



Article

The rockshelter of Château-d'Œx: pedosedimentary record of human occupations in the Swiss Prealps from the Late Glacial to the Mid-Holocene

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Parole chiave

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Summary

Situated at an altitude of 1180 m a.s.l., the rockshelter of Château-d'Œx «Sciernes-Picats» is a calcareous block emerging from an alluvial fan. Geoarchaeological investigations show that the lower part of the sedimentary sequence is the result of runoff and frost activity typical of the Bolling-Allerød interstadial. These clastic fining-upward sediments contain at the top the oldest archaeological layer, dated to 11,000 cal BC and characterised by Azilian points. After a sedimentary break during the Younger Dryas, the overlying layer is marked by the effects of cold climate conditions at the beginning of the Holocene. Abundant combustion residues characterize this occupation related to the Late Epigravettian and dated to 9,700/9,500 cal BC. Then fragmentation of the block occurred again and the vegetation gradually colonised the site. Further occupation layers characterised by anthropogenic components belong to the Early Mesolithic. Enlarging of the block fractures by dissolution caused deposition of loamy sediment and collapsing of boulders in the filling. Afterwards, runoff resumed and an important Late Mesolithic occupation dated to 6,000 cal BC took place.

Riassunto

Posto ad una quota di 1.180 m s.l.m., il riparo di Château-d'Œx «Sciernes-Picats» è formato da un grosso masso calcareo che emerge da un conoide alluvionale. Gli studi geoarcheologici mostrano che la parte inferiore della sequenza sedimentaria è il risultato del ruscellamento e dell'azione di gelivazione tipici dell'interstadiale Bolling-Allerød. Questa sequenza di sedimenti detritici, con gradazione diretta, include, al tetto, il più antico livello archeologico datato a 11.000 anni cal BC e caratterizzato dalla presenza di punte aziliane. Separato da un'interruzione sedimentaria corrispondente al Dryas recente, il livello soprastante è marcato dagli effetti delle fredde condizioni climatiche dell'inizio dell'Olocene. Numerosi residui di combustione caratterizzano questa fase d'occupazione riferibile all'Epigravettiano recente e databile a 9.700-9.500 anni cal BC. Sono ancora attestati i fenomeni di gelivazione mentre la vegetazione gradualmente colonizza il sito. I successivi livelli d'occupazione, caratterizzati da una componente antropica, sono attribuibili al Mesolitico antico. L'allargamento per dissoluzione delle fratture nel blocco ha causato la deposizione di sedimenti limo-sabbiosi e la caduta di blocchi nel riempimento. In seguito, è attestata la ripresa dei fenomeni di ruscellamento cui è associata un'importante fase d'occupazione riferibile al Mesolitico recente e databile a 6.000 anni cal BC.

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Fig. 1 - Château-d'Œx «Sciernes-Picats» (Western Switzerland Prealps). The rockshelter, situated at an altitude of 1180 m a.s.l., is surrounded by summits which peak at over 2300 m (Vanil de l'Écri, Vanil Noir). / Château-d'Œx «Sciernes-Picats» (Prealpi svizzere occidentali). Il riparo, situato a un'altitudine di 1.180 m s.l.m., è circondato da picchi che raggiungono i 2.300 m (Vanil de l'Écri, Vanil Noir).

Introduction

Research carried out in the rockshelter of Château-d'Œx «Sciernes-Picats» is incorporated within the framework of human occupation in the alpine regions after the last ice age (Crotti *et al.* 2002; Crotti & Bullinger, 2008; Crotti 2008, 2009; Bullinger & Huber 2010). The discoveries in the region of Trentino and Alto Adige (northern Italy) in the 1970's (Bagolini 1972; Broglio 1992; Lanzinger 1996; Bertola *et al.* 2007) followed by those in the northern French Alps (Bintz 1999), have shed new light on this subject and have revealed a first human presence in the mountain zone (900 - 1400 m a.s.l.) during the Late Glacial at the end of the Palaeolithic, followed by increased evidence of settlement in the mountain and subalpine (1400 - 2200 m a.s.l.) zones during the Mesolithic.

In the Central Alps, which correspond to the territory of modern Switzerland, research started at a later stage. The discovery in 1989 of the rockshelter of Château-d'Œx, situated at an altitude of 1180 m a.s.l., in the western Prealps, can be considered as an important breakthrough. Excavations were programmed on a regular basis between 1990 and 1999 and uncovered a long sequence of human settlements since the Azilian at the end of the Allerød, around 11,000 cal BC. Recent investigations were carried out in 2011 in order to complete the stratigraphic observations of the lower levels dating back to the Late Glacial (Crotti & Bullinger 2013).

Sedimentological and micromorphological analyses were undertaken and focused on a profile considered as representative of the shelter's sedimentary sequence. The results of these geoarchaeological investigations are presented here briefly. The reconstituted chronology integrates some archaeological data, in particular the typology of projectile points which characterize the cultural facies of the successive settlements.

Geological context

On a regional scale (fig. 2), the site is located between the tectonic units of the *Simme Nappe* in the Château-d'Œx valley, and the *Préalpes Médiannes Nappe* forming the Vanils range on the northern edge of this valley (Plancherel, to be published). The shelter is situated at the foot of a 7 metre high limestone block, whose volume is estimated around 1000 m³, set on the right edge of an alluvial fan. This fan was formed at the outlet of the Paray valley, surrounded by summits which peak at over 2300 m (Vanil de l'Écri, Vanil Noir).

The Sciernes-Picats block consists of a massive limestone stratified in meter-thick beds with cracked flint nodules. A microscopic observation shows that this rock is a pale grey micritic limestone, a type of mudstone typical of the Late Jurassic (Malm). A sample taken from the roof of the cavity shows that it was made of a dark grey-brown limestone which turns light grey after alteration, containing calcite veins and stylolites (irregular serrated surfaces formed by pressure dissolution). A small block discovered at the base of the infill was also analysed. It is a fine-grained dark grey-brown limestone which turns light grey-brown after alteration, and is often found in the local sediment in the shape of blunt rocks. This type of grainstone with clastic quartz is related to the Middle Jurassic (Dogger) formation. More specifically this is a sparitic limestone with clastic quartz (~5%) and bioclasts, mainly fragments of mollusc tests (max. 10%). Both rocks reveal that the Sciernes-Picats block may have been transported by a debris flow from the Paray valley. This flow of material may have been caused by a breach in the moraine dam due to the thawing of the permafrost after the final glacier withdrawal in the Prealps.

