

microclimates of l'Aven d'Ornac and other french limestone caves (Chauvet, Esparros, Marsoulas)

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Résumé:

We assess the aerodynamics of the atmosphere in some limestone caves using a 5-year monitoring of the Aven d'Ornac system, shorter thermal vertical profiling experiments, and comparison with the time series from other French caves. In the first rooms, located under the Aven opening, our records indicate, for each year, a succession of a summer regime characterized by stable parameters (except for the perturbations introduced by tourist visits) and a winter regime, in which the inner air temperature drops and is highly correlated with that outside. Atmospheric composition suggests that during the winter regime the cave is ventilated by the outside air. We show that the onset of the winter regime is governed by a thermo-convective instability involving the inflow of the outside cold and dense air. Atmospheric temperature and composition allow us to follow the stepwise progression of the winter regime toward the adjacent rooms. In the Salle Plane (SP), a far room of the Ornac-Issirac karstic system, in which the winter regime has never been observed, the air temperature is extremely homogeneous and steady, and is characterized by a half-daily signal of amplitude less than 0.03 °C, which is correlated with the derivative of pressure versus time. This correlation, which is also observed in various other confined caves, may be explained by pressure-induced temperature changes relaxed in less than 1 h by thermal exchanges with a large volume of rock whose temperature is assumed to be constant. The various microclimates of karstic cave systems should be taken into account for the conservation of the caves open to tourists and for the interpretation of growth laminae of speleothems. Copyright 2006 Royal Meteorological Society.

cave; cave management; microclimate; thermo convection; confinement; physical mechanism; France