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Climate of the Past Discussions

Interactive comment on "Diatom-oxygen isotopic record from high-altitude Petit Lake (2200 m a.s.l) in the Mediterranean Alps: shedding light on a climatic pulse" *by* Rosine Cartier et al.

Anonymous Referee #2

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Review for: Diatom-oxygen isotopic record from high-altitude Petit Lake (2200 m a.s.l) in the Mediterranean Alps: shedding light on a climatic pulse at 4200 cal. BP

Authors: Rosine Cartier, Florence Sylvestre, Christine Paillès, Corinne Sonzogni, Martine Couapel, Anne Alexandre, Jean-Charles Mazur, Elodie Brisset, Cécile Miramont, Frédéric Guiter

General comments: Cartier et al. present a novel diatom ∂18O dataset spanning the past ∼5000 yrs from Lake Petit in the SW French Alps. The focus of the study lies in the local to regional characterization of hydroclimate perturbations around the 4.2ka climatic event and is thus relevant within the scope of CP. The oxygen isotope data

(4 data points for the time slice) show a clear excursion towards higher values, which the authors primarily interpret to be the result of drier conditions with increased evaporation in the Lake Petit watershed. By using already published data from a previous 'multiproxy' study of the Petit sediment record the authors further suggest that the period was characterized by precipitation induced flood events. While the interpretation of the oxygen isotope data appears mostly sound (detailed comments below) it is sometimes hard to follow the argumentation regarding the sedimentary indicators that suggest a higher frequency of flood events/catchment erosion during this period. Since this is quite a central statement for the hydrological reconstructions I would suggest the authors provide a complete lithostratigraphic account of the record (eg. Are there any discernible or identifiable flood layers?). In a broader sense the manuscript contributes an additional hydroclimatic dataset that will help to paint a regional picture of climate repercussions during the 4.2ka event in the Mediterranean borderlands. The manuscript is in most parts appropriately structured, in some parts appropriately illustrated, but suffers from a large number of spelling mistakes and grammatical flaws.

Specific comments:

Site settings - the seasonal distribution is quite important in this setting. If possible provide precipitation data for summer and winter months. Also, what controls winter snow depth in this setting? From the data presented it seems as if snow depth (by the end of the season?) varies largely from year to year.

- p.4, l. 1-4. Temperature dependent fractionation of rainfall is suggested as the main driver of seasonal oxygen isotopic composition. However, ∂18O of precipitation at Malaussene is lower (by almost 1per mill) during summer and higher during winter- please explain.

Material and methods - please provide a more complete description of the lithology of the record. Are there any discernible flood layers present? If so, does the frequency and/or the flood layer thickness increase during the respective time interval?

- have event layers (e.g. flood layers) been removed prior to the construction of the age model? - a new age-modelling algorithm has been applied to the Lake Petit core- please provide an age-model figure.

Discussion - p. 6 l. 3-6: Why start with human impacts if you can rule those out for the respective time interval? Emphasizing the different factors influencing the hydrological setting is more important in the context of the study- I suggest to start the discussion with those.

- Somewhere in the discussion (and in the site description section) it would be worth noting that the water residence time is short.

- P. 6, L. 27-28: 'Today, Mediterranean precipitation favours runoff and erosion in steep areas (Kosmas et al., 2002)'. Please specify more precisely what type of precipitation favours (intense) runoff and flooding. Also the seasonal distribution of this type of precipitation is important here.

- P. 6, L. 28-31: 'Geochemical data showing high terrigenous inputs to Petit Lake between 4400 and 4000 cal. BP (Fig. 4), interpreted as an increase of runoff in the watershed (Brisset et al., 2013), are thus consistent with a greater seasonal variability of the Mediterranean climate characterised by intense precipitation occurring in fall and spring and significantly drier periods in the summer months (Durand et al., 2009)'.

The statement of changes in seasonality is not supported by the data. Wouldn't an increase in convective precipitation during summer with Mediterranean moisture sourcing also explain both an increase in ∂18O and catchment erosion induced by heavy precipitation events. Also, snow cover in early spring would probably inhibit catchment erosion, leaving only heavy precipitation events in summer and early fall to explain an increased erosion pulse.

- P.7, l. 6-8: 'In summary, the rapid increase in δ18O diatom from 4400 to 3900 cal. BP is most likely the result of an increase in water evaporation possibly associated with a

shift in precipitation origin and distribution over the year. This state lasted for ca. 500 years'.