Stratigraphy

The reference profile (fig. 3) is located in the eastern part of the shelter where the sediments are best preserved. Nine main layers have been identified and are described below from the bottom up, with a preliminary field interpretation.

Layer 9: rounded or angular heterometric blocks and stones. Compact matrix composed of angular gravel, slightly sandy silty, pale grey-yellow. Most elements are a mudstone-type limestone similar to the Sciernes-Picats block (Late Jurassic, Malm), others are a yellowy-grey grainstone-type limestone (Middle Jurassic, Dogger).

Debris flow that probably also carried the Sciernes-Picats block.

Layer 8: Pale yellow-brown sandy loam, reasonably well sorted, very compact. Millimetre thick beds of well sorted ochre-yellow silts at the top. Thickness: 8-10 cm.

Runoff deposits, oxidised, slightly pedogenised.

Layer 7: Coarse sand, slightly silty, well sorted, greenish dark grey, some small gravel. Lenticular, widening towards the block; abrupt boundary with the underlying layer. Maximum thickness: 5 cm

Runoff deposit, on erosive contact.

Layer 6: Poorly sorted gravel with some scattered stones. Compact yellowy pale grey sandy silt matrix with gravel. Distinct lower boundary, probably erosive.

The top part of the layer is heterometric and coarser; the middle part contains a large amount of stones and blocks, some of which are cryofractured. The matrix gradually becomes more loamy and brownish yellow near the top, mainly due to bioturbation. Some lateral roots and secondary carbonates are found in the form of pseudomycelium. Thickness: 55-65 cm.

Essentially cryoclastic deposit, slightly pedogenised.

Layer 5: Fairly fine platy gravel (1-5 cm), with a tendency for subhorizontal deposition. Abrupt lower contact, probably erosive, and showing a break in the sedimentation. Some components are corroded, and are very close together near the base of the layer. The matrix is made up of brownish black sandy loam with some charcoal, containing humus and bioturbations. Some lateral roots and pseudomycelium. Thickness: 10 cm.

Deposit formed by cryofracturing of the block, pedogenised and anthropised.

Layer 4: Gravel and stones (1-10 cm) fairly polyhedral. Brown-

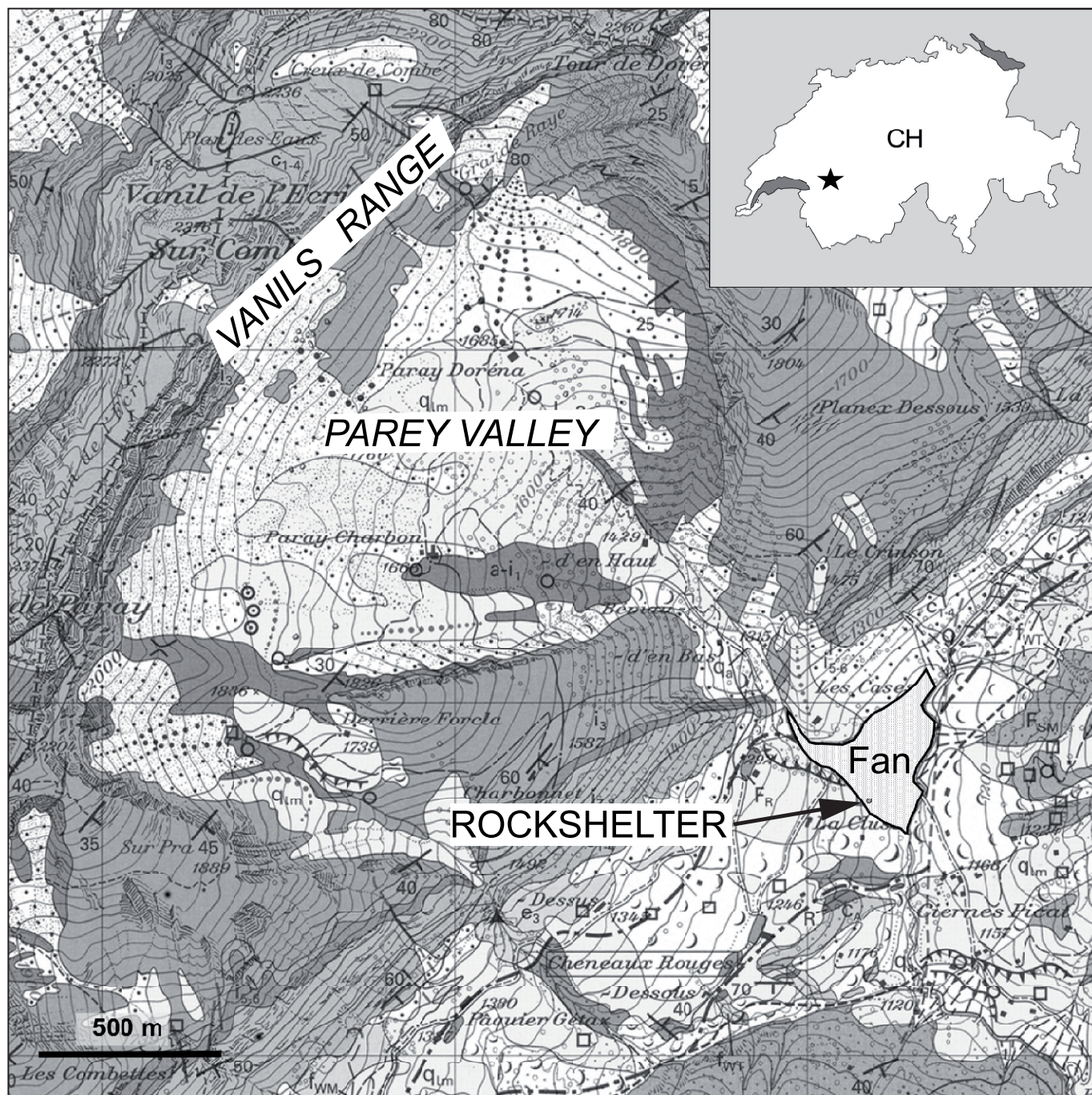


Fig. 2 - Château-d'Œx «Sciernes-Picats» (Western Switzerland Prealps). Geological map showing the location of the rockshelter. Coordinates 46°30'27"N / 7°10'2"E. / Château-d'Œx «Sciernes-Picats» (Prealpi svizzere occidentali). Carta geologica con la localizzazione del riparo. Coordinate: 46°30'27"N / 7°10'2"E.

