S4 Summer School on Speleothem Science

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Lecture Abstract:

Speleothems in the context with other Palaeo-Climate archives

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The fundament of speleothem research is an accurate timing of the carbonate precipitation, which is then used as an archive storing mostly indirect climate tracers (proxies) as discussed in previous lectures of this summer school. In this lecture I will try to investigate whether the timing of carbonates itself is of climate significance as initially proposed by Andy Baker in the early 90s and how this can be related to other carbonate archives for example of marine origin. In first order such a correlation can only exist if climate change is to influence both continental and marine climate in a way that carbonate precipitation varies with average regional climate conditions. However, there is no common mechanism expected as continental carbonates depend on active groundwater flow (precipitation) and excess CO_2 from soils, while marine carbonates are of biogenic origin and depend on water temperatures and food supply. Why then such an exercise?

Northern Europe reveals a variable secondary carbonate precipitation through time based on the available U-series ages spanning the past two climate cycles, with predominant carbonate precipitation during climate warm phases. Similarly, the growth of deep water corals in the north-east Atlantic appears to be climate depended revealing a northward expansion of those ecosystems during climate warm phases while subtropical ecosystems persist. The origin of marine ecosystem changes has been related to glacial southward movements of the polar front, which must have affected evaporation and precipitation in mid-northern latitudes. Thus, as corals may suffer from cooling waters and decreasing food availability, continental carbonates might be affected through variable moisture sources and the impact on the continental biosphere driven by changes of the marine boundary conditions.

Correlating such temporal evolutions, however, one finds further similarities regarding the observed age patterns, which in general are biased through sampling strategy, sample availability and temporal decrease in time resolution using U-series methodologies. Those phenomena typically result in the fact that we generate large numbers of ages for the past few tens of millennia, but with increase age of the studied deposits our ability to reconstruct the time framework rapidly vanishes (open-system behaviour, lack of deposits, reaching towards the end of the dating methods). Therefore, the availability of information on the climate

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driven changes of coral growth and continental carbonate deposition decrease with increasing age of the archives. Thus, the question arises of how such biases can be considered?