

Interactive comment on “Two-dimensional impurity imaging in deep Antarctic ice cores: Snapshots of three climatic periods and implications for high-resolution signal interpretation” by Pascal Bohleber et al.

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Dear editor,

This is an interesting study employing LA-ICP-MS mapping of ice cores from Antarctica. The glaciology/climatology aspects are not my area of expertise, so my substantive comments below mainly concern the methodology. The paper is generally easy to follow, but there are many instances of awkward phrasing. I have a list of suggested typographical improvements below, but the paper should have a quick edit by a native

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English speaker. I recommend minor revisions.

A washout of 34 ms is quoted (i.e. the system is capable of returning to baseline with a repletion rate of 29Hz). Yet it says in the paper L70-71 “With washout times in the tens of ms range, the recording of baseline-separated single pulses at high repetition rates becomes possible; 294 Hz and a dosage of 10 were used here”. There is no way with a washout of 34 ms that that you would see baseline-separated single pulses, so some rewording is needed here. Additionally, the term “dosage” is not used all that commonly in the LA-ICP-MS literature. I would define it in one sentence, and the recent JAAS article by Šala et al. could be cited.

The isotopes ^{23}Na , ^{25}Mg and ^{88}Sr were measured, with dwell times of 4, 4.6 and 10 ms respectively. What was the total sweep time (i.e. including settling) and the duty cycle?

L138-140 “The relative higher background level seen in Na has been observed before in LA-ICP-MS ice core analysis and was suggested to be related to the use of NIST glasses as reference materials (Della Lunga et al., 2017).” Same would probably apply to any soda-lime glass. But my main query here were the signal intensity maps not background-corrected? And if not, why?

Typographical improvements L54 “In presence of a variable signal” – reword start of sentence.

L56 delete “on this ground”

L63 “keeps the ice samples surface temperature durably at” – change to “keeps the surface temperature of the ice samples consistently at”

L91 “Sample selection was guided to consider ice of” change to “Sample selection targeted ice at”

L93 change to “calls for mapping large areas”

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L99 change to "local maximum in grain radius at around 3.5 mm"

L106 use of "sections" is confusing in this sentence. Are we talking about different samples, or area / domains within a sample.

L109 delete 'their'

L121 "In-grain intensities of Mg and Sr" is not clear.

L129 change to "in the Mg and Sr signal distribution"

L133 delete "the image of"

L146 change to "since they are superior in such cases"

L159-160 change to "allows image segmentation based solely on the LA-ICP-MS images to be performed"

L174 change to "between 3-6 times higher than for"

L176 and 177. I do not follow either of these two sentences" "Both effects translate into an analogue situation for the ratios, with the exception of the Mg/Sr ratio. In grain boundaries, the latter shows only comparatively a small difference between MIS 2 and MIS 5.5."

L186-7 delete "It is important to note that this analysis assumes the continued presence of optimized instrumental settings, thus no further artifacts are introduced."

L188 what is the "transversal dimension"? Do not follow.

L192 change to "since it features"

L197 change to "while comparatively smaller grains"

L200 change to "only a small influence". I do not follow "the relative transversal position" part of the sentence.

L202 delete "at the steps shown here"

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L210 change to "but extend approach to samples from core sections"

L217 replace "analyzing" with "of"

L218-9 reword to "However, prior to the advent of the LA-ICP-MS imaging technique, elemental maps had to be acquired using arrays (grids) of laser spots with spot sizes larger than 100 μm , followed by spatial interpolation"

L231 change "may have fractions" to "may be"

L237 I do not follow 'may show "pinning of" or "dragging with"

L244 delete "exemplarily" (this word is used incorrectly in all instances in the paper

L254 delete "here analyzed"

L257 delete "already investigate"

L262-3 "image analysis applied to investigating the chemical images is advantageous"

L269 delete "signal of"

L272 replace "task" with "goal"

L296 change to "not a generally applicable value, however as the larger grains"

L305 change "recording" to "imaging"

L311 change "regarding" to "for"

L321-2 "are more distributed" is not clear

L324-6 change to "Simulations of coarser resolution experiments shows that the spatial significance of a single line profile increases as the imprint of grain-boundaries weakens at coarser resolution."

L326 change to "This allows settings to be adapted specifically fit-for-purpose"

Figure 5 caption. Change second sentence to "A linear regression (red dashed line) is

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shown purely as a visual aid.”

Figure 7 caption. Change first sentence to “Example images illustrating the effect of decreasing the spatial resolution of the original image (a) in 35 μm steps in the vertical and horizontal direction (see text).

Table 2 caption. Delete “Overview on results from”

Interactive comment on The Cryosphere Discuss., <https://doi.org/10.5194/tc-2020-369>, 2020.