ish black loam matrix, quite meagre, with charcoal, lateral roots and pseudomycelium. The heterometry of this layer differentiates it from the previous one. Thickness: 15-20 cm.

Deposit formed by fragmentation of the block, anthropised.

Layer 3: Gravel. Pale grey-brown silty sand matrix, with some centimetric lenses particularly near the base of the unit. Elements often platy, with a strong tendency for subhorizontal deposition, especially near the southern part of the cross-section beyond the profile. The lower limit is clearly defined by a layer of small blunt stones and blocks. Numerous roots and signs of bioturbation. Thickness: 20 cm.

Deposit of clasts formed by fragmentation or partial collapse,

deposit of matrix formed by runoff. Pedogenised and anthropised.

Layer 2: Sediment gradually more humus-bearing and less sandy. Brownish black matrix. Intensive bioturbation and numerous roots. Thickness : 5-10 cm.

Deposit formed by fragmentation of the block and enriched in organic material. Bottom of the topsoil.

Layer 1: Dark brown topsoil, primarily loam, containing a large amount of gravel of variable roundness. High levels of organic matter and numerous roots. Small blocks on the surface have been blunted through dissolution. Thickness: 15 cm.

Current topsoil

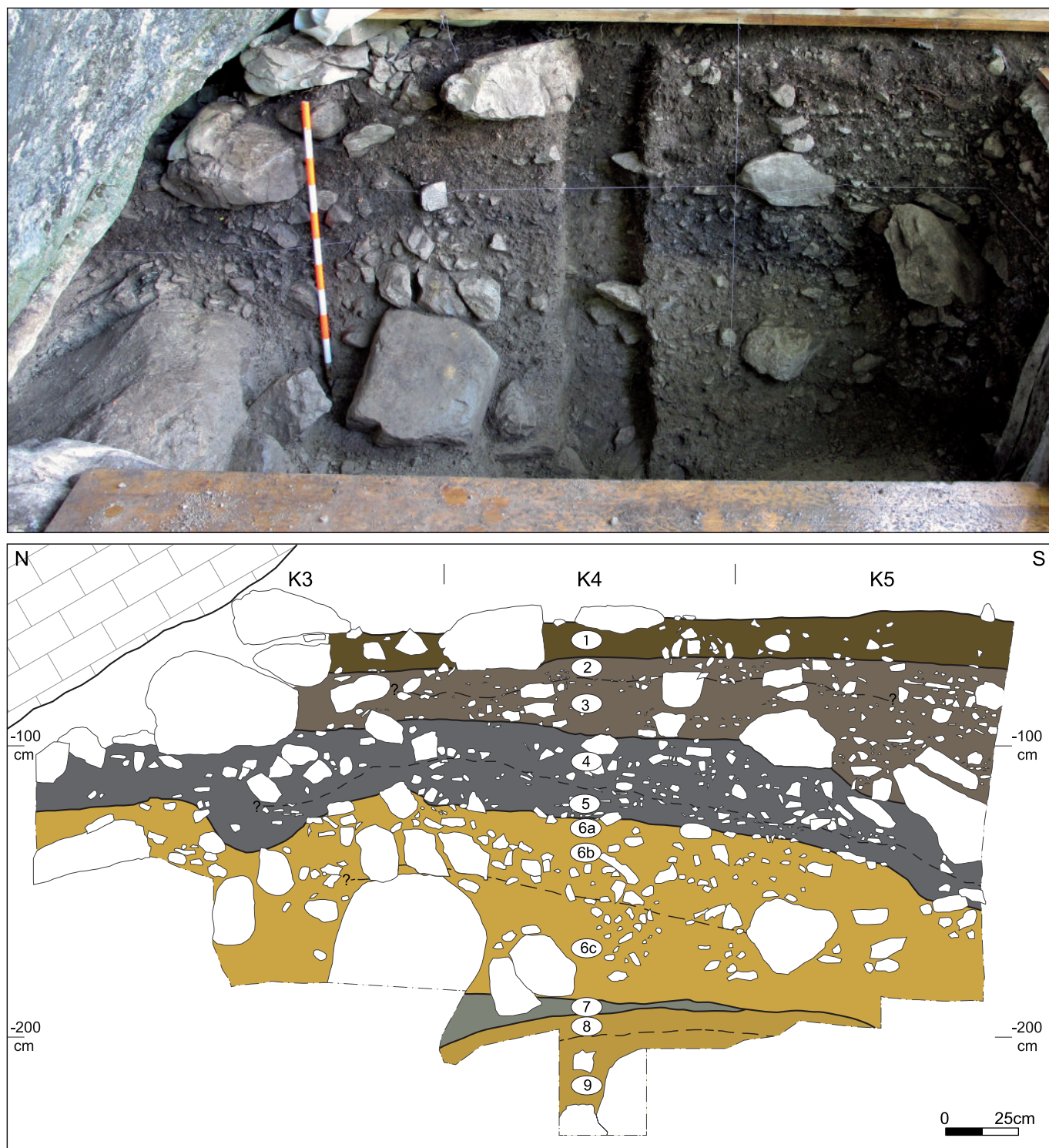


Fig. 3 - Château-d'Œx «Sciernes-Picats» (Western Switzerland Prealps). Cross-section 11, in the eastern part of the rockshelter fill.

