THE CONTRIBUTION OF ENVIRONMENTAL MONITORING TO THE PRESERVATION OF DECORATED PALEOLITHIC CAVES IN THE MIDI-PYRÉNÉES REGION:

the Examples of Gargas (Hautes-Pyrénées) and Marsoulas (Haute-Garonne)

François BOURGES, Éric MAUDUIT, Alain MANGIN
Dominique d’HULST, Pierre GENTHON, Robert BÉGOUËN

While the ambiance of a cave is clearly necessary to understanding its parietal art, the physical and chemical nature of the underground environment also plays an important role in the conservation of this art. Knowing how to preserve this heritage and how to best present it to the public are thus crucial issues in the context of particularly fragile artistic remains.

We show that through environmental monitoring it is possible to identify the specific balances and sensibilities of these sites based on a detailed description of the natural environment and the manner in which it functions. These operations constitute a quantitative reference base that can aid in both the conservation of parietal art and the management or development of these sites.

The measurements and analyses show that a cave is not a closed system with static features, but on the contrary, a complex environment in which dynamic internal and external exchanges take place. A systemic approach allows us to understand the global functioning of a complex natural system without having to describe the details of its internal phenomena: the functional properties of the environment are thus expressed in terms of an entrance/exit relationship. In this way, the relationships between the fluxes shed light on the conditions of the equilibrium of the system.

In karst and cave environments, the entrances are mainly zones of flux originating from the exterior climate (rain, pressure, temperature), while the exits are composed of the underground parameters (temperature, air or water composition and flow). The functioning of a karst system diminishes the variations of the entrances (climatic effects, anthropogenic influences), and thus regulates the flux of the exits. We suppose that this capacity to regulate the natural environment determines its stability and thus constitutes an essential criterion for the quality of the preservation of decorated caves. It is also possible to describe, at all time scales, the types of functioning of the environment, as well as the states of stability or instability.

Some phenomena (thermal impacts, physical modifications, aerodynamic effects, modifications to infiltration regimens) can alter this regulation and temporarily or definitively eliminate the dynamic balance that ensures the physical integrity of the environment (loss of stability). This destabilization can trigger secondary regulations associated with preservation risks (condensation, drying).
State of the wall of the large painted panel in Marsoulas. The prehistoric parietal decoration consists of a violet sign (SV) and a red sign (SR) on the ochre and black background of a bison (FB), whose outline goes beyond the limits of the photo and engraved lines (TG). The modern degradations consist of removed material (light zones), which are the result of scaling following the alteration of the stone support (AI), as well as impacts (Im) and diverse scarifications (Sc). The pigment was also spread by rubbing degrading part of the violet sign (Fr).
In the Gargas Cave, which has been monitored since 1994, some modifications to the walls by microorganism pollutions have been observed, as well as physical instabilities leading to drying or condensation. An excessive number of tourist visits and unsuitable modifications (lighting or closings and communications) have been identified as responsible for these destabilizations. A collaborative intervention with the Museum National d'Histoire naturelle (Pr. A. Couté) identified and eliminated the biological pollutions. A complete overhaul of the site, including the elimination of the pollution sources, the identification of energy thresholds and preservation of the confinement level of the site, reestablished a stabilized functioning system and satisfying wall conditions. Continued parietal monitoring during and after this work enables us to quantify its effects over the long term and to correct residual problems.

The Marsoulas Cave was subjected to numerous excavations that disturbed the site. Recent research (Fritz et al.) has revealed a rich archaeological potential. Meanwhile, the parietal art and its stone support has suffered degradations whose rapid evolution motivated a rescue operation. Environmental monitoring shows that the part of the cave nearest the entrance was destabilized by its closure to the exterior, which acts as a hot point in summer and causes seasonal changes in condensation and drying on the walls. The internal parts of the cave are stable, on the other hand. The first sector of the cave acts as an active interface where most of the thermal and gaseous exchanges occur. We propose to transfer the active interface of the cave to the exterior by attaching a constructed airlock structure to the current entrance, which will create a thermal and atmospheric buffer between the underground environment and the exterior. The expected result is to protect the decorated parts from the alteration processes and to thus extend the regulation identified in the deep part of the cave to the rest of the site. This buffering structure, located completely outside of the decorated cave, will thus allow us to avoid any interventions inside. As it will be installed on part of the former location of the slope that closed the cave, it will have no effect on the natural environment.

In principle, a systemic approach enables us to make observations without formulating hypotheses on the nature and functioning of the environmental elements: in this way, it is possible to address the preservation of sites in a neutral and global manner. The procedure of intervention is largely self-limiting: the modifications or constructions realized with the aim of preserving the site are undertaken with a strict respect for the dynamic balance of caves. A permanent dialog must be established between archaeologists and underground environment specialists to adapt the research questions to the specificity of each site.