph.**

200 **We moved this sentence to the end of the paragraph (Lines 410 - 413).**

201

202 **R2:**

203 *Line specific comments:*

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

205 **AR: We would change the wording to: ‘...are necessary to *determine* the timing of ...’.**

206 **We changed this wording, see Line 43.**

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

208 **AR: We would change the wording to: ‘...basin *around* 17 – 16 cal ka BP *based on***  
209 **radiocarbon dating...’.**

210 **We changed this wording, see Line 108.**

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

212 **AR: Similar to R1 comments about ‘provocative’, we will revise.**

213 **We removed this adverb as well (Line 132).**

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

216 **AR: The data are only from Little Protection because we investigated the Allerød**  
217 **re-advance in our two cores from the Lake Escarpment Moraine, and Dragonfly Kettle**  
218 **data creation took place before the Allerød re-advance hypothesis was published and we**  
219 **did not measure bulk density. We will include this information on Line 155.**

220 **Please see this new text in Lines 171 - 173.**

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

222 **AR: Thanks! We will correct that.**

223 **Corrected in Line 370.**

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

227 **AR: We will include the core name in parentheses after Vincent-1 for clarity. We will do**  
228 **the same if there is another occurrence of this.**

229 **We included the core name on Line 377.**

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

232 **AR: We will change this to potentially.**

233 **We changed this wording on Line 388.**

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

235 **AR: We will clarify which moraine the core is from within this section.**

236 **We include which moraine the cores are from in Line 387 and Line 389.**

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

238 **AR: Thanks, we will clarify that.**

239 **We included this on Line 422.**

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

242 **AR: Identification was rare at the time of sampling, partly due to the small size of the**  
243 **macrofossils available to be collected. Dr. Ole Bennike identified some of the dated**  
244 **samples. We opted for measurements of  $\delta^{13}\text{C}$  to provide a basis to infer terrestrial vs**  
245 **aquatic nature of samples dated. The samples that we identified as likely aquatic material**  
246 **had identifiable spores of aquatic material and the samples inferred to be terrestrial do**  
247 **not. So, we will change this sentence to be ‘We move forward using samples assumed to**  
248 **be terrestrial from a lack of identifiable aquatic macrofossils and supported by  $\delta^{13}\text{C}$**   
249 **values’.**

250 **We include this new sentence in Lines 430-431.**

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

254 **AR: The Unit 2 ages are trustworthy as minimum-limiting constraints on moraine**  
255 **abandonment, but the evidence for slumps and rip-up clasts in Unit 2, plus the**  
256 **stratigraphic discordance in radiocarbon ages, are reasons to doubt the reliability of**  
257 **radiocarbon ages to reflect the age of the sediment they are within. We will include these**  
258 **reasons within this paragraph (Line 348) to clarify.**

259 **As described above, we have changed wording in the discussion section to better**  
260 **our interpretation of the ages in each Unit. Please see Lines 439 - 457.**

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

265 **AR: We can change the wording for more clarification here: “According to this**  
266 **interpretation, our radiocarbon ages from Unit 2 could reflect plant death anytime**  
267 **between moraine deposition and kettle basin stabilization.”**

268 **We have included this in Line 475.**

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

271 **AR: Thanks, we will correct to ‘Moraine can remain ice cored for...’**

272 **Corrected on Line 479.**

273

274 **R3:**

275 Line 99/100: the 13,750-15,250 cal yr BP is from wood sample. This is an important point that  
276 may be more discussed later in the discussion section. Is the age calibrated against IntCal20 as  
277 your dataset? If not, it should be recalibrated and compared. This is also a general comment for  
278 all radiocarbon ages presented in the paper.

279 **AR: We will include this in the discussion around Line 365. The age is from wood within a**  
280 **marl layer that was deposited in a pond, so it is another basal radiocarbon age from a**  
281 **lake deposit and supports our conclusions. All radiocarbon ages in the text were**  
282 **recalibrated with IntCal20 and will be mentioned on Line 167.**

283 **We have included that Nichols Brook acts as another example of delayed kettle**  
284 **formation on Lines 475 - 477. We have stated that all ages in the text have been**  
285 **recalibrated with IntCal20 (Line 186).**

286 Line 204: Please justify here why you applied a MAM age (bleaching problem) and also which  
287 model was used (MAM-3 or MAM-4 ?). What is the  $\sigma_b$  value used to calculate your MAM  
288 model? Also, even with a MAM age you may always over-estimate the depositional ages.

