Tropical Soil Activity on Socotra Island, Arabian Sea, since the LGM: Evidence from Speleothem ^{14}C

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The Indian monsoon is one of the largest tropical weather systems and provides the majority of rainfall to the Arabian Peninsula and Indian Subcontinent. Global climate changes are manifested in the (sub)tropics by monsoonal precipitation variability impacting vegetation and soil carbon dynamics. ^{14}C in stalagmites is closely coupled to soil activity (i.e. carbon cycling) and subsequent host rock dissolution with strong carbonate dissolution in a closed system leading to high reservoir effects. In contrast, open carbonate dissolution conditions cause much lower reservoir effects, when soil CO_2 exchanges with the dissolved C species. Other contributions to the reservoir effect can be introduced by soil CO_2 from decomposing old soil organic matter. Hence, ^{14}C can serve as a tracer of carbonate dissolution, soil activity and vegetation.

Here, we present a ^{14}C record of stalagmite M1-5 from Moomi Cave, Socotra Island, in the western Arabian Sea. An improved U/Th-chronology confirmed a high average growth rate of 132 µm/yr over an approximate time span from 27 - 11 kyr BP. ^{14}C results reveal a very high overall reservoir effect expressed as dead carbon fractions (dcf) of 30-57%: After an enduring phase of very high reservoir ages during the LGM (dcf >50%) before 18 kyr BP, a decreasing trend to ~35% is observed during the deglaciation. The monotonic decrease of dcf is interrupted twice, just prior to the start of the Boelling/ Allerod warming of the northern Hemisphere and during the Younger Dryas manifested by elevated dcf (44.3 ± 3.1).

We interpret this unique record as a dramatic change of soil activity and thus deduce an enhanced vegetation growth, starting ~18 kyr BP synchronous to global warming of termination I. Hence, a direct long term influence of the polar warming is evident in the (sub)tropical soil carbon cycling.