

# Tradition and innovation between the Mesolithic and Early Neolithic in the Adige Valley (Northeast Italy). New data from a functional and residues analyses of trapezes from Gaban rockshelter<sup>1</sup>

Emanuela Cristiani<sup>1</sup>, Annaluisa Pedrotti<sup>1</sup>, Stefano Gialanella<sup>2</sup>

<sup>1</sup> Dipartimento di Filosofia, Storia e Beni Culturali, Università degli Studi di Trento, IT  
emanuela.cristiani@lett.unitn.it; annaluisa.pedrotti@unitn.it

<sup>2</sup> Dipartimentodi Ingegneria dei Materiali e Tecnologie Industriali, Università degli Studi di Trento, IT  
stefano.gialanella@ing.unitn.it

**ABSTRACT** – *The Neolithisation of the Northern Italy is particularly interesting since archaeological data show dynamics of interaction between the last hunters and the early farmers of the region. In this paper the authors present the results of use-wear and residues analyses carried out on an assemblage of trapezes from one of the key-sites of the Neolithisation in the Adige Valley: Gaban rockshelter. The functional data have been compared and discussed with other strands of archaeological evidence available for the region.*

**IZVLEČEK** – *Študij procesa neolitizacije v severni Italiji je zanimiv zato, ker arheološki podatki kažejo na dinamike interakcij med zadnjimi lovci in nabiralci ter prvimi poljedelci v regiji. V članku predstavimo rezultate analiz sledov uporabe in ostankov na trapezoidnih kamenih orodjih z enega ključnih najdišč v dolini Adiže: v spodmolu Gaban. Rezultate analiz primerjamo in analiziramo v kontekstu ostalih arheoloških podatkov v regiji.*

**KEY WORDS** – *Mesolithic-Neolithic transition; use-wear and residues analyses; trapezes; hunting strategies; aesthetic traits; ochre*

## Introduction

The Neolithisation of northern Italy is peculiarly interesting, since several strands of archaeological evidence suggest more intense interactions between the last hunters and the early farmers in the region than elsewhere on the peninsula (*Bagolini and Biagi 1988; Biagi et al. 1995*). The active role of local Mesolithic groups in the formation and definition of the first Neolithic of the region has been described by various authors (*Bagolini in primis*), on the basis of various strands of evidence (techno-typological similarities in the lithic industries of the transition, presence of pottery in the Castelnovian levels, etc.) as

an acculturation phenomenon. The dynamics of the transformations in north-east Italy have not yet been defined and fully understood. However, the archaeological record shows that Neolithisation was a gradual process in which diffusion, interactions and exchanges were involved.

The Neolithisation of the Adige Valley occurred in the second half of the 6<sup>th</sup> and the first half of the 5<sup>th</sup> millennia calBC. Mesolithic hunters had inhabited diverse ecological niches across the Alpine region since the Preboreal (c. 9500 calBC), and numerous

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sites were located both in the lowlands and at high altitudes, suggesting the dynamism of human adaptations across the region. The role of local groups in the formation and definition of the first Neolithic of north-east Italy has been emphasised by some authors, who define this change as a slow and gradual process of acculturation (Broglia 1990; 1994; Bagolini and Biagi 1988; Biagi et al. 1985; Pedrotti 2001; 2002). This vision of the Mesolithic-Neolithic sequence in the south of the Alps is based mainly on the evidence of the lithic industries, as well as the continuity of raw material acquisition modalities, technological, morphological and typo-metrical aspects of tools and microliths between the Mesolithic and the Neolithic (Bisi et al. 1986). However, these similarities are not absolute, and in fact, new lithic types appear in the Early Neolithic of north-east Italy (for example, the so-called burin of Ripabianca: Bisi et al. 1996); also, the dimensions and asymmetry of microliths seems to have increased during this period.

Given their technological and morphological variability, the category of trapezes (the microliths which characterise the Castelnovian and the Early Neolithic) could be considered as a good proxy for defining transformations that took place in the Adige Valley during the early-middle Holocene. Furthermore, some archaeological findings and the results of the rare functional analyses carried out on trapezes testify to the multitasking nature of these microliths: they were, in fact, used in different ways: a) as projectile points at the sites at Loshult in Sweden (Malmer 1969), Nizhneye Veretye in north-east Russia (Oshibkina 1989), at Duvensee 9 (Bokelmann 1991) and Seedorf (Bokelmann 1994) in Germany, and in England. At the Star Carr site, for instance, there were microliths still covered with resin remains (Clark 1954); b) as composite knives for plant gathering, processing and cutting organic soft material at Gleann More in Scotland (Finlayson and Mithen 1997) and at Uzzo Cave in Sicily (Longo and Isotta 2007).

