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## **OURSALP programme: Contribution of the Baré d'Onnion Cave (Haute-Savoie, France) and first conclusions of the programme**

### **OURSALP Programm: Beitrag der Baré d'Onnion Höhle (Haute-Savoie, Frankreich) und erste Schlussfolgerungen aus dem Programm**

ALAIN ARGANT, JEAN-MARC ELALOUF and CÉLINE BON

#### **Summary**

The OURSALP-Programme aimed to register bears of all epochs in the Jura and the French Alps. The first conclusions of the OURSALP-Programme mainly concern the Chartreuse massif which yields the youngest *Ursus spelaeus* known in the Prealps. In the Chablais Alps, the Baré Cave at Onnion (Haute-Savoie, France) diggen by J.-C. SPAHNI and D. RIGASSI in 1950–1951, yielded an important palaeontological material, with many bear remains. The <sup>14</sup>C-AMS dating of six pieces determines the chronology of the fauna assemblage, from 21,970 ± 250 BP to 36,100 ± 1,400 BP. Three morphotypes were selected among six second upper molars of cave bear and ancient DNA analysis was attempted at the CEA Saclay in Gif-sur-Yvette. One positive result indicates that they belong with certainty to the *Ursus spelaeus* group.

## **1 The OURSALP programme**

The OURSALP project (Bears of the Jura and of the Alps) was born in 2002 by coincidence. First, there was an invitation to tender for a Collective Action of Research (ACR) by the “Sous-Direction de l'Archéologie” of the French minister of Culture and Communication. This was not accepted in spite of “its large scientific qualities” but not enough directed towards archaeology, “presenting too much paleontological characteristics”, which was true. But in spite of that, thanks to the financial help of the Natural Regional Park of Chartreuse, of the “Réserve des Hauts de Chartreuse”, of the DREAL (ex-DIREN), of the Natural Regional Park of the Vercors, of the ARPA, of the General Council of Haute-Savoie and some others, the ambitious and at that time innovative OURSALP programme was able to go ahead.

## 1.1 Objectives

The aim of the OURSALP-Program is to register bears of all periods, in the French Alps and the French Jura, including nearby areas. Three main areas of research were involved:

1. The species: Their requirements, ethology, ecological demands.
2. The populations: Particularities – or not – of alpine versus jurassic populations, dynamics, last populating of the area.
3. Man and bear: Possible relationship between them and possible role of man in the extinction of bears.

## 1.2 The research strategy

1. Listing of the sites yielding remains of bears: Checking old collections, results of modern excavations, publications or reports, personal researches.
2. Constitution of a rigorous chronological record by <sup>14</sup>C-AMS datings on bears' bones, indispensable to relate bears' presence to climatic conditions.
3. Pollen analysis of sediments contemporaneous with bears remains to attempt to be precise about the palaeoenvironmental conditions.
4. Close collaboration with the speleologists who most often discover new sites and play the first role on the ground.

## 2 The site of the Baré d'Onnion (Haute-Savoie)

### 2.1 General data

The Baré d'Onnion Cave (Haute-Savoie, France) is situated at an altitude of 1,190 m in a rocky ridge overlooking to the north the village of Onnion in the valley of the Risse, a tributary of the Arc (Figs. 1, 2). In 1950–1951 J-C. SPAHNI and D. RIGASSI carried out several digging campaigns, collecting a large quantity of palaeontological material and a lesser amount from stone tool making which they attributed at the time to the Moustertian. Except the article by SPAHNI & RIGASSI (1951), few papers mention the Baré d'Onnion (BOURDIER 1952, ROUCH-ZURCHER 1991).

More recently (about 20 years ago), clandestine diggers removed a large quantity of new material. All of this material is now held in Annecy, either in the Musée-Château (SPAHNI-RIGASSI collection) or the Conservatoire d'Art et d'Histoire (Conseil général de Haute-Savoie). Palaeontological study of the bears (*Ursus spelaeus*, *U. arctos*) and of the cave lion (*Panthera spelaea*) is currently underway (A. ARGANT, LAMPEA-UMR 6636 CNRS) as is a taphonomic study (M. LURET, J-C. CASTEL, Muséum d'Histoire naturelle de Genève).