Top: view of the cross-section.

Bottom: stratigraphic section of the deposits with the reference profile in the central part (K4). At the base, the debris flow which also carried the rockshelter block (layer 9). In the lower part, sandy (layers 8, 7) and coarse deposits (layer 6) originate from runoff and cryofracturing. In the upper part, the gravelly and more pedogenic sediments contain the main human occupation levels (layers 5 to 1). / Château-d'Œx «Sciernes-Picats» (Prealpi svizzere occidentali). Sezione stratigrafica n. 11, nella zona orientale del riparo.

In alto: vista della sezione. In basso: sezione stratigrafica dei depositi con il profilo di riferimento nella zona centrale (K4). Alla base il debris flow che ha trasportato anche il grande blocco che costituisce il riparo (livello 9). Nella parte inferiore, depositi sabbiosi (livelli 8, 7) e clastici (livello 6) originatisi dal ruscellamento e dalla gelivazione. Nella parte superiore, i sedimenti ghiaiosi e maggiormente pedogenizzati sono quelli più intensamente antropizzati (livelli 5 to 1).

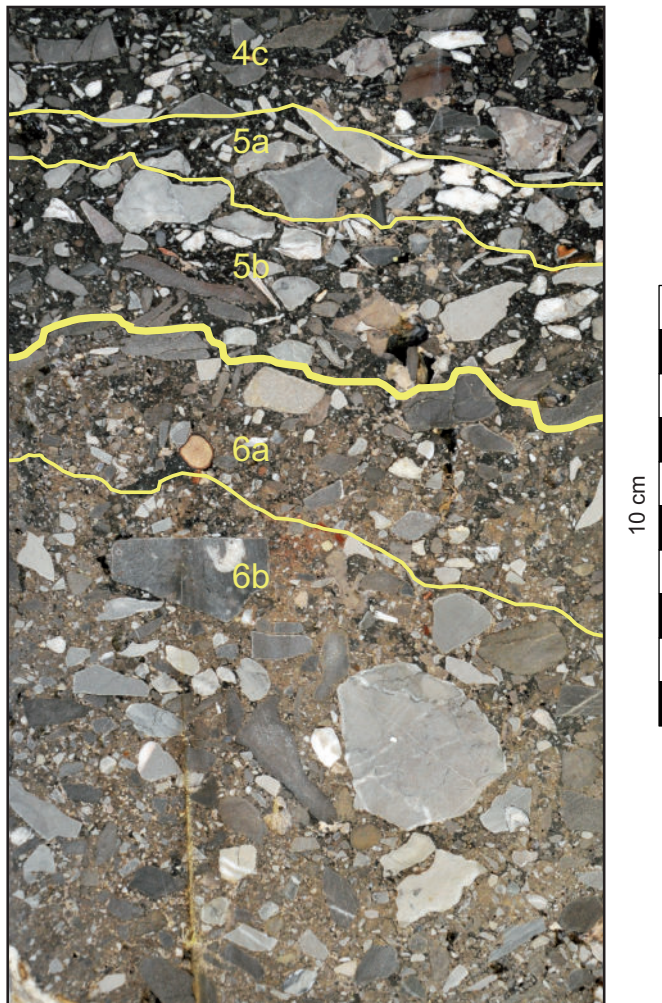


Fig. 4 - Château-d'Œx «Sciernes-Picats» (Western Switzerland Pre-alps). Vertical polish section through layers 6, 5, and 4 showing the contrast between the coarse clasts in the cryoclastic layers at the bottom and the archaeological levels with some flint artifacts and burnt limestone gravel at the top. / Château-d'Œx «Sciernes-Picats» (Prealpi svizzere occidentali). La sezione sottile verticale dei livelli 6, 5, e 4 evidenzia il contrasto tra i depositi detritici di origine crioclastica alla base e i livelli archeologici contenenti manufatti litici e ghiaie calcaree alterate termicamente al tetto.

Geoarchaeological analyses

The main goals of this study were to clarify the sedimentation dynamics and to detect the traces of human occupation specific to each stratigraphic unit. Different analytical methods were applied. Grain-size analysis and geochemistry of 13 bulk samples of the whole profile were carried out and combined with micromorphology of 3 monoliths encased during field work in the occupation layers, to allow identification of post-sedimentary processes and anthropogenic features (fig. 4). The combination of these approaches has led to a general understanding of site formation processes and palaeoenvironmental conditions at Sciernes-Picats. It is important to note that only one column, in the centre of the rockshelter, was sampled and examined. Lateral sampling control, which might have provided additional information, was, however, not implemented because of the small dimensions of the archaeological site as well as the simple geometry of the layers.

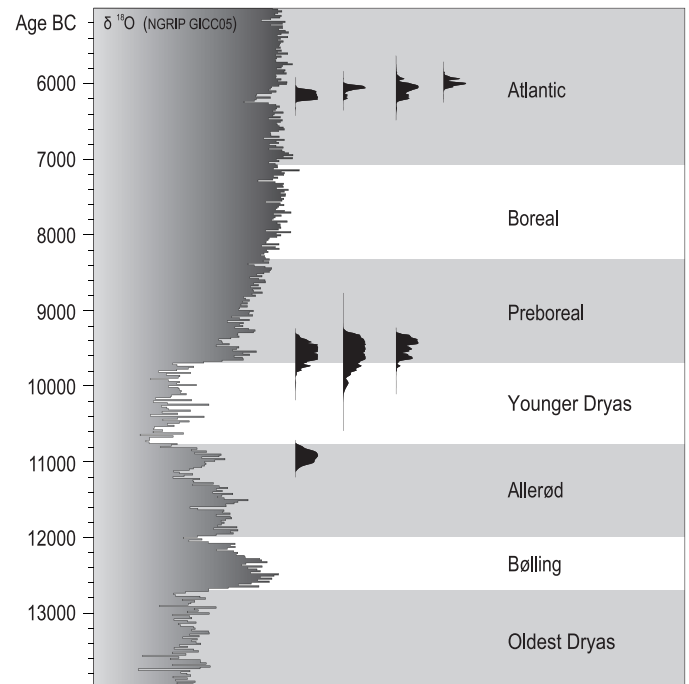


Fig. 5 - Château-d'Œx «Sciernes-Picats» (Western Switzerland Pre-alps). Calibrated Radiocarbon dates (NTCAL13, Reimer et al. 2013) in relation with the NGRIP GICC05 Curve (Andersen et al. 2005; Svensson et al. 2005). / Château-d'Œx «Sciernes-Picats» (Prealpi svizzere occidentali). Datazioni radiometriche calibrate (NTCAL13, Reimer et al. 2013) rispetto alla curva NGRIP GICC05 (Andersen et al. 2005; Svensson et al. 2005)

