



Evaluating the potential of tree-ring software for cross-dating of annually laminated stalagmites

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Three small stalagmites (Zoo-rez-1, -2 and -3) from Zoolithen Cave (Bavaria/Germany), which grew at close distance to each other, show a nice continuous lamination consisting of pairs of a clear and a brownish-pigmented layer. Dating of the stalagmites by the $^{230}\text{Th}/\text{U}$ -method was impossible due to low uranium concentration and a high content of detrital ^{232}Th . All three specimens were analyzed for radiocarbon and show the increase typical for the atmospheric bomb peak, which is delayed by 2 to 4 years. The radiocarbon decrease is not preserved suggesting that they stopped growing around AD 1970. A piece of charcoal found below one of the stalagmites was dated also by the ^{14}C method providing with a calibrated 1s-age range of AD 1671-1951.

For a more precise dating of the three stalagmites, we counted the number of visible laminae and determined their thickness on scanned thin sections using the software *analySIS pro* (Olympus). Due to partially discontinuous layers, three tracks (one directly at the growth axis and two left and right of the growth axis) were measured on Zoo-rez-1 and -2. On Zoo-rez-3, only one track was measured. To estimate the counting uncertainty, each of these tracks was divided into three sections ending at prominent layers, which could be followed through the complete thin section. In addition, each track was measured/counted three times. Afterwards, the three sections of the different tracks were combined and tracks were cross-dated visually and by means of established typical tree-ring methods (software programs *TSAP-Win*[®] and *COFECHA* (Holmes, 1983)). This results in counting errors of approximately 7 layers on 100 counted layers. The three measured tracks on Zoo-rez-1 and Zoo-rez-2 were cross-dated visually on the thin sections and with the help of the tree-ring programs. In the last step, the three chronologies were cross-dated with each other to further improve and finally verify their chronologies. In summary, this study shows how established tree-ring techniques can be used to construct speleothem chronologies.

Holmes, R.L., 1983. Computer-assisted quality control in tree-ring dating and measurement. *Tree-Ring Bulletin* 43, 69-78.