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Climate of the Past Discussions

Interactive comment on "Stable isotope and trace element investigation of two contemporaneous annually-laminated stalagmites from northeastern China surrounding the "8.2 ka event"" *by* J. Y. Wu et al.

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I. General comment:

The paper submitted by Wu et al. addresses the impact and characteristics of the climate variations during the 8.2ka event recorded in two speleothems from North-Eastern China (Nuanhe Cave). Both stalagmites were appropriately analysed for the palaeo climate purpose. Good dating results accompanied by high resolution δ18O, δ13C and Ba/Ca records offer the possibility to investigate the effect of the 8.2 ka event

closely regarding seasonal differences. In addition, the study offers the chance to enhance the understanding of the coupling mechanisms between North Atlantic climate and the Indian/Asian monsoon systems. The authors suggest that the δ13C and Ba/Ca signal are influenced mainly by the climate conditions of the winter season while the δ18O variations are ruled by the summer monsoon regime. This leads to the effect that the 8.2ka event reflects only in the Ba/Ca and δ13C signal but not in the δ18O. The submitted paper is very well suited for the scope of CP. Nevertheless, the manuscript would benefit from a more detailed and structured discussion of the proxy records. First, some introductive comments on the atmospheric circulation patterns influencing the cave might facilitate to follow the conclusions the authors draw. Second, the authors could give more weight to the discussion of the correlation between climate and climate proxy (δ18O, δ18O, Ba/Ca) in general. Third, the final synthesis contains important insights to the seasonal circulation patterns and climate conditions at 8.2ka B.P. and highlights the value of the study, but should be stated more precisely. The manuscript would benefit from a clearer explanation by the authors. In some cases an interpretation is hinted but not clearly and in details explained, which might be the weakness of this manuscript (e.g. monsoon regimes, influence of seasons on different proxies). However, the multi-proxy records presented here are excellent and highly suitable for discussing the effect of the 8.2ka event in Northern China. With some further discussion the manuscript could be a profound investigation of the complex climate conditions and trends between 8.6 ka and 7.8 ka before present. To conclude, the submitted paper should be published with major/minor revisions. The specific comments are listed below.

II. Specific comments

Section 3.2 - Page 1596 - Lines 13-22 The discussion regarding the correlation of the δ18O records from NH33 and NH6 in the different intervals would benefit from adding correlation coefficients for each. In addition, the important frequency of 20 years should be proven by a frequency analysis or preferably a wavelet analysis. Probably the reasons for the high frequency variation in the records should be commented.

Section 3.2 - Page 1596 - Line 27 In the case of kinetic fractionation a relationship between δ18Odrip and δ18Ocalcite exists although the description requires more complex models (Dreybrodt, 2008; Scholz et al., 2009). These should be mentioned. Other parameters like temperature, cave air ventilation or pCO2 of cave air should be named which complicate an interpretation of the δ18Ocalcite as a climate signal.

Section 3.2 - Page 1597 - Lines 3-7 The authors state that if the δ18O largely reflects changes in the δ18O of meteoric precipitation, the observed variations likely relate to the proportion of summer monsoon to the annual total. However, it is not clear and no test is shown if the δ18O value indeed fulfils this requirement. Is this supported by the cave monitoring or other observed values? In this context the reader might appreciate a general comment on the climate influence on the δ18Oprec signal at the specific location (Lachniet, 2009; Mook, 2006). At the cave site 60% of annual precipitation occurs from June to September. For the authors this is the reason why the variations of drip water δ18O value reflect the proportion of summer monsoon precipitation to the annual total. However, this statement must be handled with care, because precipitation occurring during the summer month is partially lost due to evapotranspiration. Hence, although the summer monsoon precipitation has a high contribution to the annual amount of precipitation, it is possible that it contributes less than initially assumed to the annual amount of infiltration water forming the drip water in the cave. This fact must be considered and in the best case tested with monitoring data from the cave or data available from other caves in the region. Equation like that of Thornthwaite and Mather (1957) can help to evaluate the amount of evapotranspiration (or more sophisticated Penman (1948)). It is possible that due to the high humidity during summer monsoon evaporation is highly reduced and summer monsoon contributes largely to the annual amount of cave drip water. The second question arising here is, if the precipitation from the remaining months shows a rather stable behaviour compared to the monsoon driven summer precipitation. Only then, the assumption is valid, that the

δ18O variations of the cave drip water reflect the proportion of summer monsoon to the annual precipitation. Maybe the authors could also discuss in this context the influence on the δ18O signal of the drip water of varying contributions winter precipitation.

