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Annually laminated stalagmites from Zoolithencave (southern Germany) and their potential for high-resolution climate studies

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Two small stalagmites from Zoolithencave (southern Germany) show annual lamination and are dated to AD 1821 to 1970 (Zoo-rez-1) and AD 1835 to 1970 (Zoo-rez-2). Chronologies of the two stalagmites were conducted by 14C bomb peak detection at the top of both stalagmites, 14C-dating of a piece of charcoal from the consolidated base part of Zoo-rez-2, lamina counting, and cross-dating of the laminae (Riechelmann et al., in review). The concentration of Mg, Ba, Sr, Al, P, and Y of both stalagmites was measured by LA-ICP-MS. Samples for d18O and d13C analyses were micro milled with a resolution of 50 μm in Zoo-rez-1 and 130 μm in Zoo-rez-2, which corresponds to a resolution of three samples per year for Zoo-rez-1 and an annual resolution for Zoo-rez-2. Soil and host rock samples were analysed by XRD and their Ca, Mg, Sr, and Ba concentrations determined via ICP-OES. Meteorological and GNIP station data were used for comparison with the proxy data, calculating the infiltration, and modelling the d18O values of the calcite precipitating in the cave using the model of Wackerbarth et al. (2010). Modelled and the measured d18O values of the two stalagmites show similar patterns. This can be explained by the transfer of the rainwater d18O signal into speleothem calcite. The d18O values of the rainwater reflect local temperatures. Therefore, the d18O of the stalagmites can be used as a temperature proxy and provide the opportunity to calibrate the proxy in the time interval overlapping with meteorological data. The studied element concentrations show two groups in the principal component analysis, one with Mg, Ba, and Sr and the other with Y, P, and Al, respectively. The second group is influenced by detrital material in the stalagmites. Prior calcite precipitation does not have an influence on the Mg, Ba, and Sr concentrations. Mg shows a correlation with d18O which suggests an influence of temperature on the leaching of Mg from the soil and the dolomitic host rock. Especially, Ba shows a strong leaching from the soil because the Ba concentration in the stalagmites is higher than in the host rock.

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