Simon Larsson

We kindly thank Simon Larsson for taking the time to consider and comment on our manuscript. Below we provide a response to each individual comment.

Tephra studies are becoming increasingly complex as we are refining methodology and analysis and thereby detecting hitherto unknown deposits, reinterpreting old ones, and having more and more trouble separating some of them (chemically and chronologically). It is good to see a study with the intention to highlight a possible problem with a well-used isochron such as the Vedde Ash, but there are some major issues with this manuscript that would probably have to be remedied for the conclusions to be accepted.

1. As already commented, the study is missing a complete tephrostratigraphic description and has only sampled visible tephra layers (I'm assuming - this is not explicitly stated. While these can be argued to be "stratigraphically separated", there is a high likelihood of redeposition in such an environment as that of the study site and a complete tephra count for the sequence is, in my opinion, required to motivate the layers as being separate and primary deposits.

   We thank Dr. Larsson for raising this point and allowing us to clarify our rationale for why these tephra layers are primary deposits. As outlined in the manuscript, our primary argument relies on the fact that all the layers contain pristine and non-abraded glass shards with the inclusion of minimal lithics, and that each tephra layer features sharp upper and lower contacts with the interstitial organic sediment.

   In addition to the above, it is also near impossible to get bulk reworking of a tephra layer as required by the presence of three discrete layers, taking place decades to centuries after its deposition, let alone two times in a row. Moreover, given that Torfdalsvatn's catchment is low relief with minimal topography, the bulk of the reworking would be wind derived, which primarily mobilizes sub-50-micron grains and hence the reworked tephra would be very fine ash and each storm input would be expected to be normally size graded due to settling through the water column (i.e., Stoke's Law).

   Finally, tephra grain counting between layers would not be useful to discern tephra redeposition in Iceland where tephra comprises the background. Given that it is a volcanic island, the parent material of all soils is volcanic (Arnalds, 2004). While glass shard counting can be useful for distal locations in Europe, where Icelandic tephra shards are either primary or secondary deposits, we always find various glass grains present in Icelandic lake sediment due to the constant mobilization of the soil into lakes from the surrounding catchment.

2. The study is missing a complete description of the creation of the age models. It is specified that it is Bayesian and that IntCal20 was applied to create the age model for

the older study's sediment sequence, but no other specifics and no reference for software used is included. The creation of the age model for the present study's sediment sequence is not described explicitly (should it be assumed that the same procedure is applied as for the older?).

We thank Dr. Larsson for raising this point and allowing us to clarify our construction of age models. In L66-76, we outline how we constructed age models for both sediment records, i.e., from Björck et al. (1992) and the one presented in this study (TORF12-1A-1B). L75-76 states that, "Age models for the Björck et al. (1992) and TORF12-1A-1B sediment records were both created using the R package rbacon and default settings (Fig. 3, Blaauw and Christen, 2011)." While we included a citation for the R package (rbacon), we realize that we had forgotten to include a citation for R itself, which will be included during revisions.

3. As already commented, the study re-uses quite old radiocarbon dates with wide error margins, recalibrating them to create an age model for the old sediment sequence. This is interesting for comparison purposes but should be interpreted with a great deal of care. The suggested ages for the three tephra layers are based on linear interpolation between two other tephra dates spaced >60 cm apart, which is in my opinion not too robust of an age model. The study would greatly benefit from, if not require, a more complete chronology.

   We thank Dr. Larsson for raising this point and allowing us to clarify our rationale for not obtaining new radiocarbon dates. The dates that we calibrated were indeed generated several decades ago, but there is no reason to believe that they are any less reliable than ones generated today. The Björck et al. (1992) samples were dated with high-precision AMS techniques that remain the primary method used. While the uncertainty can be larger in samples dated several decades ago, the median ages of the original dates and those today remain similar. As an example, we compare 14C ages from the original Torfdalsvatn study (Björck et al., 1992) and another from the mid-late 2000s (Axford et al., 2007) – see Table below. Both samples were taken near the base of the G10ka Series tephra, and we recalibrated them using IntCal20 to make them directly comparable (Reimer et al., 2020). Given their similar stratigraphic location with respect the overlying tephra layers, the similar median age of the two samples is expected. The older sample from Björck et al. (1992) simply has a larger range of uncertainty, but the median age itself is not substantially different from a more recently dated sample (Axford et al., 2007).

   In terms, of derived ages from our new sediment core, it is safe to assume that sedimentation rate is linear between the two layers as shown by multiple prior studies from the early portion of Torfdalsvatn's sediment record (Björck et al., 1992; Rundgren, 1995; Alsos et al., 2021). Therefore, we feel comfortable interpolating the ages between the two tephra age control points and deriving age estimates for the three bimodal Katla tephra layers.

In the revised manuscript, we will be sure to emphasize the higher uncertainty of our age estimates due to the old 14C dates and age model interpolation, but that the median ages should be reliable. Ultimately, our results provide a baseline for future studies to improve age estimates and correlations to other localities.

Lab ID	Depth below G10ka Series	Material	Conventional ^{14}C age ± σ	Calibrated age BP ± σ	Reference
Ua-1890	8 cm	Moss macrofossil	9180 ± 210	10330 ± 370	Björck et al. (1992)
NSRL-14518	1.4 cm	Bulk sediment	9100 ± 25	10240 ± 10	Axford et al. (2007)

4. There is little-to-no lithostratigraphic description of the sample cores. This should be provided and expanded upon when comparing the sediment sequences of the older study and the current one, and hopefully this could provide better motivation for the assumptions being made about the tephra findings in the current study correlating to those in the older study.

   We thank Dr. Larsson for raising this point and agree that further descriptions of the core may be helpful. We will gladly include more detailed lithostratigraphic descriptions of our core TORF12-1A-1B in a revised manuscript and how it compares to that of Björck et al. (1992).

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