Section 3.2 - Page 1997 - Lines 11-19 A short comment on the reasons why higher δ13C values relate to lower biological activity (fractionation during plant respiration) could be enlightening to a reader who is not familiar with the δ13C system. The authors discuss the increasing trend towards 8.2ka before present and link it to lower biological activity. However, after this time the records show severe discrepancies which need discussion. What could be the origin for the different behaviour, since this cannot be linked to climate?

Section 3.2 - Page 1997 - Line 17 It should be explained once what is meant by “climate deterioration”, because this expression has different connotation depending on the respective climate zones and regions.

Section 4.1 - Page 1598 - Line 14 The term “Permafrost” is used here. Per definition permafrost is soil which is frozen for two or more years. If this is the case stalagmite growths is not possible. Maybe a different term should be used. It should also be discussed, if the dripping ceases completely or is reduced during this time. Are these information derived from cave monitoring? (December to February are three months (four were written accidentally).)

Section 4.1 - Page 1598 - Line 19 Do the authors mean “growth axis” as written or “growth rate”? A short explanation of “steady hydrological state” could clarify if the water characteristics or the flow path or something different are indicated by this.

Section 4.1 - Page 1599 - Line 13 Same case as in Section 3.2 - Page 1597 - Line 1

Section 4.2 - Page 1599 - Line 21 and following The δ18O records from Nuanhe are in this section compared to records from Dongge Cave and Qunf Cave both showing the 8.2ka event more clearly. However, as stated by the authors both caves are influenced by the regime of the Indian monsoon. There are some other caves and speleothems which probably could be suited for comparison in this study. These stalagmites are HS4 from Heshang Cave (Hu et al. 2008), C996-1 from Jiuxian Cave (Cai et al. 2010) or SB10 from Shanbao Cave (Shao et al. 2008) showing a less comparable change in the signal as recorded in Greenland or Dongge/Qunf. Hu et al. (2010) approach the 8.2ka event in their study. It could also be enlightening to include the COMNISPA record from Vollweiler et al. (2006) from the Alps which also lacks the 8.2ka peak (discussed in the respective paper) although it is directly influenced by North Atlantic climate. The interpretation is offered that Nuanhe Cave is influenced by the East Asian summer monsoon while Dongge and Qunf Cave are influenced by the Indian monsoon. The reader would appreciate further discussion why the Indian monsoon reflects the 8.2ka event while the EASM does not (maybe including information about the stability of the two monsoon systems).

Section 4.2 - Page 1600 - Lines 19-21 The authors could describe more clearly why only the δ13C record from NH33 is selected as the true climate signal. It should be discussed before why NH6 does not show the same signal decrease after the 8.2ka event and why this cannot be the true climate signal.

Section 4.2 - Page 1601 - Line 1 The Ba/Ca ratio is only shown for NH33. Was it measured also for NH6? If yes, it could be also shown and discussed. Maybe the Ba/Ca ratio helps to explain the differences in the δ13C record from NH6 compared to NH33.

Section 4.2 - Page 1601 - Line 5 The term “prior calcite precipitation” can help here to clarify the discussion.

Section 4.2 - Page 1601 - Line 27 The linking mechanism between EAWM and North Atlantic climate could be discussed more closely. The westerlies are suggested as the coupling element, however, this need further discussion. Throughout the discussion section the interpretation could be stated more clearly why Ba/Ca and δ13C are influ-

enced mainly by the winter climate (although dripping ceases during winter) and less by summer climate.

Section 4.2 - Page 1601 - Line 27 to Page 1602 - Line 14 The synthesis can be clarified. Several questions arise (some named earlier): 1. Did summer monsoon change little or was it influenced by other hydrological processes? 2. Which is the coupling mechanism between EASM and NADW? 3. Why is only winter climate influencing Ba/Ca and δ13C? 4. Why is the Indian summer monsoon more stable than the EASM?

Section 5 - Page 1603 Line 5 Please, explain more clearly “reorganisation of low-latitude atmospheric circulation and hydrological cycles”.

III. Technical corrections

Section 4.2 – Page 1600 – Line 6 The comma between “δ18O” and “records” can be deleted.

Section 4.2 - Page 1601 - Line 11 A comma is missing between “soil” and “plant”.

IV. References

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