

Interactive comment on “Cryogenic and non-cryogenic pool calcites reflect alternating permafrost and interglacial periods (Breitscheid-Erdbach Cave, Germany)” by D. K. Richter et al.

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referee: “The term SINTER is EXCESSIVELY used throughout the paper! I suggest the authors follow Hill Forti (1995, 1997) terminology when discussing various speleothems and avoid using associations like: rhombohedral crystal sinters, pool sinter, sinter formation, etc.. The term sinter is rather confusing when used in the context of this paper, especially considering the common definitions listed below and the fact that the SPELEOTHEM term was introduced to specifically define all secondary precipitates in caves: [. . .] For example: small sinter precipitates - tells nothing to cavers or

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karst scientists, whereas spar precipitates or simple crystal (rhombohedral or or types) are much easier to understand. Same problem for: small sinter precipitates from sinter basins - this is really confusing! I suggest authors to refrain using sinter but naming the types or subtypes of speleothems they investigated. If some of the samples are not in the form of speleothems, aggregates is a viable alternative.”

You are right. We will exchange the term ‘sinter’ by using ‘speleothem’ in the next manuscript version. For example we will use ‘speleothem particles’ instead of ‘small sinter precipitates’, ‘aggregates and individuals of crystals rhombohedral faces’ instead of ‘rhombohedral crystal sinter’, ‘aggregates and individuals of translucent crystals’ instead of ‘translucent crystal sinters’ and ‘speleothem particles from active sinter basin’ instead of ‘small sinter precipitates from sinter basins’ and so on.

referee: “Because the Conclusion chapter does not really convey any conclusions, I suggest it is merged with chapter 5, which can be renamed: Results Discussions. If authors insist in having a Conclusion chapter, then they need to do a better job in emphasizing the main results of their study, how these results are different or unique when compared with those already published by Lacelle et al., Zak et al., Spoetl, Richter etc.”

We will keep the chapter 5 named “Discussion” and will rename chapter 6 to chapter “7 Outlook” and will add chapter “6 Conclusion”:

6 Conclusions

Based on the data shown here, these following main points are concluded: - Weichselian cryogenic cave calcites from the “Herbstlabyrinth-Advent” Cave system are present as rhombohedral and spherulitic aggregates. - Geochemical data (d18O and d13C) from these precipitates match those of known slow cryogenic cave precipitates reported from other Central European cave localities. - Oxygen and carbon isotopic composition of composite crystals indicate the transition from non-freezing to freezing conditions. - Variable geochemical signatures are interpreted to reflect cave air ventilation changes. - The overall isotope trend is in agreement with an initially Weichselian

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climate evolution around interstadial 4 commencing with permafrost conditions followed by warmer and finally renewed cold conditions. - After melting of the ice body polymict "crystal sands" are accumulated on the floor and on collapsed blocks – present state. - The combined petrographical and geochemical data shown here are clear evidence for the significance of cryogenic cave calcites as important but complex cave archives of climatically cold periods.

referee: "Fig. 2 and fig. 4 should be merged, so that Fig. 4 becomes an inset of Fig. 2."

We will combine these two figures. Though Fig. 4 will become much smaller but we agree that this reason not deserves a separate figure. We will add than another figure instead to underline new facts concerning der C-O isotopic composition of cryogenic cave calcites while freezing of water.

referee:"It will be easier to follow the explanations in text and also in the cartoon if the X-axis in Fig. 9 is reversed to show OLD in the left and YOUNG in the right side. This way the events on the cartoon and graph will "flow" in the same direction."

We will change this according to your suggestion.

referee: "I have to argue the following statement made by the authors on page 1020, line 12 (under ch. 5 Discussion): There is no field or petrographic evidence, however, suggesting that fluctuating . . . ". This is not entirely correct, as papers such those of Andrieux (1963), Diaconu (1990), Onac (1996) discuss various aspects concerning genesis and morphology of speleothems as a result of fluctuating paleo-waters in pools. In addition, there are cathodoluminescence studies that show zoning in pool spars due to changes in water chemistry as a result of fluctuating supply of solutions."

We will change this passage as follows: "In the case of the localities 1-5 there is no field petrographic evidence suggesting that fluctuating paleo-water levels in the cave represent controlling factors for formation of crystal accumulations and other modes

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of formation are consequently discussed. However, other authors (e.g. Andrieux, 1963; Diaconu, 1990; Onac, 1996) described various aspects concerning morphology of speleothems as a result of fluctuating paleo-waters in pools from other localities."

referee: "It would be useful if authors can add a table with all their isotopic values (even if published as supplemental online materials). Have authors analyzed the present day dripping water in the cave (d18O, d13CDIC)? If yes, these data should be included in the table as evidences for their discussion chapter."

