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Climate fluctuations during OIS 6-7 reflected in the dynamic of pedogenic carbonates at the Bau de l'Aubesier rockshelter, Monieux, Vaucluse (France)

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Among continental environments, karstic systems have long been used to reconstruct palaeoclimate due to their high sensitivity to climate factors of global significance. Speleothems offer the most reliable record of high resolution climate variability. Because they formed at depth, changes in stable isotope compositions, lamina thickness and trace elements reflect fluctuations in the hydrological regime in direct response to climate factors with minimal interference from the local soil cover. In contrast, the type of soil cover above the karsts plays a dominant role in the hydrological regime that controls the formation of pedogenic carbonates in the rockshelter deposits of the exokarstic. Thus, their study provides a qualitative assessment of palaeoenvironmental changes on local to global scales. Such a perspective is needed to obtain a high-resolution record of environmental shifts in synchrony to human occupation in prehistoric rockshelters.

The use of pedogenic carbonates in caves as human-linked palaeoenvironmental archives is illustrated here by the integrated field and micromorphological study of the H1 layer at the Bau de l'Aubesier rockshelter (Vaucluse, France). H1 offers a unique example throughout Europe and the Mediterranean basin of repeated occupation and fire-use by Neanderthal along the course of OIS7. The 40-cm-thick, exceptionally well preserved microstratific sequence displays a succession of distinctive depositional episodes with related crypto-soils that are separated by sharp discontinuities. Their common characteristics indicate formation from the combined action of

water-dripping along the cave walls, detrital input from the plateau soils along fissures, limestone fragmentation by frost and biochemical weathering, growth at the cavity surface of a cryptogamic vegetation cover with minimal perturbation. The balance in this range of processes between the distinctive pedo-sedimentary episodes reflects changes in the type of soil cover in the surroundings, dripping conditions along the cave walls, and the temperature and hydric regime at the cavity surface. A comparison of the three interdependent sub-systems (plateau soils /shelter walls/ cavity surface) thus allows a qualitative estimation of the related climatic conditions with a special focus on seasonality.

Rapid warming and related forest development during OIS 7 is well recorded at the bottom of H1 by a sharp interruption in freeze-thaw processes, establishment of a marked seasonal contrast with snow falls (active carbonate dissolution) and high summer evapotranspiration (carbonate cementation), together with the development of brown acid soils on the plateau and cryptogamic vegetation in the cavity. A subsequent cooling and drying pulse is suggested by the development of microlaminated calcitic pendents, associated with ice-lenses, and reduction of the cryptogamic vegetation. The wet/warming trend is then rapidly reactivated with its typical twin association of dissolution/reprecipitation and brown acid soils/cryptogamic vegetation repeatedly pulsed by cooling excursions with increases in frost. Then, optimal development of the cryptogamic vegetation together with total carbonate dissolution, phosphatic holo-transformation of the calcareous clasts due to slow percolation of phosphate-saturated water indicate a moist and cooling episode with low seasonal contrast, and development of acidifying vegetation with podzolic soils, highly sensitive to spontaneous combustion as documented by the abundance of chars. Increase in the detrital production of carbonates by freeze-thaw processes, decreased dissolution, and reduced cryptogamic development then indicate a gradual shift to colder conditions with an increased seasonal contrast before the sharp return to glacial conditions with marked cooling (dominant freeze-thaw processes) at the end of the H1 layer. This would tentatively correlate with marked cooling during OIS6.