



Naturally damaged speleothems, a new facies caused by Glacial cave ice?

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Natural speleothems damage is a widespread phenomenon throughout Central European caves. Rock fall (inkasion), mass wasting, compaction of sediments, undercutting by erosion, frost shattering near entrances, inundation of the cave or desiccation of sediments can account locally for some of the damages. Historically, broken and leaning stalagmites were first depicted by Schaffernath from Postojnska jama in the 1820ies and discussed by Hohenwart in 1832, clearly excluding rock fall or earthquakes as a cause. Earthquakes have nevertheless been suggested several times as the only cause of these damages. Here we present evidence from four caves (Postojnska jama/Slovenia, Geisloch/Frankonian Alb, Baumannshöhle/Harz Mountains, and Adventshöhle/Rhenish Massif) that suggest cave ice as the only logical cause for most of the speleothem damage observed. Specifically broken and leaning stalagmites, missing older stalactite generations, precariously placed sinter fragments, speleothem piles along the sides of passages, speleothem fragments placed at places away from the line of fall, and flowstone pieces fixed on steeply sloping surfaces can best be explained by the action of ice which filled the caves during Glacial times. In addition, precipitation of calcite in ice pools may have left a puzzling "sand" consisting of mm-sized calcite rafts or linings observed for example in newly discovered parts of the Adventshöhle. In detail the consequences of the thawing and freezing of cave ice and of the advance and retreat of permafrost remains an unexplored process highly important for the preservation of the older speleothem generations. If accepting speleothem damage as a consequence of Glacial cave ice, then it should be possible to use it as a marker facies for the extent of the zero temperature line during past Glacials.