An additional table in the manuscript with all data would lead to a duplication of information because these data are presented in the figures. We suppose that interested colleagues should ask the authors for submitting them. We prepare a pdf with the data.

referee: "pag. 1012 - abstract, line 8: ". . .reflect mean levels of cave ventilation" I don't quite understand this statement and it is not properly elaborated anywhere in the manuscript. Either delete it from abstract, or make the case in your discussion section!"

Actually it is described in the discussion section of the manuscript (see page 1021, line 20-27). But we will add some information to the abstract as follows: "Particularly, the C/O isotopic composition of Breitscheid cryogenic cave calcites reflect mean levels of cave ventilation in comparison with the carbon and oxygen isotopic composition of other caves with cryogenic cave calcites of Central Europe."

referee: "pag. 1013, line 10 - "...between warm and cold periods." What are the authors trying to say? warm to cold periods within a year (like seasons) or glacial/stadial to interglacial/ interstadial? There are many caves (that host perennial ice accumulations) in which such crystals form most of the year, and therefore no need for such transitions! It is important that authors clearly state that this is the scenario for the cave they studied, and it is not a general trend in caves"

"between warm and cold periods" will be replaced by "between glacial/stadial to interglacial/interstadial"

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referee: "pag. 1013, line 14: temperature rising (not warming)"

This will be changed in the next manuscript version.

referee: "pag. 1014, line 2: "before mentioned types of "crystal sands" - There is no mention of such crystal sand in any previous page, so please define it."

We will define "crystal sand" at the beginning of the methodology chapter (page 1015, line 2) as follows: "Accumulations of "crystal sand" (loose individual crystals and aggregates – mostly sand sized, sometimes more than 2 mm in size) covering the cave floor ..."

referee: "pag. 1014, line 13: is the age of the karst Cenozoic or is the karst that is formed on Cenozoic rocks? Please clarify"

You are right, this passage is misleading. We will change it as follows: "The reefal deposits of the Iberg Limestone (Kayser, 1907; Krebs, 1966), located on a volcanic basement in the Rhenohertzynic trough of the Rhenish Slate Mountains (Krebs, 1971), are well known for their abundant karst phenomena, which are Late Cenozoic age (Stengel-Rutkowski, 1968)."

referee: pag. 1016, line 22: what is your explanation the only here you find white to buff-colored crystals?

"Possibly only at this locality a relict water pool on top of the ice was present due to progressively freezing leading to the precipitation of cryogenic cave calcites. This water pool was large enough to allow a long geochemical evolution of the remaining fluid during slowly freezing."

referee: "pag. 1019, line 21: observation 1 under Discussion: I don't see the point made by the authors. Most speleothems that form in pools or at pool surface (rafts etc.) are precipitated because of degassing of CO₂. What are the evidences that support this hypothesis? are there any obvious differences in stable isotope composition? Authors need to make this point a bit clearer."

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Explanation: In Figure 8 you can observe the very low d¹³C-values of the rafts at the lower range of the area of the common speleothems isotopic composition. This because evaporation effects (including kinetic effects by CO₂ degassing) are more important in environments, where a thin water film is present (stalagmites, stalaktites, sinter curtains etc.). In contrast precipitation of rafts occurs in water basins, where these effects are far less important. So there is a clear difference in their isotopic composition.

Following references will be added: Andrieux, C. 1963. Étude cristallographique des pavements polygonaux des coulées poly-cristallines de calcite des grottes, Bull.Soc.franc.Minér.Crist., LXXXVI, 135-138.

Diaconu, G. (1990), Closani Cave. Mineralogical and genetic study of carbonates and clays, *Miscellanea Speologica Romanica*, 2, 3-194.

Onac, BP 1996. Mineralogy of speleothems from caves in Padurea Craiului Mountains (Romania), and their palaeoclimatic significance, *Cave and Karst Science*, 24(3), 109-124.

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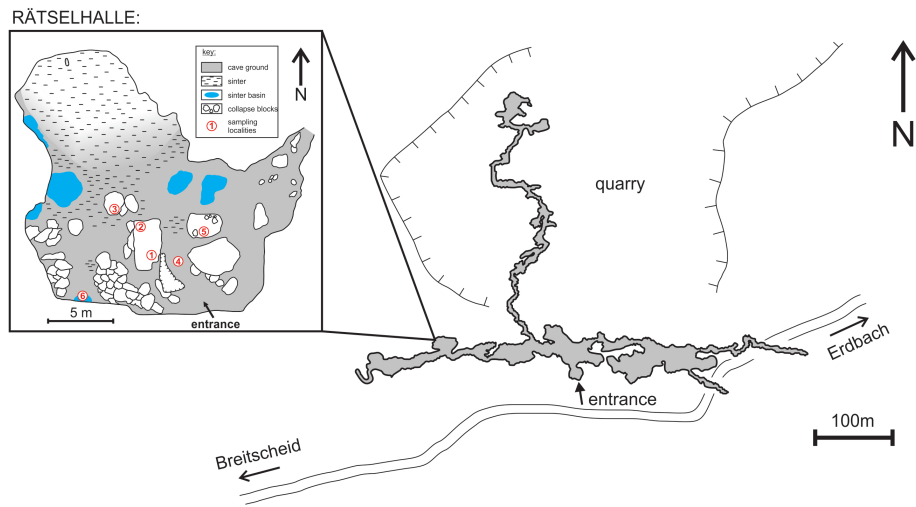