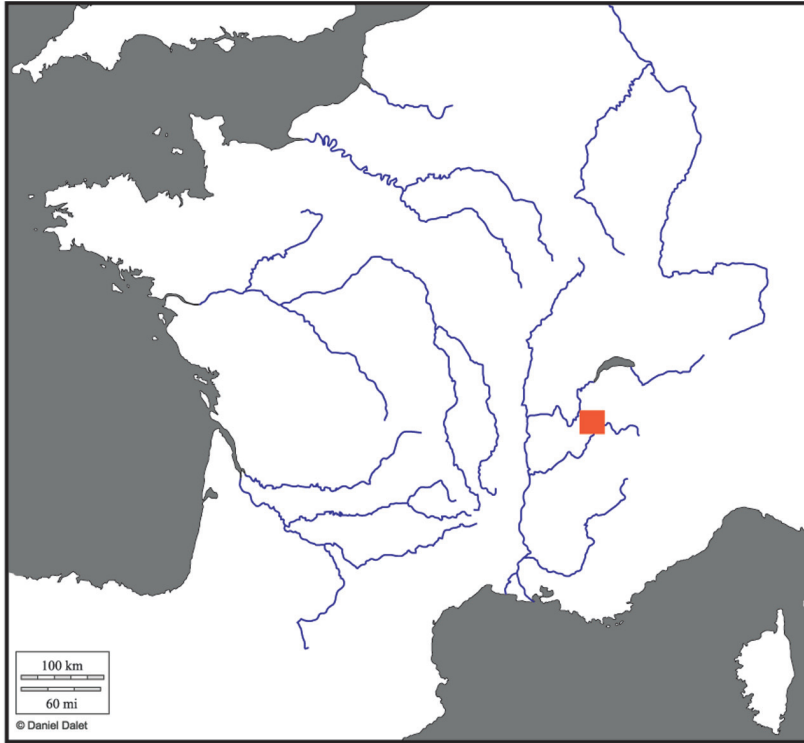


Fig. 1: Location map of the Baré d'Onnion Cave.

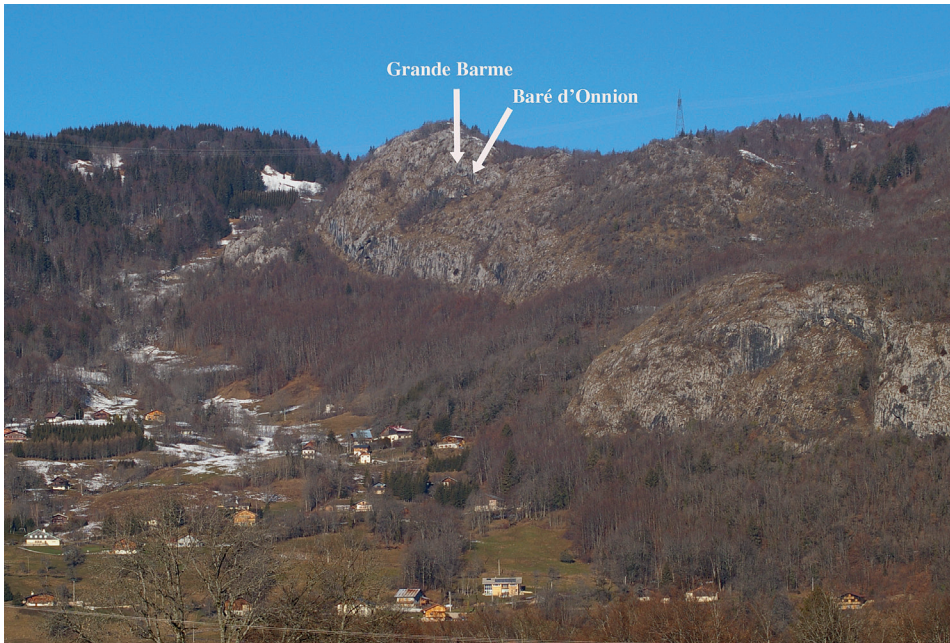


Fig. 2: View of the Rocher Blanc at Onnion (Haute-Savoie) where the Baré Cave is found (arrow).  
Photo: J. SERRALONGUE.

## 2.2 Palaeontological data

The remarkable palaeontological material of the Baré d'Onnion Cave is very abundant and coherent within the different collections. Unfortunately it is not located in the stratigraphy and must be globally studied. It is well preserved, only slightly worn by rolling, but without anatomic connections. This means that it was transported, but over a short distance. It very probably corresponds to the withdrawing of the Grande Barne Cave which is situated just above the Baré Cave (Fig. 2). Formerly, it was the endokarst of this big upper cavity, today without any old layers left (SPAHNI & RIGASSI 1951).

