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1 Study of speleothems in archaeological context: case studies from Southwestern France

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Interest in speleothem studies results in general from several different factors: their large spatial and temporal distribution; their good preservation in endokarstic environment; their high-resolution continental palaeoclimatic records thanks to δ13C and δ18O variations; and their potential to be dated by absolute methods. Speleothems grown in archaeological contexts, however, have been underexploited until now. Our study aims to demonstrate that such speleothems have great promise to both provide regional palaeoenvironmental information and to precisely define the occupation periods of archaeological sites.

We studied speleothems from three caves in Southwestern France; two of them were frequented by prehistoric people for extensive periods. The speleothems are stalagmites and flowstones inserted in the detrital filling. Thermal ionisation mass spectrometry (TIMS) ^{234}U/^{230}Th dating was carried out to precisely constrain the growth period of these speleothems. Results obtained with this technique are reliable with error terms of less than 2-3 % (2σ) for the studied period.

We also analysed high-resolution variations of carbon and oxygen isotope ratios.

These ratios, time-constrained with TIMS dating, were compared to those obtained with other climate proxies.

In the sites that we studied, TIMS dating of speleothems allowed us to time-constrain occupations that were settled between speleothems or were contemporaneous to their growth. These occupations were too ancient to be dated by ^{14}C, and other dating techniques turn out to be both difficult to apply and less precise than the TIMS dating of speleothems.

Moreover, we note that, in the speleothems from these three caves, the isotopic signal ($i.e.$ of δ13C et δ18O) reveals a coherent reaction to climate conditions. Thus, the signal is not random and corresponds to a regional climate reality.

In addition, although δ18O results are usually used to determinate climatic impacts in speleothem studies, in the present case the δ13C seems to better account for local variations, mainly controlled by biological activity outside the cave environment. The palaeoenvironmental information generated by this study complements results from the geological, palynological and palaeontological studies usually conducted in prehistoric sites.

Finally, in a more global perspective, the regional palaeoclimatic signals provided by speleothems were compared to other proxy records (from marine, polar and lacustrine cores). The speleothems analysed here grew during some parts of the MIS 5, including the Last Interglacial. These results allow us to contribute to the debate on climate variations during this time period. In addition, reproducing this kind of study could improve the time-constraint of some records with loose chronology.

We show here that studies of speleothems from archaeological contexts provide the opportunity to better understand the chronological and environmental situation of prehistoric occupations, in addition to the more widely recognized advantages of speleothem studies for palaeoclimatology. By applying this approach to many other sites, we will be able to both determine a time frame for human cultures in a given area and better define relationships between cultural and palaeoenvironmental evolution.