289 **AR: We will add a clause here that we and other studies in glaciofluvial environments use**  
290 **MAM’s because of the increased potential for incomplete bleaching from subglacial or**  
291 **turbid water sediment transport that can sometimes shield sediment from complete**  
292 **bleaching. We will include more specifics with the MAM in the results section.**

293 **We have included why we use the MAM on Lines 223 - 225.**

294 Line 224 from 247: I recommend presenting the data by units but also by separating Kent  
295 moraine and Lake escarpment moraine sites. They are far away from each other... In my  
296 opinion, correlating data and units separated by more than 50 km is risky.

297 To avoid any confusions, you should write a paragraph for the Kent moraine sites and the  
298 different cores and then another one for the Lake escarpment site.

299 # Chronology section should be organized as in figure 5 :

- 300 • Kent moraine with ages from VIN1 to VIN4, SONG1, 15ABB7
- 301 • Lake escarpment ages with 13DFK1 and 21LPB1



302 **AR: This comment is in alignment with comments by other R's and will be addressed**  
303 **with a new results section (see above).**

304 **Please see new results section from Lines 248 - 307.**

305 Line 265 : "*For 20VIN3, 20VIN4, and 21SONG1, the basal ages cluster around 14,700 cal yr*  
306 *BP*". This sentence should be placed at the end of the section after a detailed review of the  
307 ages.

308 How do you calculate the mean age of 14,700 yrs? Did you use an oxcal model to determine a  
309 pdf age?

310 **AR: The word 'cluster' was a non-technical term that describes the general agreement**  
311 **within uncertainty around 14,700 cal yr BP. We will replace this sentence with the details**  
312 **of each core in this new chronology section described in the general comments.**

313 **Each cores lowest age is now discussed individually in the new results section**  
314 **(Lines 248 - 307).**

315 Line 265 : SONG1-age is taken from Unit 3 whereas VIN-4 and VIN-3 ages are from unit 2. Why  
316 are you mixing ages from different units? Your ages are maybe "basal" but are in different  
317 stratigraphic units. Please justify.

318 **AR: We will include the Unit information for each radiocarbon sample in the new**  
319 **chronology section described in the general comments. The reason they are in different**  
320 **units is the availability of material for dating. We will clarify in the text that ages in Unit 2**  
321 **are used as minimum-limits on deglaciation, and Unit 3 ages are used as minimum-limits**  
322 **on kettle basin formation.**

323 **The new results section outlines the Unit that each age is from (Lines 248 - 307)**  
324 **and the next discussion section describes the interpretation of the radiocarbon**  
325 **ages in each Unit (Lines 439 - 457).**

326 Line 266: "*The basal ages from the Lake Escarpment Moraine are 15,000-15,400 and*  
327 *16,650-17,350 cal yr BP.*" Again, I strongly recommend not mixing here the two sites. This  
328 sentence and all data from Lake escarpment should be placed together, in another paragraph.

329 **AR: See new strat/chronology section described in the general comments.**

330 **The sites are now described individually in the new results section (Lines 248 -**  
331 **307)**

332 Line 267 : "*The basal ages are not the oldest ages, however*". Please delete this sentence or  
333 rephrase it.

334 **AR: This will be rephrased in the discussion section.**

335 **This sentence was deleted when we rewrote the results section.**

336 Line 270 : "Combined macrofossils ..." : this is an important information that is not highlighted in  
337 the text and in figure 5. You should draw a different symbol for combined-fossils ages in figure 5,  
338 not only use stars. How many fossils are combined? Are they terrestrial or lacustrine?

339 **AR:** In Unit 2, the sediment is very minerogenic, but millimeter- to sub-millimeter-sized  
340 macrofossils were present. Aiming for 2 mg of dry sample often meant 10+ pieces were  
341 combined. Please see response to R2 for terrestrial vs lacustrine samples. We will  
342 change the symbol for combined macrofossil vs full macrofossils in Figure 5 and the  
343 supplementary age-depth plots.

344 Please see figures 5a, 5b, and all the supplementary files for updated symbols  
345 showing the difference between radiocarbon sample types and lines 177-179 and  
346 430-431 for macrofossil identification text.

347 Line 271 : *"In 20VIN3, the basal age is 14,350-15,150 cal yr BP, yet combined macrofossils*  
348 *higher in the core, at the Unit 2/3 boundary, produce an age of 15,350-15,650 cal yr BP."* Again,  
349 these ages should go with the Kent moraine.