Fig. 1. Figure 2. Sketch map of "Herbstlabyrinth-Advent" Cave system showing position of 'Rätselhalle' as well as a speleological map of the "Rätselhalle" with indication of sampled locations.

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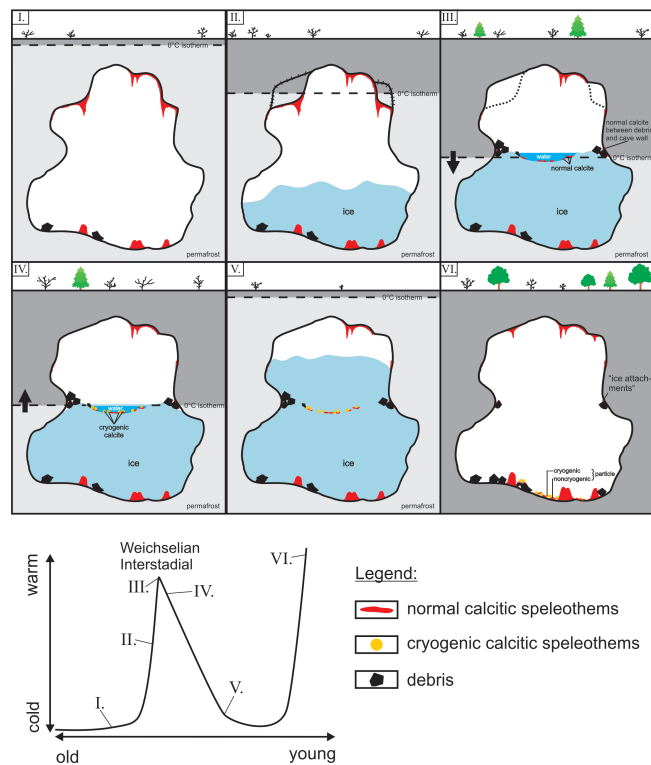


Fig. 2. Figure 9. Cartoon illustrating proposed succession of events that lead to the formation of cryogenic and non-cryogenic calcites in the course of a Weichselian interstadial. Refer to schematic temperature

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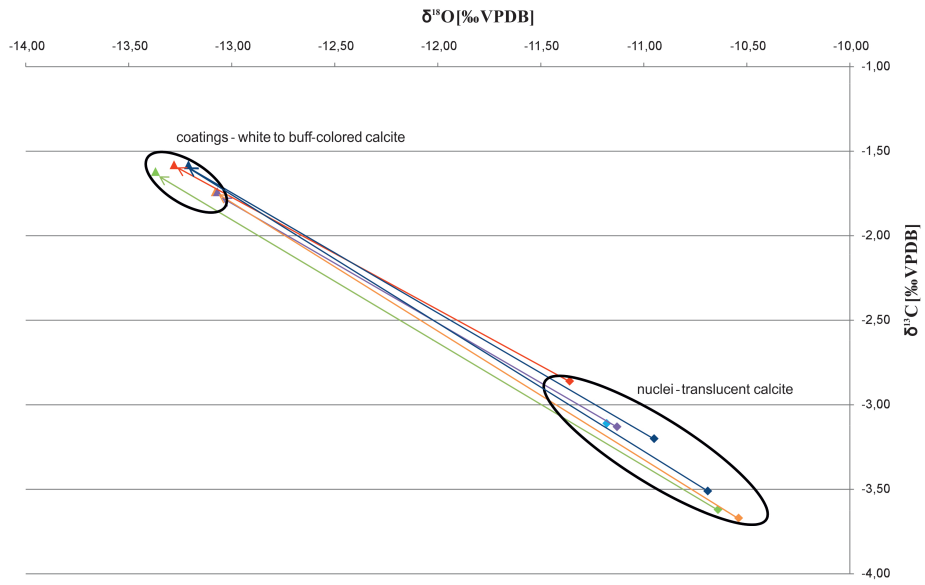


Fig. 3. Figure 8. Carbon and oxygen isotopic composition of selected zones of composite crystals with translucent nuclei and white to buff-colored coatings.