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# Nouvelles données sur l'évolution paléoclimatique de l'époque magdalénienne, d'après l'étude lithostratigraphique du Roc-aux-Sorciers (Angles-sur-l'Anglin, Vienne, France)

## *New data on the palaeoclimatic evolution during the Magdalenian: Results of a lithostratigraphical study of the Roc-aux-Sorciers cave (Angles-sur-Anglin, Vienne, France)*

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RÉSUMÉ

Situé à quelques kilomètres d'Angles-sur-l'Anglin (Vienne, France), le Roc-aux-Sorciers a livré, dans les années 1927 et 1950, une industrie du Magdalénien moyen et supérieur. Les analyses des sédiments du remplissage attribués, par ailleurs, au stade isotopique 2, mettent en évidence deux séquences climatiques dans les six ensembles définis au cours des fouilles. Une première séquence, correspondant aux niveaux d'occupations du Magdalénien moyen et au début de l'occupation du Magdalénien supérieur (base du remplissage de l'abri) montre que le climat est globalement froid, et particulièrement humide, ce qui ne corrobore pas l'hypothèse de l'oscillation d'Angles-sur-l'Anglin (climat doux et humide) émise par Bastin en 1975. En fait, le climat évolue progressivement vers un léger réchauffement de la base au sommet de la stratigraphie. Au cours de la seconde séquence correspondant à la période d'occupation du Magdalénien supérieur, le climat, relativement constant, est un peu plus chaud et assez humide. Les données stratigraphiques et sédimentologiques apportent donc des informations nouvelles sur les conditions de dépôts du remplissage et sur la paléoclimatologie de la région du Poitou-Charentes au cours de l'occupation magdalénienne.



ABSTRACT

Situated a few kilometres from Angles-sur-Anglin (Vienne, France), the Roc-aux-Sorciers cave has yielded in 1927 and 1950 industry of the Middle and Upper Magdalenian periods. Our analyses of the sedimentary filling, dated from isotope stage 2, demonstrate the existence of two climatic sequences in the six ensembles defined during the excavations. A first sequence, at the base of the cave filling, corresponds to the occupation levels of the Middle Magdalenian and of the early Upper Magdalenian. At that time, the climate was globally cold and particularly humid, a conclusion that does not support Bastin's 1975 hypothesis on the oscillation of Angles-sur-Anglin, which postulates a mild and humid climate. In fact, the climate evolved progressively towards a slight warming from the base to the top of

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the stratigraphy. During the second sequence, corresponding to the occupation period of the Upper Magdalenian, the relatively stable climate was slightly warmer and quite humid. Stratigraphical and sedimentological data thus provide new information on the conditions under which the filling was deposited and on the palaeoclimatology of the Poitou-Charentes region during Magdalenian occupation.



## Abridged English version

### *Introduction*

The Roc-aux-Sorciers, in the vicinity of Angles-sur-Anglin (Fig. 1), is located at the base of Jurassic limestone cliffs.

The presence of Magdalenian industry was noted as early as 1927 by Rousseau (1933), while the excavations at St-Mathurin (Garrod and Saint-Mathurin, 1949; Saint-Mathurin, 1969, 1984) (1947 to 1957) have brought to light an exceptional frieze (Hammer et al., 1997) and a sedimentary sequence of the utmost importance for the knowledge of the period. Sedimentological analyses allow us to specify the paleoclimatic conditions of deposition and do not confirm Bastin's paleoclimatologic hypotheses on a "temperate oscillation of Angles-sur-Anglin" (Bastin, 1975a, 1975b).

### *Stratigraphy*

The 310 cm-thick section (Fig. 2) comprises of six different ensembles entirely lacking traces of cryoturbation. From base to summit, six ensembles are observed, namely: the yellow ensemble (Ej, Middle Magdalenian) consists of four sub-ensembles and is characterised by a stony sediment embedded in a sandy and silty matrix. "Ej base" contains large amounts of stones, 9 to 10 cm in diameter, and a high percentage of fine sand and silt. "Red Ej" probably owes its colour to a high concentration of ochre. "Black Ej" has yielded many hearths. "Upper Ej" (Ej sup) contains poorly rounded heterometric stones, of a diverse nature at the base and homogeneous (limestone) at the top.

A zone of collapse of the rock face contains many blocks larger than 20 cm, a high percentage of stones of 9 to 10 cm, associated with a small percentage of sandy silts.

The orange ensemble (Upper Magdalenian) consists of small elements of limestone in a silty sediment. The granulometric curves of the fine fractions and the morphoscopy of the quartz are those of a loessic silt.

In the sediments, dated Upper Magdalenian, by their industrial artifacts, we find an abundance of limy elements of 1 to 2 cm embedded in a sandy and silty sediment. The top of Em (Fig. 2) contains a high percentage of limestone blocs of over 20 cm. The granulometric curves of fine fractions are those of a sorted sediment, an aeolian deposit.

### *Methods*

The granulometric analyses of particles under 2 mm were performed on the unprocessed sediment with a Coulter LS-230 granulometer in the sedimentology laboratory of Tautavel. Mineralogical analyses of clay fractions were performed on three preparations for each sample (natural, glycoled, heated tests) by using the Holtzapffel protocol (Holtzapffel, 1985). The samples were analysed in the sedimentology laboratory of Lille 1 with the Philips Cu anticathod X-ray diffractometer. Diffractograms were interpreted semi-quantitavely with the Macdiff software. Calcimetry on the fraction of unprocessed sediment under 2 mm was done on Bernard's calcimeter in the Lille 1 laboratory of sedimentology. Quartz exoscopy was studied in Tautavel with the scanning electron microscope Philips XL30 ESEM and the dispersive energy microprobe EDAX. Isotopes ($\delta^{13}C$) were studied in the laboratory of biomineralisations and paleoenvironments (UMR 7193, ISTeP) of UPMC with a DualInlet mass spectrometer, while major and trace elements were analysed by ICP-AES and ICP-MS at the CRPG, Nancy. Heavy minerals were investigated at the Institute of Human Paleontology, Paris.

### *Results and discussion*

In a study of the rock face, BRGM (Baltasset et al., 1994) observed many cracks and fractures. The instability of the cliff explains the presence of numerous fallen blocks and stones of limestone in the filling of the Bourdois cave. However, one does not find as many stones and blocks over the whole stratigraphical column. Other factors must therefore have favoured fragmentation of the wall, such as microseisms (Alimen, 1950; Saint-Mathurin, 1984), fluid circulation or the action of frost or thawing.

Two sedimentary sequences are observed, leading to the definition of two climatic sequences.

Results on the Ej ensemble (Middle Magdalenian) show a high concentration of rounded quartz, frequent signs of dissolution, a high percentage of coarse sands, a significant percentage of kaolinite and smectite, and three important peaks of 9 to 10 cm-size stones (Fig. 3). A high degree of humidity is suggested by these observations and confirmed by the presence, in late fillings of cracks, of palygorskite deposited in sediments of the cave from water that trickled down the cliff.

The succession of colours over a small thickness of sediment, the peak of coarse sands and the three peaks of 9 to 10 cm-size stones are indicative of a cold climate (Fig. 5). Thus Bastin's hypothesis on an oscillation at Angles-sur-Anglin, defining a mild and humid climate, is not supported.

The area of collapse, showing blocks larger than 10 cm and numerous stones of 9 to 10 cm, may be a result of microseisms rather than of extreme cold.

The orange ensemble (beginning of the Upper Magdalenian) is characterised by a predominance of small stones, a decrease of the percentage of coarse sands, less roun-