Microclimates and landscape archaeology : the case of Enlène cave (France)

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Motivation

Connecting the material culture with its natural context is a successful practice in archaeology.
This landscape-archaeological approach was applied to the cave environment to investigate to **what extent the microclimate influenced the use of the underground space by prehistoric humans.**

Study Site

The Enlène cave is one of the so-called "cavernes du Volp" located in a multiphase karstic massif of the French Pyrenean piedmont. The river Volp flows in a low gallery while the two upper galleries contain most of the prehistoric remains.
The Enlène cave is connected to the outside by two entrances at different levels, to the drainage gallery by a vertical pit, and to the Trois-Frères cave by a long and narrow tunnel.
The Enlène cave is interpreted as a basecamp while the connected Trois-Frères cave contains mainly symbolic representations such as rock art.
Despite archaeological excavations in the 19th and 20th centuries, the cave and its entrances geometry were not modified justifying the assumption that **the original microclimate pattern has been preserved.**

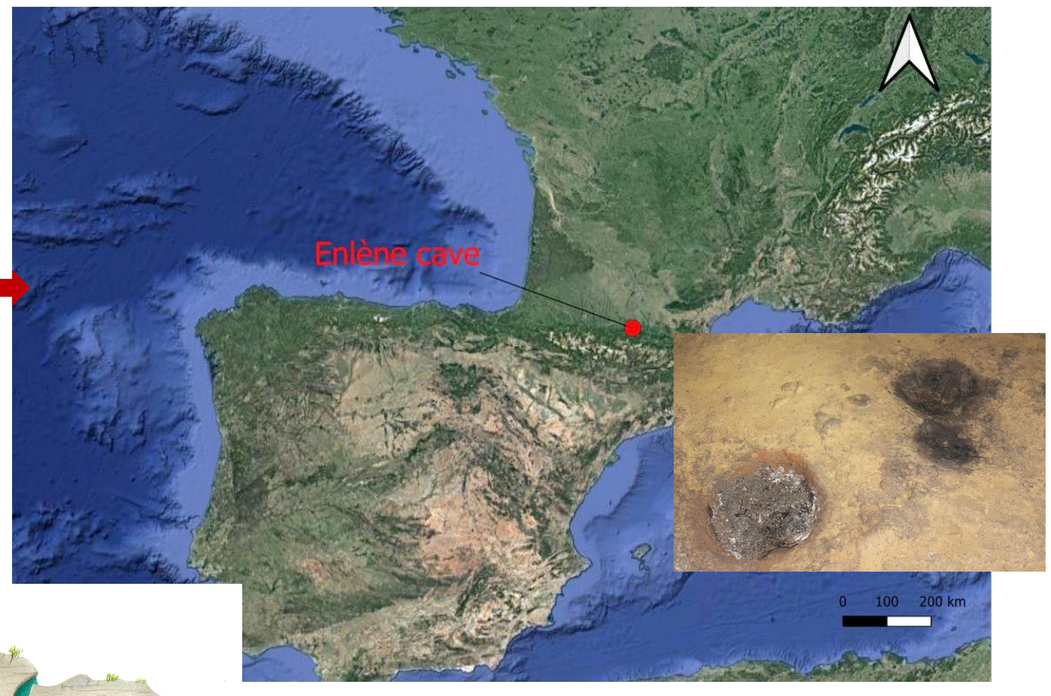

Figure 1: Location; of the study site and picture of fire places in the « salle du fond »

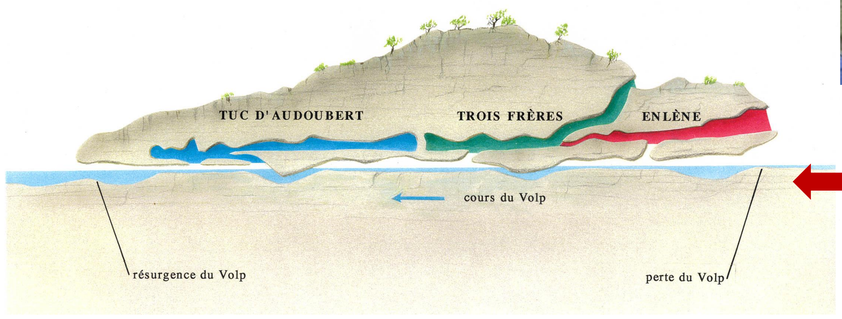

Figure 2 Cross section of the « cavernes du Volp ». The Enlene cave is connected with the river Volp by a pit to the « trois frères » cave by a narrow gallery and to the outside by a natural entrance porch

