Reviewer comments in black, response in violet.

**General comments:**

The manuscript by Tapia et al. presents P/Ca records from stalagmites of 2 caves in northwestern Spain. Their findings suggest accelerated phosphorus leaching during sudden climate transitions, as supported by sensitivity tests with a model. As a non-specialist I enjoyed reading this paper, although the number of figures and information presented in the paper felt a bit overwhelming at some points. To improve this I have listed some comments below. There are also smaller (technical) corrections that have to be made to improve the form and readability of the manuscript.

**Specific comments:**

Line 126: How was the temperature obtained? –

We have added the citation for the cave temperatures, the cited study reports the methods and frequency of cave temperature measurements.

Line 130: These values do not correspond to the values in Table 1. Are these values also presented in figure 2, results from new measurements? Should they not be presented after the method is introduced. Due to the large spread in the data (for LV especially), maybe also report the standard deviation with the average.

Line 130 describes the median P/Ca of bedrock from the two cave sites and cites Figure 2. No P/Ca determinations are listed in Table 1, Table 1 lists the number of P/Ca samples measured. We propose to update the header in Table 1 to "P/Ca # samples" to reduce confusion. Figure 2, as a box/whisker plot, illustrates the spread in the data including the $5^{th}$, $20^{th}$, $80^{th}$, and $95^{th}$ percentiles.

Line 140: first mention fCa, explain – this will be defined here

Line 182: Not sure if you have defined D before – D, the distribution coefficient, will be defined

Line 202: temperature – this will be corrected

Line 206: I don't count 12 stalagmites, and there are 2 bedrock samples in figure 2

We will update to " The median P/Ca ratio ranges from 0.1 to 0.2 mmol/mol across 9 datasets from 7 different stalagmites (GAE and NEI provided data during two distinct periods)"

Line 207: GAEL? – We will take care to use the three letter abbreviation (GAE) throughout

Line 207-213: Text is a bit repetitive, it feels like a list, due to the 'In GAE', 'PGM-LIG section of GAE' two times in a row. Rewrite it more naturally.

We propose to rewrite (also addressing Reviewer 1 comment) to:

The PGM-LIG section of GAE features numerous analyses with higher P/Ca than other samples, despite very slow growth and higher signal smoothing than other coeval stalagmites such as BEL and GAR, and features a positive correlation with Al/Ca ratios in the acid soluble fraction (Supplemental Fig. 1).

Line 213: How many points or % data was removed by applying this filter? Is the uncorrected + corrected data available in the supplementary?

We propose to include in the supplementary figure of Al/Ca vs P/Ca (now Figure S3, formerly S1) the number of excluded samples for each sample and increment. As described and illustrated in the figure, the largest number of points was excluded in GAE (82/230 analyses), and in other stalagmite segments of the PGM-LIG numbers are low (7 in BEL, 10 in GAR, 8 in GLD, and 3 in NEI) and are low for GS22 (8 in GAE, 3 in GLO, 2 in NEI, and 0 in ROW).

Line 329: what does A and B refer to? Panel or model? - done

Overall, there is some inconsistencies with the use of abbreviations in text and figures**;** Penultimate Glacial Maximum (PGM) to the Last Interglacial (LIG) are also called GL and DE in Figure 3. I assume you are talking about the same events, and since there are already a lot of abbreviations in the manuscripts, try to remain consistent. In the manuscript there is also GS 22 and GS22 (e.g. in text and SFigs)

These will be clarified in the revision. The PGM-LIG transition is subdivided into three time intervals in Figure 3 describing glacial, deglacial and last interglacial conditions to compare the P/Ca ranges. The use of a third category for the deglaciation means that PGM and LIG cannot be used in Figure 3.

The notation of GS22 will also be unified.

Table 1 : Units are missing for P/Ca and Mg/Ca. -done

Figure 1:Description needs more details for panel C: 'average precipitation per month (bars) and average temp…' - done

Figure 2: Penultimate Glacial Maximum. Maybe also note the abbreviations of e.g. PGM, LIG, GS 22 in the caption/figure. And what do the different colors mean?

The label for PGM will be expanded and noted in the Figure.

Figure 3: Note in the caption that the P/Ca values presented in this figure are corrected using Al/Ca.

This will be noted.

Figure 4: mention GS 22 or GS22 in the caption - This will be noted.

Figure 5 and 6: why split up these figures, can be combined in 1

For readability, these figures are split because fitting to one page would require significant compression of the size of each panel, and each stalagmite has both the P/Ca and d13Cinit trends. We propose to retain these as separate figures.

Figure 7: Again, the caption is a bit confusing, panels A, B, D, C and models A, B, C, D? I get a bit lost with the text and the reference to the panels. Maybe use letters for the individual panels and numbers for the models? Partitioning of an element (E) is normally written as $D_E$ and not just D.

We agree this is confusing and propose to rename the models to numbers so they do not coincide with panel names.

Figure 8: Legend is not readable

We propose to increase the size of the figure to a full page, and increase font in the legend.

Figure 10: I like this summary figure. Maybe add theoretical high or low stalagmite P/Ca for both scenarios (example p/ca with an arrow up or down next to it). Explain what red arrows mean (more or less intense P flux?)

We agree with these suggestions to make this figure more useful and will implement them.

Table S1: 2 of pCO2 in subscript, °C temperature – we will correct

Figure S2: The rightmost column illustrates. 2 of pCO2 in subscript - we will correct

Figures: In general, check if your figures are color-blind friendly, and if not, try to adjust them accordingly.

In the figures presenting data, color is redundant because distinct symbols and line patterns are used in all cases where different colors are used.

Data availability: Exactly how will the data be made available? Since the manuscript is already published on BGD and even citable, the data should be made available through an open repository as soon as possible.

We will provide a link to data in the ETH Research Collection repository with the revised manuscript.

**Technical corrections:**

In general, references in text have to be checked and corrected for form. Often a space is missing before the lit ref (example in line 37, 39, 42, 47..., 522 etc) or brackets have to be removed (examples line 164, 445, 465 etc.). Other examples of problems: Missing point in Kost et., al (line 129). Missing point after (Frisia et al., 2012) (line 57). Remove

brackets on Kost et al., 2023 in line 125. Add closing bracket and point after ‘see Kost et al., 2023 for overview’ in line 117. There are numerous other small issues.

The reference citations in text will be checked and corrected.

Also check the text for double spaces (line 39 – before ‘Current monitoring’ and line 47- before ‘Karst regions’), or lack of spaces (line 326: ‘Fig.7’). – these will be fixed.

**Citation**: https://doi.org/10.5194/egusphere-2025-1000-RC2