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The Cryosphere Discussions

Interactive comment on "Influence of the Tungurahua eruption on the ice core records of Chimborazo, Ecuador" *by* P. Ginot et al.

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Responses to comments of V. Pohjola (Referee):

My general view after reading the MS by Ginot et al is that this is a very good study of the effects of how a volcanic signal is imprinted into an ice record, and how the effects of the episodic warming alters the pre-volcanic record. I do not know of any other study like this, and such this work is an unique record of such a case. This will be a valuable tool / aid help ice core scientists to understand how (proximal) volcanic events may alter/imprint the glaciochemical data in ice core records. My general comments on issues that may be handled before final publication of the present MS are: 1. The conclusion part is in proportion to the rest of the text large. Some of the issues taken up in the conclusion should better be moved into the discussion part of the MS.

→ The paragraph of conclusion takes again mainly elements presented in the preceding paragraphs, and presents some prospective to this work. In this context, there are no parts to move in the preceding parts.

2. The indecis in Fig 3 and in the discussion part is by the large volcanic imprint of the solute into the ice matrix better to name volcanic signature indecis, than elution indecis. The latter, as used in the referenced literature assume there is no external addition of ions into the melting ice. This is the case at least for the ions SO4, Ca, Mg, and F. 3. It me be interesting to add a simple correlation analysis between the 1999 and the 2000 values of the different parameters to strengthen the arguments that the parameters are preserved/altered.

→ In the manuscript, I presented in Table 1 a comparison of the average concentrations amounts of the various chemical parameters over the entire length of the profiles divided into 4 zones. Significant changes are illustrated by bold values. On my point of view, the best comparison is still visually, illustrated in figure 2, with the two superposed profiles of core A and B. Actually, a correlation analysis between the two cores would be interesting, but is difficult to apply correctly due to two points: 1) the depth scale was matched from isotopic profile as best we could, but is not perfect... and 2) the sampling resolution and distribution between both cores is different.

Minor comments: P1345, li 4-8 The surface snow i5 melting and water percolation induced from the ash deposition caused a preferential elution and re-localization of certain ionic species, while the stable isotope records were not (very: CUT) affected.

⇒ Corrected

P1345, li 8-9 some selected (ion: ADD) ratios preserved

⇒ corrected

P1346, li 27 Add here a sentence of how much water, or at least that water was lost in the eruption. Already here may the reader want to be served the facts of melting

coming in later in the text.

⇒ The sentence “This change of the surface structure evokes the fusion of the upper layer.” was inserted.

P1347, li 9 form (form:CHANGE) the ionic balance.

⇒ corrected

P1347, li 16-20 Expand and make it more clear what the bimodal peak is, and perhaps add a figure of the GNIP O18 data to further explain the reasoning here.

⇒ The following paragraph was inserted: “Because of the proximity to the equator the air temperatures measured in all meteorological stations are relatively constant throughout the year. Temperature therefore does not play a significant role in the seasonal pattern of stable isotopes in precipitaton; it is the amount of precipitation and the link to the passage of the ITCZ. In the Andean domain (Quito and Izobamba) the d18O values in precipitation range between -7‰ and -9‰ during the two dry seasons and between -10‰ and -16‰ during the rainy seasons. As mentioned, “Veranillo” is less pronounced and not always visible in the isotope record (Garcia et al., 1998 and the Global Network for Isotopes in Precipitation GNIP, IAEA, Vienna, http://nds121.iaea.org/wiser/). In the Chimborazo ice cores the d18O values range between -12‰ and -15‰ during the dry seasons and between -16‰ and -22‰ during the rainy seasons. In the 12 years time interval as recorded by the stable isotopes, three to four “Veranillos” can be identified by little negative dips interrupting the general positive d18O trend during the dry season (Fig. 2)”.

P1347, li 19 the topmost 20 cm (w eq???) of the records

⇒ corrected

P1348, li 15-29 The discussion of the 18O profile is misleading the reader to think very little percolation/refreezing was the action here. True that the 18O record is very little affected by relocation, due to more mass, in comparison with water refreezing at these

ice depths. But, as the coming discussion will show, large volumes of water flushed through the system, and is now relocated at the firn/ice boundary. This needs to be sharpened.

⇒ We checked the unpublished stable isotope data at the firn/ice transition and could not find a significant disturbance due to refreezing. We therefore added the following sentence: “Because of a relatively high firn temperature ($\sim$ -4.6°C), the melt water percolated through the entire firn layer without major refreezing, presumably down to the firn/ice transition at about 23 m depth (H. Bonnaveira, personal communication) and then drained off to bedrock through crevasses. From preliminary stable isotope data at this depth, no significant additional refreezing can be deduced.”

P1351, li 12 H+, FôĂĂĂ, Ca2+, and Mg2+ show (a: ADD) similar behavior (than/as CHANGE) SO2ôĂĂĂ 4 . The tendency of Ca2+

⇒ corrected

P1353, li 14 a (huge/large: CHANGE) quantity of liquid water was stored above the firn/ice transition at about 23m

⇒ corrected

Figure text 2. Perhaps change in fig 2b accumulated into cumulated. For a glaciologist at least accumulated is something else as well.

⇒ Corrected

Interactive comment on The Cryosphere Discuss., 4, 1343, 2010.