350 Your basal age is from unit 2 and not from unit 3.

351 Again, you have a combined macrofossils sample, should be drawn with a different symbol.

352 **AR:** See new results section described in the general comments and response above to  
353 which Unit our ages belong to.

354 Line 280 : the radial plots placed in Appendix may be placed on figure 4 on D and the field  
355 photo may be placed on Appendix.

356 **AR:** We will switch the figures.

357 Panel (d) has been switched to show the radial plots (Line 234).

358 Line 283 : Same comment made on line 204

359 Line 301 to 305 : I don't understand how you came to that conclusion. Please rephrase this part.

360 **AR:** Noted that R3 found this writing unclear, will revise for clarity.

361 We chose to remove the specific details in Lines 390-393 and describe the  
362 interpretation more broadly like we did for 20VIN4 (Line 387-388).

363 Line 306 to 314 : again this paragraph is hard to read. Maybe some rewording may be good  
364 there.

365 **AR:** Noted that R3 found this writing unclear, will revise for clarity.

366 We streamlined this paragraph to include the most important points and use more  
367 clear language. Instead of 'productive lake and landscape' we changed the  
368 wording to 'more vegetation growing in the lake and landscape'. We removed the  
369 sentence about minerogenic sediment layers because it was redundant as we  
370 subsequently discuss the rip-up clasts later in the paragraph. (Lines 394 - 403).

371 Line 317 : *"The OSL ages support our estimated age of 25 – 20 ka for the Kent Moraine from*  
372 *prior literature and affirms our confidence in the age assignments using correlations of dated*  
373 *features elsewhere"*. The sentence should be placed at the end of the paragraph.

374 **AR:** This was also noted by R1, and we will move the sentence to the end.

375 **This was moved to the end of the sentence (Lines 410 - 413).**

376 Line 317 : “our estimated ages” : Why our? Please replace by the.

377 **AR: We will replace with ‘the’.**

378 **Replaced with ‘the’, line 410.**

379 Line 317 : Also cite references for the “prior literature”

380 **AR: We will cite Glover et al. (2011), Corbett et al. (2017), Stanford et al. (2020) and Balco**  
381 **et al. (2009; 2002).**

382 **These citations are included (Line 412-413).**

383 Line 321 : You should remember that they are MAM ages.

384 **AR: We state that these ages are from a minimum-age model and why we use the MAM in**  
385 **the methods in Line 204.**

386 **Our MAM explanation is now placed in Lines 223 - 225.**

387 Line 322 : “*The basal ages, taken at face value, indicate the deposition of the Kent Moraine*  
388 *occurred shortly before ~15 ka; this does not agree with our OSL age or the regional*  
389 *correlations*”. Why? Please develop in the main text this conclusion. It is not a problem for me  
390 that lacustrine conditions occurred after the deposition of the sediments dated with OSL. Again,  
391 your OSL ages may overestimate the true age.

392 **AR: Section 5.2 will be restructured to explain these arguments better. Also see response**  
393 **to R2.**

394 **Restructure is found in lines 439 - 457.**

395 Line 324 : “contradicts the 17 ka age ...”. Please cite the references here for this age. Based on  
396 which dating method? OSL, 14C or cosmogenic?

397 **AR: The 17 ka age was the oldest basal radiocarbon age from the Lake Escarpment**  
398 **moraine. This will be made more clear in the restructured 5.2 section.**

399 **This was deleted in the restructuring.**

400 Line 338 : “We derived”: why derive? Use another word.

401 **AR: We will change to “The age of...”**

402 **This was deleted in the restructuring.**

403 Line 339 : “fish bone”: again a missing information in figure 5 : Another symbol should be used  
404 for this sample!

405 **AR: We will define this sample as aquatic in Figure 5 and use a different symbol in the**  
406 **Supplementary Age-Depth plots.**

407 **See Figure 5 on Line 334 and Supplementary Figure 5.**

408 Line 334 : “*The macrofossil-rich rip-up clast in 20VIN1 holds evidence for two important*  
409 *interpretations: 1) the landscape was ice-free and at least sparsely vegetated as early as*  
410 *19,350-19,600 cal yr BP (consistent with our OSL ages suggesting ice sheet retreat by 19.8 ±*  
411 *2.6 – 20.6 ± 2.9 ka), and 2) the landscape stored this long-dead vegetation for thousands of*  
412 *years before it was redeposited.*” This sentence is not in a good position in the text. I  
413 recommend placing the sentence on line 338 after “*trustworthy age of 14,350-15,150 cal yr BP*”