List of fauna:

*Ursus spelaeus*, *Panthera spelaea*, *Panthera pardus*, *Canis lupus*, *Vulpes vulpes*, *Martes martes*, *Cervus elaphus*, *Capra ibex*, *Rupicapra rupicapra*, *Marmota marmota*, *Arvicola terrestris*, *Microtus nivalis*, *Microtus arvalis*, *Microtus agrestis*, *Pitymys subterraneus*, *Clethrionomys glareolus*, *Talpa europea*, *Sorex araneus*, *Myotis* sp.

The  $^{14}\text{C}$ -AMS dating of six pieces of bears (*U. spelaeus*, *U. arctos*), cave lion (*Panthera spelaea*) and herbivores including *Capra ibex*, was possible and determine the chronology of this faunal assemblage (Tab. 1). The ages obtained range from  $21,970 \pm 250$  BP to  $36,100 \pm 1,400$  BP. The dispersion of these dates confirm that these animals were successively present over a period of more than 16,500 years during the OIS 3, ending not long before the last glacial maximum (Fig. 3).

**Tab. 1:** List of the  $^{14}\text{C}$ -AMS dates obtained on the Baré d'Onnion palaeontological material.

Baré d'Onnion Cave (Haute-Savoie, France)				
Dated material	Code labo.	Age BP	Age cal. BP	Age BC
			(2 $\sigma$ )	(2 $\sigma$ )
Skull <i>Ursus spelaeus</i>	Lyon 3089 (Poz)	$21,970 \pm 810$	<b>27,570–25,660</b>	25,620–23,710
Bone Herbivore	Lyon 3094 (Poz)	$25,620 \pm 370$	<b>31,050–29,630</b>	29,100–27,680
Skull <i>Ursus spelaeus</i>	Lyon 3091 (Poz)	$28,440 \pm 550$	<b>34,450–31,580</b>	32,500–29,630
Bone <i>Capra ibex</i>	Lyon 3093 (Poz)	$31,300 \pm 750$	<b>37,740–34,595</b>	35,790–32,645
Tooth <i>Panthera spelaea</i>	Lyon 3092 (Poz)	$34,600 \pm 1100$	<b>41,870–37,125</b>	39,920–35,175
Skull <i>Ursus arctos</i>	Lyon 3090 (Poz)	$36,100 \pm 1400$	<b>43,930–38,590</b>	41,980–36,640
Bone <i>Capra ibex</i>	ETH Zürich-4532	$38,470 \pm 810$	<b>44,280–41,840</b>	42,330–39,890