Sedimentation in the shelter

Most of the sediment accumulated in the shelter is endogenous, originating mainly from the ledge, and overall granulometry reveals a predominance of the gravel fraction. Layer 9 is particular because this very coarse deposit, which includes the Sciernes-Picats block, belongs to the upper part of the debris flow. An outwash of this mass created the layer 8, which is composed of sand produced by local runoff, such as meltwater. A rapid inspection under the microscope of the sand fraction of layer 8 confirms that it is not exogenous: the angular grains belong to the same mineral spectrum as the underlying layer. In the cross-section used for this study, it is clear that this surface was eroded before layer 7 was deposited, and the sand and gravel underline the recurrence of runoff. Layer 6 contains a large amount of gravel which is better sorted than the matrix and indicates a period of frequent freeze-thaw cycles. The middle and upper parts of this unit have fewer amounts of coarse elements which remain however in the majority. Micromorphology shows that the increase in silts in layer 5 is due to exogenous influence. The increase of this same fraction, as well as the amount of sand, near the intersection between layers 4 and 3 can be associated with col-luviation.

Geochemical analyses show that the environment is basic, saturated in carbonates, with evidence of pedogenesis. The latter appears discreetly at the top of layer 8, the matrix of which is slightly decalcified. Pedogenetic processes become clearly apparent from layer 5 up, with a distinct increase of organic matter coinciding with a decrease of carbonates. Furthermore, human activities greatly influenced the upper part of the infill, starting at the top of layer 6, where phosphates record an anthropogenic input, especially in layers 4, 3a and 2.

	cm	Layers	Description	Geochronological layers		Occupations	Chronozones
				Geoarchaeological layers	Archaeological layers		
	0	1	Topsoil. Roots	1	1		
	15	2	Gravels in a humiferous matrix	2	2		
	20	3	Coarse gravels in a sandy matrix	3a	3.1	Late Mesolithic	ATLANTIC
				3b	3.2		
				3c			
	40	4	Bedded coarse gravels in a loamy matrix	4a	4.1	Early Mesolithic	BOREAL
				4b	4.2		
				4c	4.3		
	55	5	Elongated, bedded gravels in a loamy matrix	5a	5.1	Late Epigravettian	PREBOREAL
				5b	5.2		
					5.3		
	70			6a	6.1	Azilian	YOUNGER DRYAS
					6.2		
		6	Coarse, angular gravels in a silty-sandy matrix	6b			BØLLING/ALLERØD
				6c			
			Coarse, sorted sand				
	130	7	Compact loamy sand. Iron oxides				OLDEST DRYAS
	135	8					
	145	9	Gravels and boulders, in a fine gravelly matrix				
	175						

Fig. 6 - Château-d'Œx «Sciernes-Picats» (Western Switzerland Prealps). Stratigraphical table. Dashed lines indicate lacunas. / Château-d'Œx «Sciernes-Picats» (Prealpi svizzere occidentali). Schema stratigrafico. Le linee tratteggiate indicano le lacune.

Chronological reconstruction

The combination of field observations and results of laboratory analyses allow us to recreate the main events, which are set in a more general chronological framework. This reconstruction also integrates some specific archaeological data: radiocarbon dates of human settlement layers (fig. 6) and a brief overview of the projectile points, which are good chrono-cultural markers. The data used here comes from a small area of approximately 5 square metres, basically a trench measuring 3,3 m by 1,5 m located in front of the reference profile. The layers identified in the stratigraphy are, when necessary, further divided into several sub-units that use letters for geoarchaeological distinctions (for example 5b, 5a) and numbers when related to the distribution of archaeological remains (for example 5.3, 5.2, 5.1) (fig. 6).

Oldest Dryas

This sequence begins with a significant debris flow from the Paray valley containing large rubble blocks of various sizes and lithology. This flow might be related to the disappearance of the permafrost in the western Prealps at the end of the Oldest Dryas (Schoeneich, 1998). The Sciernes-Picats block is particularly large and only found enough stability at the front of the moving mass (layer 9). Runoff created gullies on the surface of the flow which were then filled with sand (layer 8). Sedimentation subsequently came to a halt for a while and the sand deposits underwent a chemical alteration in a more temperate climate. After runoff recommenced again locally, perhaps due to meltwater, the debris flow was once more subject to superficial erosion, and a second sandy gravelly layer was formed (layer 7).

Bølling and Allerød

Gelifraction becomes the dominant process as a result of an unstable climate with frequent freeze-thaw cycles: the alpine shelters of this time frame, in carbonate environments, are characterised by a substantial amount of detritism (Bintz *et al.*, 1997 ; Guélat, 2006). The first endogenous formation appears at the foot of the south face of the block in the form of an accumulation of cryoclastic fragments. Vegetation was unable to colonise this layer, although snow and runoff occasionally brought additional sediment. Stratigraphy shows that this layer was divided into two units, separated by a layer of stones which may have originated from a partial collapse of the rock face (layers 6c and 6b). The top of this cryoclastic formation, layer 6a, has a more significant matrix with a larger amount of phosphates, and evidence of trampling reveals a discreet and occasional human occupation of the shelter.

