

Interactive comment on “The Last Glacial Termination on the eastern flank of the central Patagonian Andes (47 S)” by W. Henríquez et al.

Anonymous Referee #1

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Review of manuscript entitled “The last glacial termination on the eastern flank of the central Patagonian Andes (47 deg S) by William I. Henríquez et al.

This manuscript reports the results of a study into lake cores in the valle chacabuco in central Chilean Patagonia in an area formerly occupied by a major outlet glacier of the former Patagonian Ice Sheet east of the present day North Patagonian Icefield. The study reports palaeoecological changes in this small closed-basin lake, which appear to indicate deglaciation of ~90 km had occurred in the valley by 19.4 ka, and that warming episodes occurred at 13.2 and 11 ka, with the latter being linked to the breakup of the north and south sectors of the former Patagonian ice sheet.

I am not a palaeoecologist and therefore, unfortunately, I am unqualified to comment on the data that is central to this manuscript. Instead, I focus my review on the overall

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implications of the data as interpreted wrt the glacial history in this valley, and a few general comments. From my review of these aspects of the manuscript, I believe the work to be a valuable contribution of new data in a region that is generally lacking detailed palaeoclimate records. My recommendation is for publishing the manuscript (providing other reviewers view the data positively) following minor revision.

General comments:

- The figures are poor.

Figure 1 is the only figure that gives any sort of context to the study, but it does not include many of the place names discussed in the text, making it very difficult to follow some of the discussion in the manuscript. For example when describing other records of deglaciation in the valley you mention: Sierra Colorado, Lago Esmeralda, Cerro Oportus, Maria Elena moraine, Lago Columna/Posada moraine – but none of these are shown on Figure 1. When revising the figures, ensure all of the areas discussed are shown on the figures.

The manuscript would benefit from a photo showing evidence for the upper lake terrace (591 m), which is used to infer two glacial dams in the valley.

I also felt the manuscript would benefit from a conceptual model of deglaciation in the valley that includes not only the changing ice extent, but also the changing vegetation over the time period of interest. This would be a simple way to help convey the results of your study.

- The structure of the introduction is awkward. The focus of the paper is on central Patagonia, but the opening paragraph discusses deglaciation in NW Patagonia and southernmost Patagonia (Cordillera Darwin). This is followed by a paragraph explaining the lack of data in central Patagonia, and the importance of gaining knowledge in the central sector, which is built on in the next paragraph on the importance of these data for model simulations of past climate. Then it jumps back to discussing data on the

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deglaciation of central Patagonia (which in the previous paragraph was described as missing or lacking). Finally, the present study is discussed. The introduction therefore is a bit awkward, and needs to be streamlined so that you don't jump between different ideas.

Specific comments:

- L45: Pacific Ocean rather than coast - L53: refer to Figure 1 for location - L43-60: its not clear why these sites are significant to the present study – more context required to make it relevant. - L61: I don't understand why you don't discuss the data from central Patagonia at the same time up front (L79-93)? It seems you should discuss what's been done before discussing outstanding questions and the need for more work. I realise that this paragraph is focused on western Patagonia, but it is not clear why the discussion in central Patagonia has been partitioned into east and west. - L75: You have not yet defined SWW (you do so on line 90). - L79: radionuclides (one word) - L79-86: Be more specific regarding what studies reported what results – perhaps break this into two or three sentences for clarity. - L83: 29kyr for the final LGM advance? Be clear what you mean by this. Are you reporting the timing of the maximum advance (outermost of the Rio Blanco moraines)? Or are you wanting to mention the final moraine before the onset of significant deglaciation (in this case, I guess the 'final limit' of 17.4 ka in Hein 2010). As written, it is not clear whether the date provided (incidentally, I have no idea where this number of 29 kyr comes from – wait it looks like you are taking data from Boex from Sierra Colorado rather than the rio Blanco moraines? You need to be more clear here) is meant to indicate the onset of deglaciation, or not. - L85: an event that took place... - L85: reword sentence - perhaps 'caused the breakup of North and south icefields... or something like that. The current wording is a mouthful and difficult to follow. - L90: define SWW earlier. - L95: collected from Lago Edita - L123: explain what is meant by 'changed the continental divide' to help reader understand the significant changes that occurred at the time. - L408-4099: Be more specific about the moraine limits, their relative

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order and why not just report the recalculated ages for clarity. Perhaps something like: "Cosmogenic radionuclide dating of three main Rio Blanco moraine limits by Hein et al. (2010) yielded cosmogenic ^{10}Be exposure ages, recently recalculated by Kaplan et al. (2011), of 28.7, 25.1 and 21.1 ka from outermost to innermost moraine, respectively" - obviously including uncertainties, etc. Do the same for the glacial recession and stabilisation dates too. -L413-416: Note that the age reported was considered a minimum age for the Lago Columna/Posada moraines. The inference is that these moraines should be older than 17.6 but younger than 19.6 ka. However, both of those age constraints are from single exposure dates from boulders, and thus should be considered no more than indicative. - L418: The Lago Esmeralda dates are from radiocarbon or cosmo or both? - L423: See comment above – 17.6 is a minimum. - L423: radionuclide - L415-429: A figure would help to convey this information – at present, very difficult to follow and Figure 1 contains none of the placenames. - L444: not clear what interpretation it is supporting. - L448: also report calibrated ages more clearly. - L459: So is there another explanation for why the radiocarbon ages could be old? Did Villa-Martinez provide an explanation for this outlier? Is there another reason why these radiocarbon ages could be so old? -L463: You should explain the order of the moraine belts earlier on, so it makes sense, perhaps in a figure. L465: Ok, there is actually an erratic from the Lago Columna moraine with an age of 20.0 ka; this mean is a bit awkward since it is not necessarily from the same landform as such. L470: There is an error here: the "final LGM limit" and the Lago Columna/Posada moraines as reported by Hein 2010 are only estimated at between 19.6 and 17.6 ka, based on 2 exposure dates. Within uncertainty, this still fits with your deglaciation age of 19.4 ka. With respect to the Boex dates for Elena moraines, these do appear younger than the radiocarbon ages. One thing should be noted in the manuscript is that all of the cosmo ages reported are minimum ages. This means that, for example, no erosion correction is applied. If the rock has eroded at all, the age would be greater. Likewise, if the rock is seasonally shielded by snow the age would get older. If the area has isostatically uplifted post deglaciation, the age would get older. If the rocks were deposited within

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a proglacial lake (thus shielded by water for some time), the age would get older. The point I want to make is that the cosmo ages are reported as minimums, and you might want to discuss some of these points when trying to reconcile the radiocarbon ages you obtain in your core. - L522: this lake isn't really upstream (SW) - L537: What are the implications for this wrt the Menucos moraines in Lago Buenos Aires (Douglass et al., 2006; Kaplan et al 2004)?

Please also note the supplement to this comment:

<http://www.clim-past-discuss.net/cp-2016-89/cp-2016-89-RC1-supplement.pdf>

Interactive comment on Clim. Past Discuss., doi:10.5194/cp-2016-89, 2016.