

Response to the interactive comment by G. Zanchetta

We thank Dr. Zanchetta for his positive comments on our work. We also appreciate his detailed comments on our reference list which helped to improve the manuscript. We have revised the manuscript to take into account these comments. We respond to all points item by item below, with the comments in black and our responses in blue fonts.

Interactive comment on “Evidence of a prolonged drought ca. 4200 yr BP correlated with prehistoric settlement abandonment from the Gueldaman GLD1 Cave, N-Algeria” by J. Ruan et al.

G. Zanchetta (Referee)

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Dear Editor,

I have now completed my review of the manuscript by Ruan et al. “Evidence of a prolonged drought ca. 4200 yr BP...” The manuscript is clear and well written and robustly discussed. I have just one general comment, which concerns the fact that some important references on the 4.2 event in the Mediterranean are missing. Some are just to improve the reference list like: Dixit Y., Hodell D.A., Petrie C.A. 2014. Abrupt weakening of the summer monsoon in northwest India \_4100 yr ago. *Geology*, 42, 339–342.

The reference Dixit et al (2014) was added into the Introduction of revised manuscript.

Others are more specific of central Mediterranean and need to be discussed and/or inserted in a general figures. For instances:

Finné M., Holmgren K., Sundqvist H.S., Weiberg, E. Lindblom M. (2011) - Climate in the eastern Mediterranean, and adjacent regions, during the past 6000 years: a review. *Journal of Archaeological Science*, 38, 3153–3173.

This interesting reference Finné et al (2011) examined the climate history of E-Mediterranean over the last 6000 yr and concluded with much evidence of drying conditions across ca. 4200 yr BP, which is consistent with our discussions in the manuscript. We added it with our comments into the Discussion 4.2 of revised manuscript. We presented, to the best of our knowledge, most well-dated and high-resolution Soreq stalagmite records from E-Mediterranean and compared them with our records and others from Central Mediterranean in Fig. 5, thus, no more curve was added.

More specific are:

Regattieri E., Zanchetta G., Drysdale R.N., Isola I., Hellstrom J.C., Dallai L. (2014a) - Lateglacial to Holocene trace element record (Ba, Mg, Sr) from Corchia Cave (Apuan Alps, central Italy): paleoenvironmental implications. *Journal of Quaternary Science* 29, 381–392.

This paper is also important because at corchia cave the 4.2 event is not so clear expressed in the oxygen isotope curve but very well expressed using other proxies. Other short events are here reported more robustly.

We agree that this reference is also an important study from Corchia Cave showing additional evidence of dryness around 4200 yr BP. We added it in discussion 4.2 of revised manuscript. We noticed that the authors’ climatic interpretations from the elemental proxy

were rather consistent with those from the isotopic proxy. Considering the proxy consistency and potential modelling tests in future, we preferred to present detailed comparisons of stalagmite oxygen isotopes from different parts of Mediterranean in Fig. 5.

Zanchetta G., Di Vito A., Fallick A.E., Sulpizio R. (2000) - Stable isotopes of pedogenic carbonate from Somma-Vesuvius area, Southern Italy, over the last 18 ka: palaeoclimatic implications. *Journal of Quaternary Science*, 15, 813-824.

Zanchetta G., Giraudi C., Sulpizio R., Magny M., Drysdale R.N., Sadori L. (2012a) - Constraining the onset of the Holocene “Neoglacial” over the central Italy using tephra layers. *Quaternary Research*, 78, 236-247.

Zanchetta G., van Welden A., Banerjee I., Drysdale R.N., Sadori L., Roberts N., Giardini M., Beck C., Pascucci V. 2012. Multiproxy record for the last 4500 years from Lake Shkodra (Albania/Montenegro). *Journal of Quaternary Science*, 27, 780-789.

In these last three papers the event is well defined and constrained using tephra layers. The references Zanchetta et al (2012a; 2012) also discussed climate change around the event. We added them with our comments in the Discussion 4.2 of revised manuscript. We prefer not to include Zanchetta et al (2000) because of its limited relevance to present study.

Roland T.P., Caseldine C.J., Charman D.J., Turney C.S.M., Amesbury M.J. (2014) - Was there a ‘4.2 ka event’ in Great Britain and Ireland? Evidence from the peatland record. *Quaternary Science Reviews* 83, 11-27.

Wanner H., Solomina O., Grosjean M., Ritz S.P., Jetel M. (2011) - Structure and origin of Holocene cold events. *Quaternary Science Reviews*, 30, 3109-3123.

In these last two papers is strongly challenged the idea that 4.2 event is a prominent signal in many part of the globe.