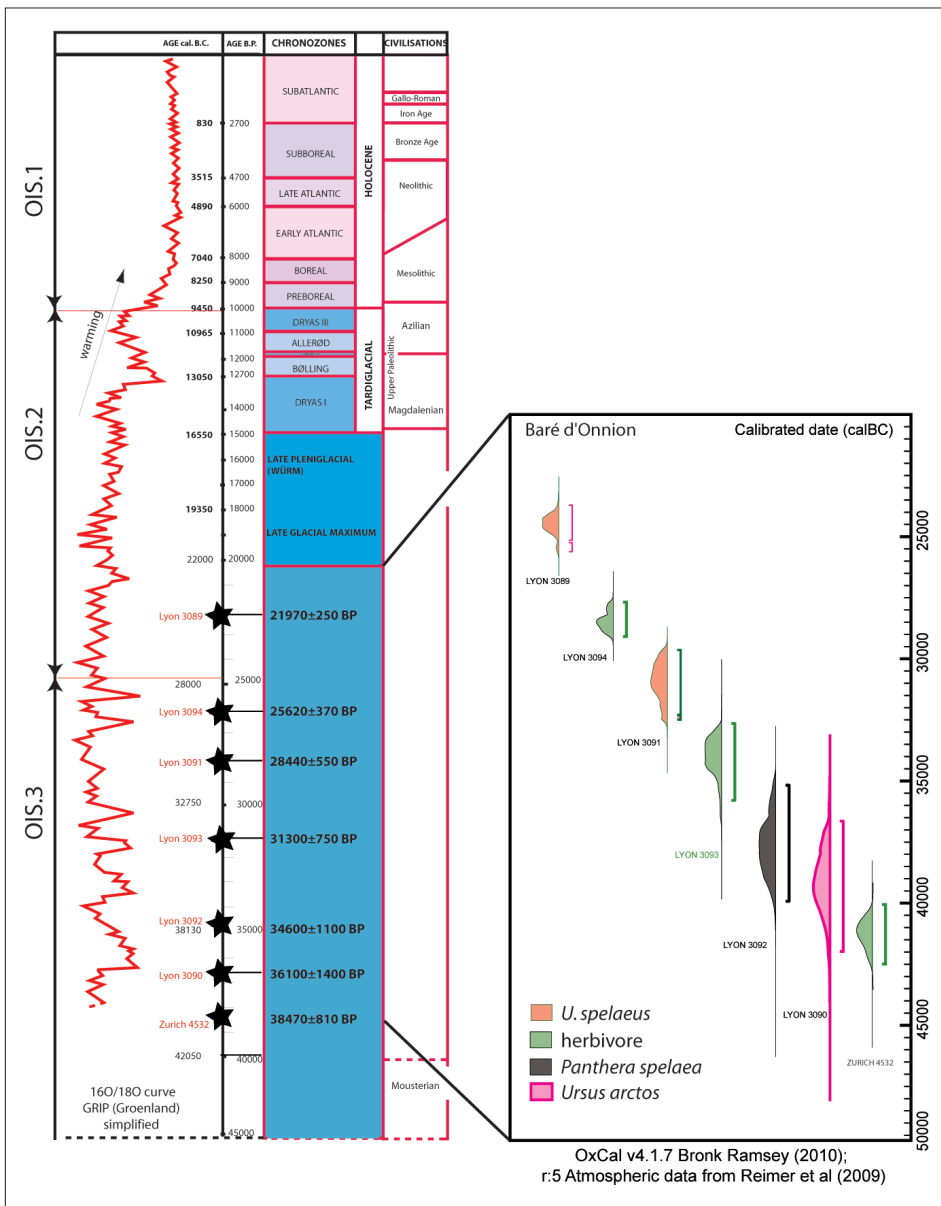


Fig. 3: Distribution of <sup>14</sup>C-AMS dates obtained from various bones from the Baré d'Onnion Cave.



Fig. 4: Baré d'Onnion. M2 series.

The teeth are most often isolated, but they form series in which, as often, several morphotypes occur (Fig. 4).

The diagram of the morphodynamic index standardized for P4/4 (Fig. 5) shows that the species of the Baré Cave is indeed *Ursus spelaeus*. *Ursus ingressus*, found at the top right of the diagrams (Figs. 5, 6; Gamssulzen, Austria and Potočka Zijalka (PZ), Slovenia) is ruled out when we examine the diagram showing the evolution of the K-index of the Mt2 in relation to the P4/4 index.

