



## **South-France caves monitoring : present day cave air dynamics characterization, paleoclimatic and archaeological interests**

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Cave climatic environment survey covers different sort of analyses on air and water, and has various interests from the conservation of prehistoric caves to the study of paleoclimates. Depending on the purpose, the cave monitoring can be entirely automatic or combine both automatic and manual data acquisitions. Apparatus are adapted to cave environment to measure specific parameters (i.e. drip rate, air humidity, CO<sub>2</sub>) and during the long-term monitorings, several generations of techniques have been used. We present here examples of cave monitoring (1996 →) from South-France: Chauvet, Orgnac (Ardèche), Esparros (Hautes-Pyrénées) and Villars (Dordogne). In all these sites, we obtained among the longest series of climatic parameters of inside the caves, coupled sometimes with geochemical and isotopic analyses on air and seepage water, which allow to better understand cave air circulation behaviour and their sensitivity to the external climatic and environmental variations. High precision temperature measurements in Orgnac and Chauvet caves, coupled with pCO<sub>2</sub> and radon analyses, allowed the reconstruction of seasonal air circulation patterns in each cave. While the Chauvet and Esparros caves are quite confined environments with temperature changes mainly controlled by air pressure variations, the Orgnac cave, like most caves, shows a well marked summer/winter regime alternation. Quantification of air flows of known CO<sub>2</sub> concentration allowed the calculation of carbon fluxes toward the earth atmosphere which is estimated to about 340 gm-2yr-1. Since 15 years, the monitoring made in the Villars cave at two different levels has shown that the air temperature displays small seasonal variations in the upper galleries while it is not detectable in the lower ones. Average annual temperature difference between these two levels is of more than 1°C, showing that local differences in a single cave can be significant. A global warming trend likely correlated with local external temperature changes is observed in both levels since the beginning of the monitoring in 1996 which is not the case in Chauvet and Esparros caves. The stable isotope composition of the seepage water of the Villars cave and drip rates measured under several stalactites give precious information about the mixture of the rainfall infiltration signal in the unsaturated zone; these long isotopic series are discussed and compared with the rainfall (quantity and isotopic composition) sampled at this site.