414 **AR: We do not believe line 338 is a better position for this sentence. The paragraph**  
415 **surrounding line 338 is describing the ages we use in our analysis, and the sentence**  
416 **above is part of the analysis. We will restructure section 5.2 for clarity.**

417 **We believe this sentence is in a better place now that this paragraph is describing**  
418 **how we interpret Unit 2 (Lines 439-449).**

419 Line 415 : “*The tundra zone is overlain by an interval with high spruce and pine pollen; this is*  
420 *the lowest unit found in the other five records (Miller, 1973; Calkin and McAndrews, 1980). This*  
421 *is likely reflecting the new forest biome associated with warmer temperatures*”. Not well placed, I  
422 recommend moving it at line 411 after “*complicates their interpretation.*”

423 **AR: We agree this sentence best fits on line 411 and will move it there.**

424 **This sentence is now in Lines 524 - 527.**

425 Line 428 : In 10Be dating you have potentially inheritance problems that may over-estimate the  
426 ages of moraines. The age gap needs to be looked at more carefully and is under-discussed in  
427 your paper.

428 **AR: We do not think this discussion is within the scope of our paper.**

429 Line 444: “*The stratigraphically lowest radiocarbon ages from Unit 3 in the Lake Escarpment*  
430 *Moraine kettle basins, which are 15,000-15,400 and 13,600-14,000 cal yr BP, pre-date the*  
431 *~13.1 ka re-advance suggested by Young et al. (2020)* ».

432 And if all your radiocarbon ages were all reworked or contained some reservoir effects?

433 **AR: With the new results section, we hope it will be more clear that these two ages are**  
434 **from terrestrial macrofossils within Unit 3, which has conformable radiocarbon ages (as**  
435 **discussed in above replies). As such, we do not think the macrofossils in these units are**  
436 **reworked, nor could they be significantly affected by a hardwater effect. We hope the new**  
437 **age-depth models will help visual the sample placement.**

438 Line 444: For the age of Young et al. : please remember on which kind of sample is based the  
439 age, piece of wood? You must discuss more here the data in my point of view.

440 **AR: See reply to general comment from R1.**

441 **We include more information on the Young data in the introduction (Lines 56 - 65)**  
442 **and on lines 566 - 568 we reference that their data is primarily based on logs**  
443 **within clayey diamicton.**

444 Line 444: Also, on line 99 an age of 13 750 – 15 250 yr BP is based on a piece of wood. How do  
445 you reconcile your data with these ages? On figure 2 this age is found really close to your site E

446 , and looking your LPB1 section the ages look mostly in agreement, right? Your basal ages are  
447 close to those published ages. This may help...

448 **AR: See reply to previous comment from line 99.**

449 Line 460 : Again the 5 kyr offset could be due to some unbleached sediments, you can not  
450 totally delete this option.

451 **AR: The MAM has been found to successfully date glaciofluvial sediments with some**  
452 **portion of partial bleaching in other glacial settings in the northeast (Rittenour et al.,**  
453 **2015), and we believe this technique is working well in our study area. Our confidence is**  
454 **bolstered by the reworked macrofossils that date to 19 cal ka BP and the agreement in**  
455 **correlations to dated moraines in Ohio and eastern New York. We will include this**  
456 **wording in our discussion near Line 347.**

457 **We mention that the 19,350 - 19,600 cal BP age lends confidence to our MAM on**  
458 **Line 448.**

459 *RC3 Figures :*

460 Figure 3: Please indicate the core's names in the insets close to the colored dots. It is hard to  
461 follow the position of the cores and the descriptions in figure 5 when you are not familiar with the  
462 area.

463 **AR: We will add the core names next to the site names in the inset maps.**

464 **See Figure 3 on Line 191.**

465 Figure 5:

466 Please use different symbols according to the samples (terrestrial, lacustrine, combined  
467 macrofossils, fish bone...)

468 A chronostratigraphic model with spectra may be much better than just calibrated ages.

469 **AR: We will include different symbols for different samples in Figure 5. We will add**  
470 **age-depth plots in the supplement to include another way of viewing the radiocarbon**  
471 **ages.**

472 **We have displayed the radiocarbon samples based on single vs combined,**  
473 **terrestrial vs aquatic in Figure 5 on Line 335 and also in the Supplementary.**

474