Methods

For more than a year (June 2017 to July 2018) continuous temperature measurements were installed at several locations inside the Enlène cave in the entrance porch and outside. Barometric pressure is also recorded outside and Radon 222 measured in the remote room as a marker of the cave aerology. The climatic pattern is compared with archaeological data (density of artifacts in each location).

Results

Relationships with outside and inside air at different levels induce a complex cave aerology resulting in successive seasonal regimes and space partitioning microclimates
The Porch: The attractive climatic sector of the open entrance porch (+10°C in winter for 1036h/year) that is at least 1h/day during 82 days from November to March hosts rich archaeological layers.
The remote room located 200 meters away from the entrance, is protected from draughts and temperature changes by an highly confined microclimate. More than 42,000 units of sandstone slabs were brought there from the outside forming a large-scale paved area with fireplaces.
The huge quantity of artifacts and elements of "chaînes opératoires" for pearls, needles and tools support the interpretation of **basecamp activities**.

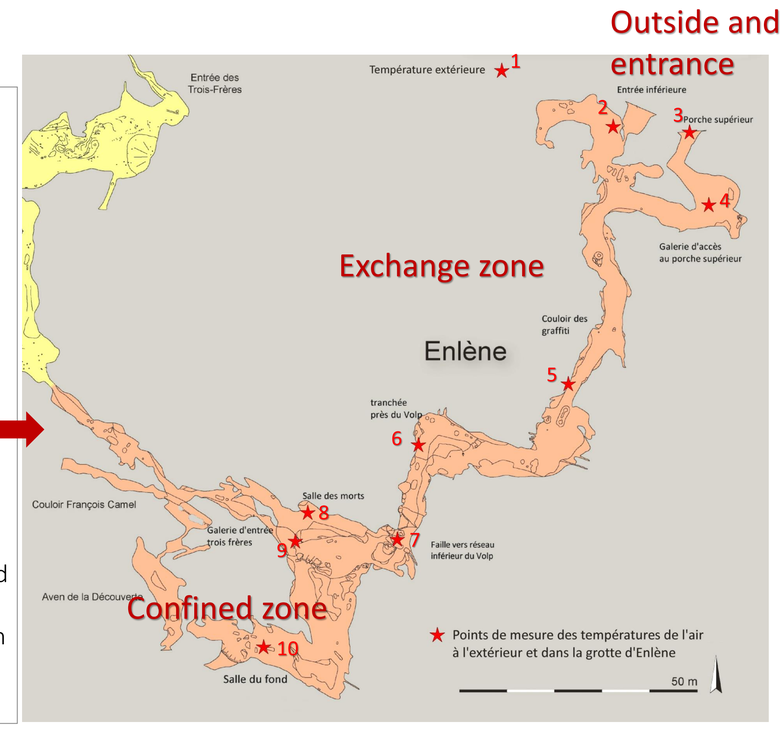

Figure 3 Location of temperature measurements (red stars).
1 outside temperature
2 low entrance
3 porch entrance
4 gallery to entrance proch
5 graffity gallery
6 trench near Volp
7 pit to Volp
8 room of dead
9 entrance to « trois frères » gallery
10 Remote room (also radon mesurement).

Internal temperatures are mesured with thermistance SB56 with a precision and stability better than 0,002 °C/year. Outside and porch temperature and barometric pressure are mesured with barologgers (Solinst). Radon with alpha-E sensor. All the temperature sensor were intercalibrated

Comparison between outside, open porch and remote room temperatures of the Enlène cave from 24 june 2017 to 07 july 2018