These two references are interesting, however, we do not agree that they strongly challenged the 4200 yr event. Actually we are in favour of the conclusion of Wanner et al (2011) that the Holocene climate change including “the 4200 yr event” show high spatiotemporal variability in a global scale. The 4200 yr climate anomaly has been widely identified around the world, but this does not necessarily mean that every signal archive can record it (Roland et al 2014). This may depend on the location and/or the sensitivity of each archive or sample, which need to be considered on a case-by-case basis and has long been in debate. In this study we focus on discussing the new record and available evidence from the Mediterranean basin. It is believed that more high resolution absolute dated records, as we show here, are essential to help clarify this issue.

Magny M., Vanniere B., Zanchetta G., Fouache E., Touchias G., Petrika L., Coussot C., Walter-Simonnet A-V., Arnoud F. 2009. Possible complexity of the climatic event around 4300-3800 cal. BP in the central and western Mediterranean. *The Holocene*, 19, 1-11. Magny et al., 2009 showed that around 4.2 to 3.8 ka there is a succession of events in many Mediterranean record. Can the authors suggest some also for their record (e.g. some part more drier/wetter than the other?)

We indeed observed intra variations within the isotopically shifted period ca. 4400-3800 yr BP in stalagmite GLD1-stm4. It can be roughly divided into three successions: two most

isotopic enrichments (dry) at ca. 4400-4200 yr BP and ca. 4000-3800 yr BP are separated by a mild isotopic depletion (wetter) at 4200-4000 yr BP. Relevant descriptions were added in the Result 3.1 of revised manuscript.

Minor point along the text.

Like Pag. 2732 when for the first time a species is quoted this must be completely Reported Modified as suggested

Pag. 2736 lines 5-10. It is unclear to me, looking also at table 1 why in the interval between 4900 and 4200 the error is so high.

The age model was developed and checked using the StalAge program, where a linear interpolation between depth and age was made through each progressive triplet of adjacent U-series dates. The large errors between 4900 and 4200 yr may be partly due to the relatively large errors of measured U/Th dates and/or inappropriate hypotheses applied in the program. This comment was added in revised manuscript.

Suggestions: Calcite precipitation out of equilibrium: the data reported to sustain deposition out of equilibrium are probably convincing, then the authors should convince the reader that the climatic signal is preserved. In this case a good argument is that the record is replicated in two different stalagmites?

We agree that replication of two stalagmite records would be a good argument for preserving climatic signals. Albeit different amplitudes the similarity in isotopic profiles of two stalagmites were observed and discussed in the manuscript. It has been known based on studies over the last years that stalagmite oxygen composition preserves climate signal even when it precipitates out of isotopic equilibrium. Actually in our study site, multiple lines of evidence indicates that the rainfall signal imprinted in stalagmite oxygen isotope (negatively correlated) is probably amplified by disequilibrium processes: longer residence time during drier (lower rainfall) period would allow extended disequilibrium processes which forces stalagmite isotope values further higher. We added more discussions in revised manuscript to further illustrate and better clarify the disequilibrium effect on stalagmite isotope record.

Pag. 2740 lines 18-20. "Thus the current climate in N-Algeria appears to be within : : : : :"

This sentence is not very clear and probably wrong. Isotopic composition of modern calcite is too low compared to GLD1-stm4.

We agree that the meaning of this sentence might have been ambiguous. We re-phased the sentence in revised manuscript.

Pag. 2741 line 22 flowstone instead of flow stone.

Corrected

Pag. 2742 line 26 4400

Corrected

Pag.2743. Line 10-11 It is unclear the reference to Irish stalagmite, please add citation and eventually insert the curve in some figure.

The cave names (Soreq) were added to clarify in revised manuscript. The references and curves had already been shown in the text and Fig. 5.

Note that several archives seem to suggest that 4.2 event is not evident at northern latitudes (see reference suggested). Overall I think that the manuscript needs moderate revision before final acceptance. It is important to discuss in more detail available literature in the central Mediterranean and to consider other quotations which suggest (and may support) the view that this event is not strongly represented in the N. Atlantic region as correctly stated by the authors.

Although climate anomaly around ca. 4200 yr BP has been identified globally, this does not necessarily mean that every signal archive can record it and indeed there are archives showing ambiguous change across the event. This may depend on the location of studied archive/sample, because the event shows variable climatic expression and high spatiotemporal variability. This may also depend on the sensitivity of the archive to climates, which has always been debated. In this study we highlight presenting our new record and comparing it with evidence from other parts of the Mediterranean basin. Suggested references were added and discussed in revised manuscript. We believe that more high resolution absolute dated records, as we present here, are essential to clarify this event.

Sincerely  
Gianni Zanchetta