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Interactive comment on "Development of a multi-method chronology spanning the Last Glacial Interval from Orakei maar lake, Auckland, New Zealand" *by* Leonie Peti et al.

Anonymous Referee #3

Received and published: 16 September 2020

Thank you for the opportunity to review gchron-2020-23, "Development of a multi-method chronology spanning the Last Glacial Interval from Orakei maar lake, Auckland, New Zealand"; I really enjoyed reading the manuscript. Peti et al. take on the unenvious task of pulling together radiocarbon, paleomagnetism, meteoric beryllium, luminescence, and tephrochronology with a Bayesian age-depth modelling framework, supplemented by dynamic time warping. The manuscript is very well-written, conclusions do not overextend the data, and the work underpins a continuous 130-ka record that will no doubt foster many proxy records to come. I can easily recommend the content for Geochronology.

I am neither a physicist nor chemist, so I cannot specifically comment on the appropriateness and accuracy of much of the methodology (e.g., paleomagnetism, luminescence). General comments about the age-depth model are followed by specific comments in the text.

General comments

Test of the model: The authors do an admirable job of stitching together the various chronological threads. However, I would like to have seen a test of the age-depth model. If this were published with a pollen record, for instance, we could see if the appearance of critical taxa corresponds with other records from the northern North Island. As is, the reliability of the reconstruction is hard to gauge. One option could be to remove a tephra, run the model, and compare the model's estimated age of the tephra to the tephra's actual age, then repeat.

Dynamic time warping: This is an interesting technique that I have not seen applied to matching proxy records. While creative, I wonder about the heavy-handedness of the warping function on the original data. The stepwise pattern in the RPI data implies the algorithm expands and compresses the record quite regularly. Further, the VADM reference curve is interpolated from a data point every 1000 yr to 200-yr resolution. All of this results in an uncertainty that is seemingly not transferred to the age-depth model. The stock +/- 1000 years does not seem realistic given the uncertainty of the Rotoehu. The authors should consider a meaningful exercise in quantifying this error. Perhaps randomly sampling 13 data points could be repeated multiple times to estimate uncertainty? From a different angle, are there RPI measurements from the top 40 m? If so, the DTW technique could be compared to the chronology established with radiocarbon and tephrochronology.

Changing sedimentation rate: I think strong caveats need to be stated when highlighting the major trends in sedimentation rate. The authors rightly point out that the changes are not strongly related to stratigraphy. However, change in sedimentation

rate is related to a change in dating technique (from RPI matching to radiocarbon and tephrochronology).

Reservoir effect: If this was a known problem, then why only have two couplets of macrofossil/tephra and bulk sediment? It is beyond the scope to resample in the current paper, but perhaps more extensive comparisons between macrofossil and bulk sediment ages would be worth investigating in a future publication.

SHCal20: Given this will be the age-depth model for many proxy records to come, along with associated inter-hemispheric comparisons, I reluctantly suggest the authors recalibrate their age-depth models with this new curve.

Specific comments

Define “high resolution”

Typically, errors are reported as 2 sigma, but here they are reported as 1 sigma. Please explain why this is the case or change to 2 sigma.

Hyphenate units and value when acting as adjective. E.g., change, “. . .using wireline drilling in 1 m-length sections” to “. . .using wireline drilling in 1-m sections”.

P1L30: Change “spall” to “span”

P2L45: New Zealand does not need to be possessive

P3L85: Delete “of” before “paleoclimatic”

P3 Regional setting: Influx of erosional material is often invoked as a confounding factor throughout the manuscript. However, the catchment of Orakei is very small and crater wall slumps were presumably removed from the stratigraphy. Please explain potential sources of the erosional influx.

P7L274: Add “)” after “Accumulation model”

P8L316: Change “. . .as identified by (Molloy et al., 2009): to “. . .as identified by Molloy

et al. (2009)”

P16L648: Delete second “associated”

Figure 8: Interestingly, the age-depth model underestimates most radiocarbon dates between the Rotorua and Okareka tephras and overestimates most ages between the Okareka and Rotoehu tephras. Any thoughts on this?

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