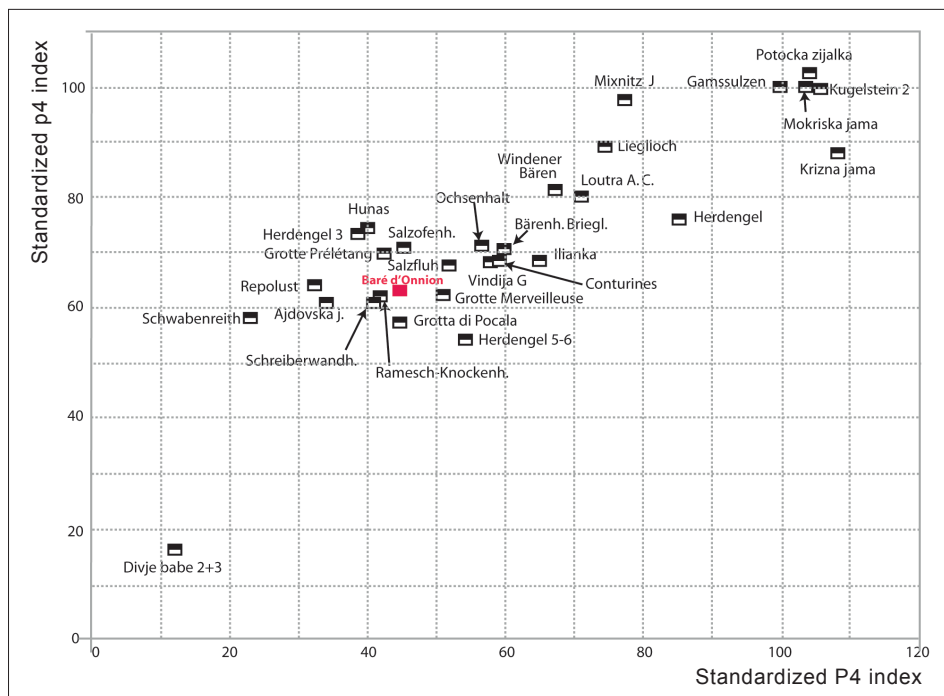
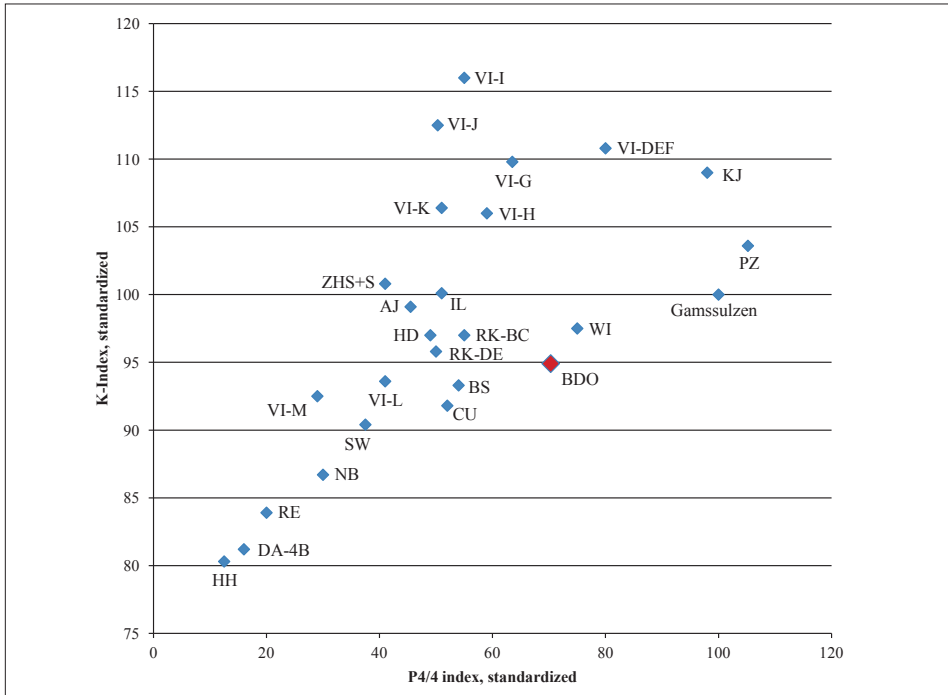


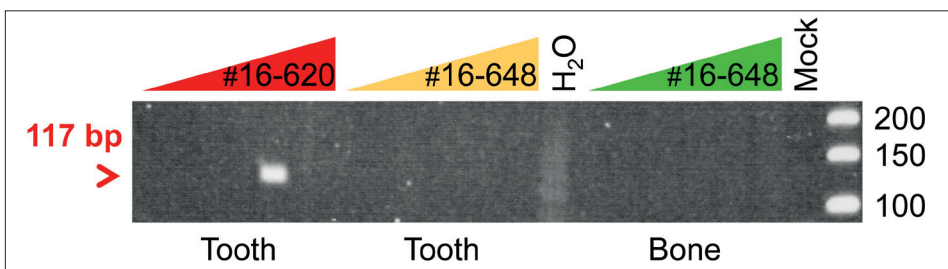
Fig. 5: Diagram of the standardized P4 and p4 indexes of bears from different sites.



**Fig. 6:** Standardized K-index of the 2<sup>nd</sup> metatarsal bone related to the P4/4 index (BDO = Baré d'Onnion).

### 2.3 Ancient DNA

DNA was extracted from six M2 specimens (Fig. 4). When available (e.g. specimen 16-648), a mandible fragment was also processed for DNA extraction. DNA analysis was performed using oligonucleotide primers targeting sequences of the mitochondrial genome that are conserved in most cave and brown bear specimens, but encompass a highly variable sequence of the D-loop. Amplification was carried out using a single round of 45 PCR cycles. The amplified DNA fragments were purified by gel electrophoresis (Fig. 7) and characterized by sequence analysis. Specimen 16-620 yielded a cave bear sequence.