Lithic industries discovered at the top of layer 6 are scarce, characterised by backed points and backed bladelets (fig.7, n° 24-26) dating back to the late Azilian. This first human occupation is radiocarbon dated to around 11,000 cal BC (GrA-55358: 11,020±50 BP, 11,110 - 10,820 cal BC, 2 σ). The analysis was carried out on a bone discovered at the junction between layers 5 and 6. This date coincides with the last temperate phase at the end of the Allerød, just before the cooling of the Younger Dryas (GI-1a, 11,089 - 10,896 BC; Rasmussen *et al.*, 2014, tab. 2).

Younger Dryas and beginning of the Preboreal

The boundary between layers 6 and 5 shows a sudden considerable reduction in sedimentation, which would coincide with the gap often observed in rock shelter stratigraphy during the Younger Dryas, between approximately 10,900 and 9,700 cal BC (Bintz *et al.*, 1997 ; Rentzel, 1998). This horizon also marks the beginning of the anthropised sequence: micromorphological analyses show that the sediment contains large amounts of flint shards, bone fragments and charcoal as well as evidence of trampling (layer 5b). Micras were probably deposited by airborne exogenous silts. As indicated by

traces of frost marks in the sediment, the climate is still cold and the forest cover has not yet reached the height of the shelter (1200 m a.s.l.). This also applies to the top of this unit (layer 5a) where the frequent evidence of combustion and the lack of trampling differ from the previous layer.

From a chronological point of view, the units 5.3, 5.2 and 5.1 belong to the beginning of the Preboreal, between 9,700 and 9,500 cal BC (ETH-9660: 10,000±95 BP, 10,050 - 9,250 cal BC, 2 σ ; GrA-55355 : 10,020±45 BP, 9,810 - 9,260 cal BC, 2 σ). These dates belong to the beginning of the Holocene, before the « 11,400 BP event », between 9,703 and 9,520 BC (Rasmussen *et al.*, 2014, tab. 2).

Arrowheads include essentially straight and narrow thick backed points as well as backed bladelets (fig.7, n° 1-23). A slightly larger point was uncovered at the bottom of this group (layer 5.3; fig.7, n° 23).

These lithic industries are characteristic of the Late Epipalaeolithic, more specifically the Late Epigravettian, similar to those found at the contemporary Altwasser Höhle shelter discovered north of the Alps in the Upper Rhine Valley (Jagher *et al.*, 2000). These Epigravettian features are also found in the Jura and the Northern Alps (Mével *et al.*, 2014). At Vitrolles «Saint-Antoine» in the Rhône Valley, typical Late Epigravettian assemblages appear distinctly at the end of the Allerød (Montoya & Bracco, 2004).

Preboreal, Boreal and beginning of Early Atlantic

The following layer (4c) is distinctly separated from the previous ensemble as a result of a sedimentation lacuna. Micromorphological analyses revealed flint shards and other remnants of human occupation. This coincides with a resumption of the fragmentation process of the block, due to the freeze-thaw cycles, as well as deposits of airborne dust. At the same time, vegetation gradually started to colonize the site. These changes in local conditions are related to the global warming that occurred at the beginning of the Holocene. A new human settlement subsequently occupied the shelter (layer 4b), leaving traces of combustion. This unit has very clearly defined limits and the archaeological remains are different from those in the previous layers: smaller flint shards, altered bone fragments and burnt mollusc shells. While airborne deposits have ceased, biological activity has increased. This confirms the climate improvement initiated during the previous stage, despite a persistence of cold weather as shown by the continuous formation of clasts, which are also produced by the thermal impact of man-made fire on the rock face. Gradually, colluvial loam accumulated in the shelter by percolation of rainwater through newly created cracks in the block (layer 4a). As the atmosphere becomes more and more temperate, frost-induced detritism decreases. Layers 4.2 and 4.3 reveal sporadic settlements. The lithic assemblages are heterogeneous, with various microlith types: obliquely truncated points, backed points, base retouched points, segments and scalene triangles (fig.8, n° 10-20). These technocomplexes belong to the Early Mesolithic. No radiocarbon date is available yet.

A discreet Late Mesolithic microlith assemblage was discovered in layer 4.1, which is at the top of layer 4 (fig.8, n° 7-9).

From Early Atlantic onwards

After a period of reduced sedimentation, illustrated by the distinct limit between layers 4 and 3, the south face of the block seems to have partially collapsed, covering this interface with a bed of stones and small blocks. This phenomenon is frequently observed in the stratigraphy of shelters in the Alps and in the Jura and has become somewhat of a reference layer (Guélat, 1991, 2006 ; Rentzel, 1990, 1998). The collapse was caused by the enlargement of cracks in the rock, stimulated by CO₂-charged solutions in a humid temperate climate related to the vegetation which colonised the top of the block. This type of event often occurs during the Early Atlantic