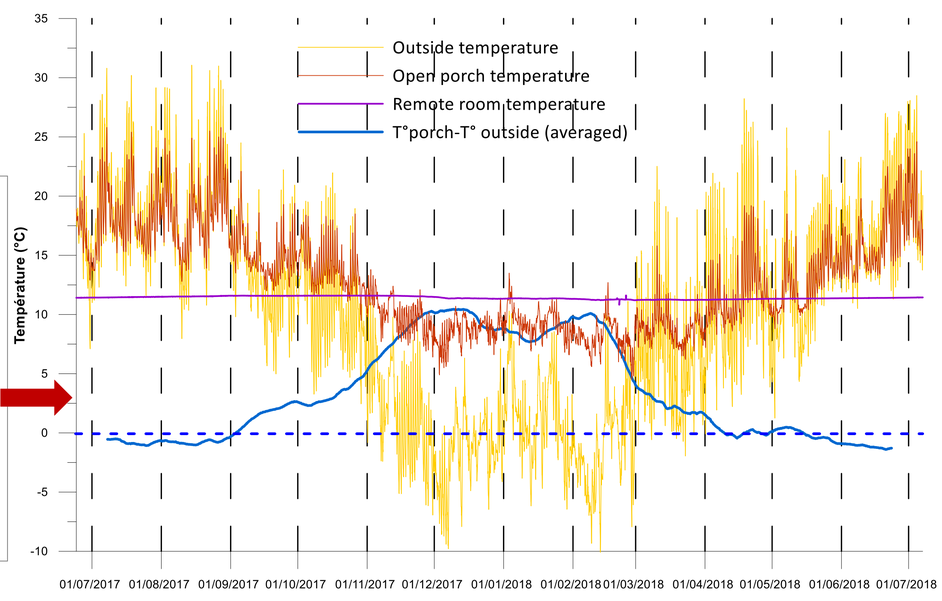

Figure 4: thermal situation is remarquable in the open porch in winter : temperature in this location is about 10°C higher than mesured outside due to advected subterranean warmer air.
Remote room is the inside reference air temperature.

Thermal signature of the climatic zonation inside the Enlène cave data from 24 june 2017 to 07 july 2018

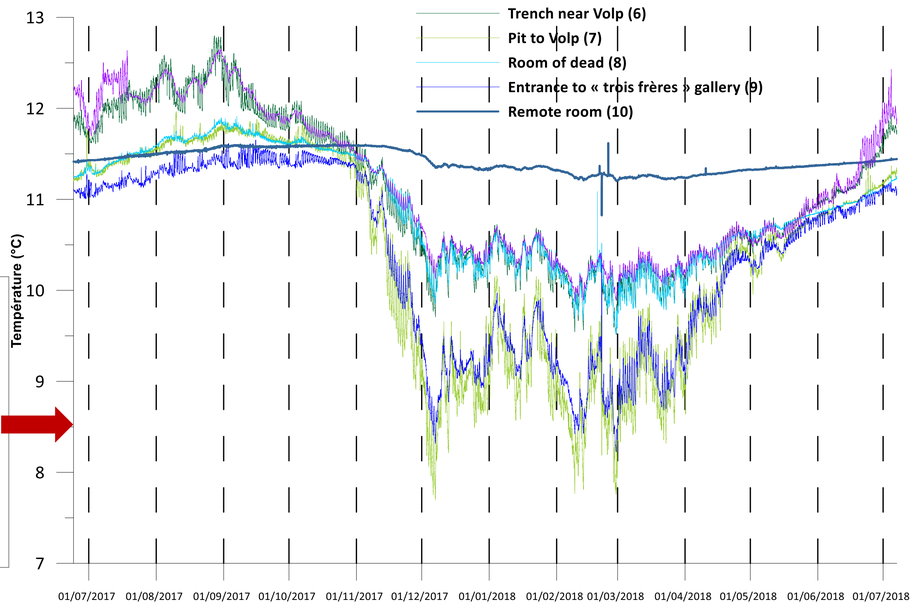

Figure 5: temperature evolutions at different locations inside the Enlène Cave.
The decreasing influence of outside temperatures generate an internal climatic zonage.

Conclusions

Attractive microclimatic locations (stable or hotter than outside) coincide with an intensive use by prehistoric humans. In the large intermediate galleries with permanent air circulations, archaeological strata are also present, but show a lower density of artifacts.

The climatic zoning identified in Enlène is in direct relationships with the occupation of the underground landscape.

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