**Fig. 7:** Acrylamide gel electrophoresis of DNA fragments obtained by PCR amplification of a highly variable domain of the cave bear mitochondrial D-loop.



### 3 OURSALP first conclusions

- The oldest cave bears:
  - *Ursus spelaeus* is already present in the Chartreuse massif before 45,000 BP.
  - Dating is difficult (limit of the  $^{14}\text{C}$  method).
  - *U. deningeri* is known only in Vercors, Jura and the nearby.

In mountains, the karstic environment makes the preservation of fossils and their discovery uncertain. They are often buried under thick layers of blocks which make their excavation impossible.

- The youngest cave bears:
  - The most recent *Ursus spelaeus* is found in the Cuvée des Ours in the Chartreuse Massif (Chapareillan, 38) at around 13,990 BP, during the Early Dryas. Two other dates in the Rhône valley (between 200 and 300 m a.s.l.) confirm their presence around 12,850 BP. This suggests that their presence does not depend on altitude. The warming of the Bölling-Alleröd period, which comes just after, seems to be one main reason for their extinction.

Calibration of  $^{14}\text{C}$  dates is now possible up to around 40,000 BP and calibrated dates (cal BP) can be placed on the climatic curves obtained from the ice cores of the polar ice sheets (GRIP, Vostock) which reflect well the global climatic changes. Pollen analysis of samples collected in caves close to the faunal remains gives uneven results that we must consider cautiously because sediments are often reworked. During the warmer interstadial phases between 43,000 and 39,000 BP, the landscape was open with herbs – mainly Poaceae – and dispersed woodlands with pine, fir and spruce at 1,700 m a.s.l. (e.g. Balme à Collomb).

The cave bear became extinct in Chartreuse at the beginning of the last cold Tardiglacial period (Early Dryas), which is apparently later than in the other parts of the alpine arch. Chartreuse seems to have been a refuge for cave bears. There is no evidence of action of Man to explain the extinction of cave bears. The reasons for their extinction are without doubt multiple, but it was likely that climatic conditions were an essential part. Only *Ursus arctos*, better adapted to warm temperatures and more carnivorous, could exist through the Tardiglacial period and resist the Holocene warming. It is obvious that the cave bear disappeared at the time of the faunal recomposition at the end of the Early Dryas, characterized by the extinction of the species of the “mammoth steppe” (BRIDAULT & CHAIX 2009).

## 4 Zusammenfassung

Das Ziel des OURSALP-Programms ist, alle Bären aus allen Epochen aus dem Jura und den Französischen Alpen zu erfassen. Die ersten Schlussfolgerungen des OURSALP-Programms betreffen vor allem das Chartreuse-Massiv, aus denen die jüngsten Funde von *Ursus spelaeus* in den Voralpen bekannt sind. Im Chablais-Massiv wurde die Baré d'Onnion Höhle (Haute-Savoie, Frankreich) von J.-C. SPAHNI und D. RIGASSI in den Jahren 1950 und 1951 ausgegraben. Die Höhle enthält wichtiges paläontologisches Material mit vielen Bären. Mit Hilfe der <sup>14</sup>C-AMS-Datierung an sechs Stücken kann die Fauna in die Zeitspanne zwischen  $21.970 \pm 250$  BP und  $36.100 \pm 1.400$  BP gestellt werden. Drei Morphotypen wurden aus sechs oberen 2. Backenzähnen von Höhlenbären ausgewählt und mit der aDNA-Analyse am CEA Saclay in Gif-sur-Yvette untersucht. Ein positives Ergebnis zeigt, dass die Bären mit Sicherheit zur *Ursus spelaeus* Gruppe gehören.

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In Annecy we always received a very warm welcome from Joël Serralongue of the archaeological service of the Conservatoire d'Art et d'Histoire (funded by the Conseil Général de la Haute-Savoie), and from Marie-Christine Lebascle at the Musée-Château (funded by the town of Annecy) where the different collections from Baré d'Onnion are held. The Conseil Général de Haute-Savoie financed the last six <sup>14</sup>C-AMS datings. ARPA financed the ancient DNA analysis of the six samples tested.

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