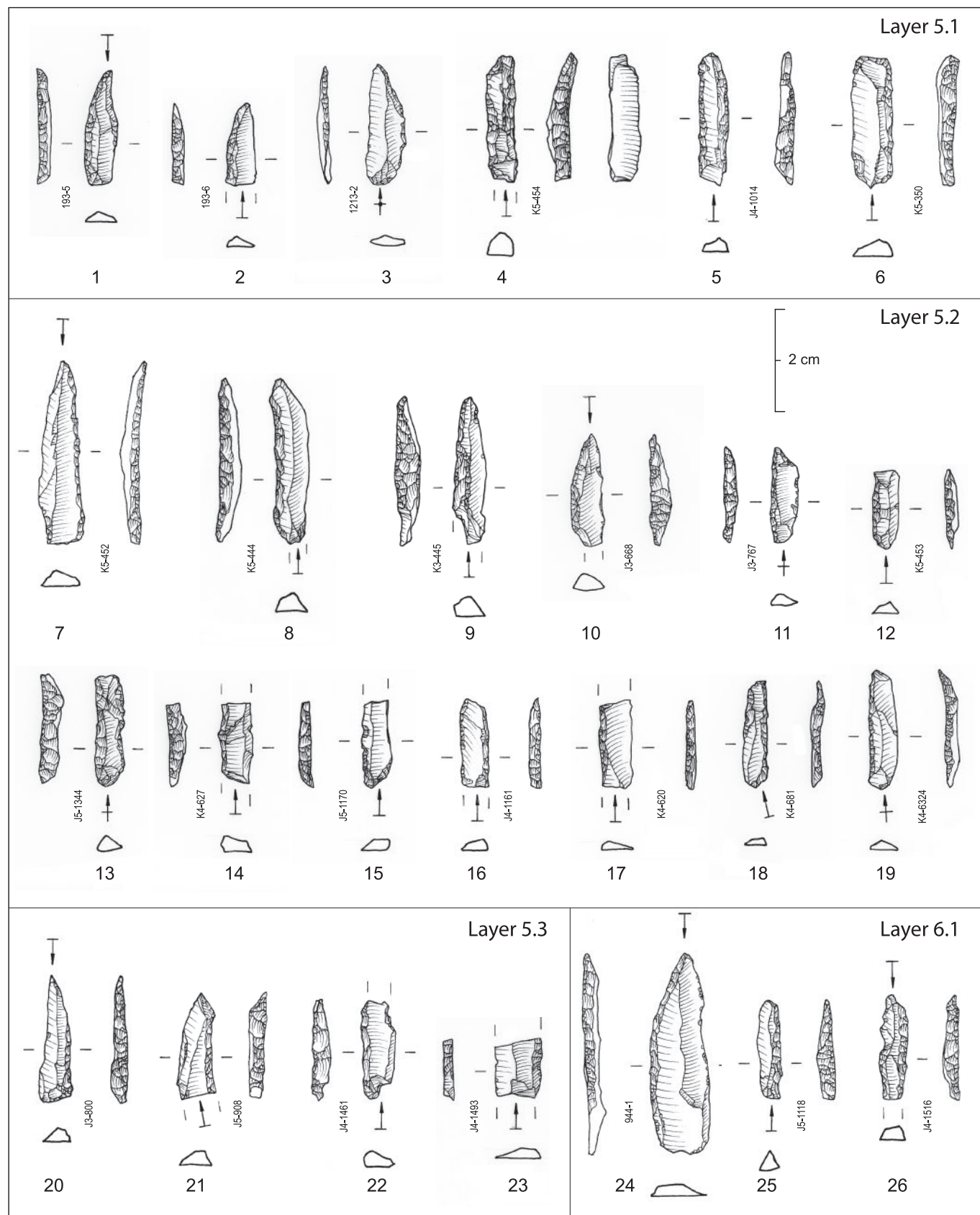


Fig. 7 - Château-d'Œx «Sciernes-Picats» (Western Switzerland Prealps). Lithic assemblages: Late Epigravettian (layers 5.1-5.3) and Azilian (layer 6.1). 1-3, 7-10, 20: Backed points; 4-6, 11-19, 21-23, 25-26: Backed bladelets; 24: Azilian point. Drawings: Belén Nión. / Château-d'Œx «Sciernes-Picats» (Prealpi svizzere occidentali). Industria litica: Epigravettiano finale (livelli 5.1-5.3) e Aziliano (livello 6.1). 1-3, 7-10, 20: Punte a dorso; 4-6, 11-19, 21-23, 25-26: Lamelle a dorso; 24: Punta aziliana. Disegni: Belén Nión.