I am not sure I can follow the reasoning here entirely as it is also in part contradictory to the statements made earlier on in the discussion. For example, on page 6 you explain the increase in catchment erosion by an increase in spring and fall precipitation (that is similar compared to today), now here you propose 'a shift in distribution over the year'. Also stronger evaporation is suggested as the main cause for the observed ∂18O signal. However, the increase in erosion is probably best explained by more frequent and intense summer precipitation events and/or local expansion of glaciers/icefields (glacial cirque just above the lake). I think this is not all wrong but I would suggest the authors to 1) take a look at other records aiming at heavy precipitation reconstructions in nearby sites for the respective time interval, what do the authors of those studies suggest in terms of precipitation type and seasonal distribution? 2) some studies have suggested moderate glacier advances during this period. Wouldn't persistence of snow/ice throughout the summer also influence the hydrological budget of the lake? And at the same time deliver erodible substrates to the lake? The lake is located just below a glacial cirque which appears to have been active not too long ago. I suggest expanding on this somewhat as this is central to the interpretation of the dataset presented.

- P. 7, l. 27-28: Based on the interpretation suggestions above chemical weathering of soils is unlikely to intensify during the proposed climate conditions. Rather soils that formed during wetter and warmer climate phases prior to the 4.2ka event were subject to erosion, resulting in the input of more weathered soil material into Lake Petit. Please revise.

- P. 8, l. 12-29: This paragraph is simply a listing of quotes from references. Please integrate these with your data in a discussion style.

Conclusions

- p. 9, l. 10-11: 'The new δ18Odiatom record for Petit Lake was used to reconstruct past hydrological changes and decipher climatic implications from local human impacts around 4200 cal. BP.'

The study focuses on reconstructing hydrological changes, it does not touch upon human impacts. Please revise.

- p.9, l. 23-25: 'This isotopic record at Petit Lake has revealed the implication of the 4.2 kyrs event in abrupt ecosystem changes in the Southern Alps and is useful to better understand the intensity and geographical extent of this climatic event in the Mediterranean region.'

Again, this study, as is, focuses almost exclusively on hydrological changes. If the authors would like to include impacts of hydrological change on ecosystem changes than this part has to be developed throughout the manuscript and not only in the conclusions.

Technical comments:

Not being a native speaker myself I have the impression that this MS can benefit from language polishing by a native speaker. Below please find a few suggestions on how to improve the text.

- p.2, l. 13: In Central Mediterranean, while speleothems from southern Italy (Renella, Corchia Cave) recorded dry conditions from ca. 4300 cal. BP to 3800 cal. BP, dry conditions were less expressed in records from northern Italy.

Revise as follows: In the Central Mediterranean the pattern is less conclusive with dry conditions recorded from ca. 4300 cal. BP to 3800 cal. BP in speleothems from southern Italy (Renella, Corchia Cave). . .

- p.2, l. 15: Is this statement true for the entire Alps? Hölloch Speleothems etc and lake sediment records showing the same pattern? Please specify.

- p.2, l. 17-19: 'transition' is used twice in sentence, maybe revise?

- p.3, l. 12: Please specify seasonal rainfall distribution, how much precipitation (in mm) during summer and winter months (fall? Spring?).

- p.3, l. 17: during instead of by, delete ice (meltwater originates from the melting of ice or snow).

- p.3, l. 19: delete being

- p.3, l. 22: in instead of at

- p.4, l. 3: rather: . . .. but rather vary due to changes in source and temperature..

- p.4, l. 5: revise to: . . .after the snow melt..

- p.4, l. 18: Please insert concentrations for H2O2 and HCl.

- p.4, l. 31: ..placed in an..

- p.5, l. 15: Oxygen isotope values not oxygen isotopes values

- p.6, l. 12: frustules instead of spicules

- p.6, l. 15: 'snow' rather than 'ice'

- p.6, l. 16: drops by instead of decreasing

- p.6, l. 20: revise sentence- During summer, waters are well mixed down to the bottom due to wind stress on the open lake surface (Cartier, 2016).

- p.6, l. 32: delete fractionation.

- p.6, l. 33: would require instead of would imply

- p.7, l. 5: delete month

- p.7, l. 7: ..increase in lake water.. .. precipitation sourcing and seasonal distribution..

- p.7, l. 9-10: . . .suggesting more humid conditions..

- p.7, l. 18: rainfall instead of humidity, sourcing instead of influences

- p.8, l. 10-11: Revise sentence, it is rather hard to understand what you want to say. What is a lake trajectory?

- Fig.2: Use one font size and style for axis labels and numbers.

- Fig. 5: Botrychium is not mentioned in text but shown in figure. Either amend text and describe the meaning of it or remove from figure.

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