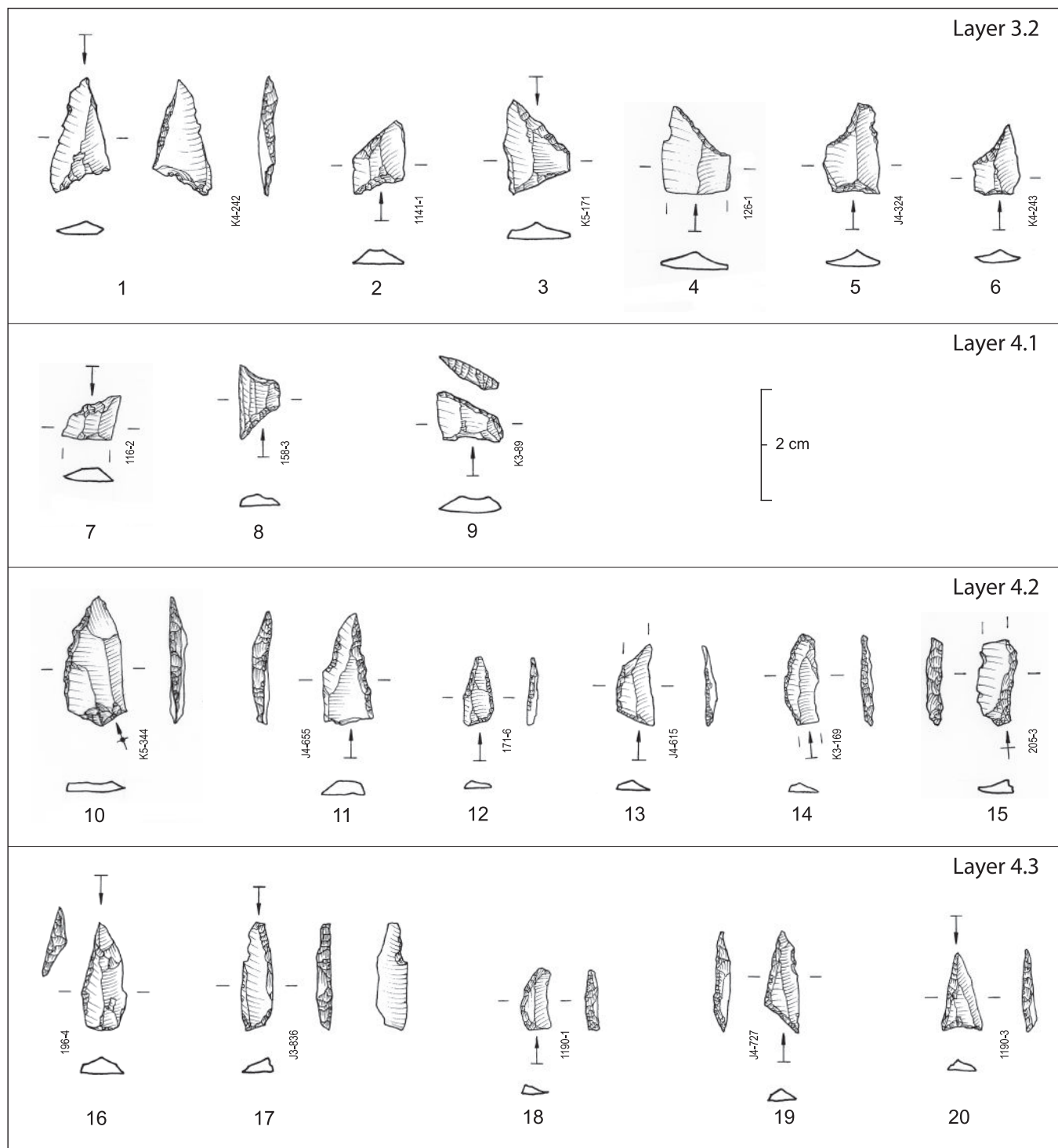


Fig. 8 - Château-d'Œx «Sciernes-Picats» (Western Switzerland Prealps). Lithic assemblages: Late Mesolithic (layers 3.2 and 4.1) and Early Mesolithic (layers 4.2 and 4.3). 1: Asymmetric triangular arrowhead ("fléchette") 2-9: Trapezes; 10-13, 16-17, 20: Microlithic points; 19: Triangle; 14, 18: Segments; 15: Backed bladelet. Drawings: Belén Nión. / Château-d'Œx «Sciernes-Picats» (Prealpi svizzere occidentali). Industria litica: Mesolitico recente (livelli 3.2 e 4.1) e Mesolitico antico (livelli 4.2 e 4.3). 1: Punta triangolare asimmetrica ("fléchette") 2-9: Trapezi; 10-13, 16-17, 20: Punte microlitiche; 19: Triangolo; 14, 18: Segmenti; 15: Lamella a dorso. Disegni: Belén Nión.

between 7,000 and 5,000 cal BC.

Subsequently, runoff increases succeeded by the formation of a loam of hydromorphic nature which might be related to the activity of gutters (layer 3c). The following deposit (layer 3b), of a similar nature to the previous one, contained flint shards, large pieces of charcoal and traces of trampling associated with a new human settlement. These remnants of human activities become scarcer in a bioturbated

sedimentary accretion (layer 3a). Pedogenetic alterations manifest themselves through the superficial dissolution of clasts. Platy gelifracts appear in the outer part of the fill and are probably related to the formation of concretions on the imbibed rock face.

Archaeological records of human occupation were numerous in layers 3.1 and 3.2, including well-preserved animal remains. These layers were preserved in the whole of the excavated area, as opposed

to the early settlements (layers 6 and 5) which were only found near the reference profile. The lithic assemblages are typical of the Late Mesolithic, characterised by trapezes most of which are asymmetric (fig.8, n° 2-6). An inversely retouched asymmetric « *fléchette* » was also discovered (fig.8, n° 1). All radiocarbon dates confirm the relatively recent nature of the lithic industries and converge to the end of the 7th millennium, around 6,000 cal BC (ETH-9659 : 7190±85 BP, 6,230 - 5,890 cal BC, 2 σ ; GrA-55357 : 7,200±40 BP, 6,120 - 5,990 cal BC, 2 σ ; GrA-55360 : 7,290±40 BP, 6,230 - 6,060 cal BC, 2 σ).

The top part of the fill (layers 2 and 1) is only partially preserved and is characterised by a lacunar sedimentation: organic matter increases greatly followed by a biological mixing of the components. Layers 2 and 1 contain Mesolithic artifacts in secondary position as well as modern elements and structures.

Conclusions

The comparison between sedimentological and archaeological data shows a good convergence and complementarity of these approaches. Unlike human occupation itself, the conservation and recording of consecutive settlements are closely related to sedimentation conditions.

The general stratigraphical table (fig. 6) highlights several lacunas in the sedimentary history of the site (erosion, decrease or absence of sedimentation) as well as important gaps in the sequence of human occupations. The top of layer 6 may have been truncated during the Younger Dryas, creating a hiatus. As a result, some Azilian elements may have disappeared.

On the other hand, a relatively constant sedimentation during the Late Epigravettian, around 9700/9500 cal BC, and during the Late Mesolithic, around 6000 cal BC, allowed an excellent preservation of remains, particularly animal bones. In both cases anthropic elements are numerous and radiocarbon dates converge.

Layers 4.3 and 4.2, which belong to the Early Mesolithic, did not benefit from such favourable circumstances. The sedimentation rate seems to have been inferior and bones are highly fragmented and altered. These layers probably correspond to multiple occupations over a wide time span, which is in accord with the lithic industries.

The top part of the fill, which contains a mixture of Mesolithic and modern artifacts in humiferous deposits (layers 2 and 1), reveals a clear decrease in sedimentation.

It is tempting to correlate these alpine establishments with climatic aspects. With regard to the Sciernes-Picats shelter, it appears that Azilian hunter-gatherers occupied the site during a warm phase at the end of the Allerød, between approximately 11,100 and 10,900 cal BC. Furthermore, the climate improvement at the beginning of the Preboreal, between 9,700 and 9,500 cal BC coincides with the Late Epigravettian occupations.

Finally, it appears that the Late Mesolithic settlements occurred immediately after a sudden cold and dry phase called the «8,200 BP event» (Lowe *et al.*, 2008; Rasmussen *et al.*, 2014).

The Château-d'Œx « Sciernes-Picats » shelter is a reference site for the Central Alps, with its large chronological sequence and the significant amount of archaeological records which are lacking in open-air alpine encampments. In addition to the geoarchaeological aspects, archaeozoological studies, raw material sources use-wear analysis and lithic technology open up new research opportunities for the study of hunter-gatherer economies in the alpine regions.

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