In this article, we present the results of a functional analysis carried out on a portion of the assemblage of trapezes from one of the key-sites of the Mesolithic-Neolithic transition in the Adige Valley: Gaban rockshelter. Our study was aimed at understanding the possible connection between the morpho-technological differences identified in the Mesolithic and Neolithic trapezes of the Adige Valley and their function. We show how these results can contribute to debates about the Mesolithic and Neolithic transformations in the region. After introducing the site and



**Fig. 1. a) Localisation of the Adige Valley and Gaban rockshelter; b) view of Gaban rockshelter.**

the characterisation of the chronological and stratigraphical context of our research, a methodologic approach to the analyses of trapezes will be defined. In the conclusions, the results of functional and residue analysis will be discussed and compared with other strands of archaeological evidence available for the region.

### Gaban rockshelter

Gaban rockshelter is among those sites found in the Adige Valley that humans used continuously from the Mesolithic (7500 calBC) throughout the Neolithic and Middle Bronze Age (1600 calBC). It is situated about 3km north of the city of Trento at 270m asl. The site is in a dominant position on the eastern side of the Adige River (Fig. 1.a). The shelter is about 30m long, 6m high and from 2 to 4m wide (Fig. 1.b). Bernardo Bagolini conducted the first archaeological excavations at this site, starting in 1971 and ending in 1979. Further research focused on Mesolithic levels, and was carried out by Kozłowski and Dalmeri from 1982 to 1984. Bagolini divided the excavation area into 5 sectors (from south to north sectors II, I, IV, III and V). Drainage works in the 1600s and 1700s removed Bronze and Copper ages levels from sectors I and III, partially including the Neolithic layers. In the other sectors (II, IV, V), the sequence,



**Fig. 2. a) The Gaban Venus; b) technological features of the artefact: 1) traces of abrasion visible on the shoulders (3.2x); 2) traces left by engraving the necklace (6.3x); 3) cutting traces left during the production of the osseous blank of the Venus (1.6x); 4) decoration visible on the lower part of the body (upper surface) (2.5x); 5,6) traces of abrasion visible on the lateral side of the lower part of the body (5:1,6x; 6:5x); 7) position of the Venus on red deer metatarsal.**

still visible in the remnant at the centre of the shelter, is untouched, and the different cultural levels have been radiocarbon dated, although the correlation of various sectors remains problematic. Kozłowski and Dalmeri excavated in sectors III and IV. In 2007 excavations at the site recommenced under the direction of Annaluisa Pedrotti (University of Trento)<sup>2</sup>.

The Early Neolithic, characterised by the eponymous Gaban group, is represented by spits 1 to 10 in layer D; the Late Mesolithic (Castelnovian) was found in spits 1 to 6 in layer E (Bagolini excavations), while its early phase was marked as layer FA (Kozłowski and Dalmeri excavations); the lower layers, FB and

FC, are representative of the Early Mesolithic occupations (Sauveterrian). The Early Mesolithic presence at the site was attested across 12m<sup>2</sup> in the course of Bagolini's excavations (Bagolini 1980), while Kozłowski and Dalmeri exposed an area over 6.5m<sup>2</sup> in sectors IV and III, excavating over 1m of sediment from this occupation phase (Kozłowski and Dalmeri 2002).

The available dates for the Late Mesolithic (Layer E) and Early Neolithic (layer D) range from the beginning of the 7<sup>th</sup> to the middle of the 5<sup>th</sup> millennium calBC (Tabs. 1, 2). The Castelnovian occupation at the site begins around 7000 calBC (layer FA) and ends around 5900 calBC (layer E). Two dates (K1A-10362; UtC-10453) available for layer D (spit 9), stratigraphically related to the Early Neolithic occupation, are too early when compared to other dates from layer D (Bln-1777; Bln-1777a; Bln-1778), and they are also too early for the Early Neolithic chronology of north-east Italy in general (Perrin

2007). It is possible that these dates – which cluster around the end of the 7<sup>th</sup> millennium calBC – could relate to the Castelnovian occupation and refer to residual materials from areas disturbed by digging on the upper levels. In fact, it should be pointed out that sector IV was indeed cut by several Neolithic pits (unedited field diaries, Kozłowski and Dalmeri 2002; Perrin 2007).

### The Neolithisation of the Adige Valley

Bagolini and Biagi introduced the term 'Gaban' to define the Early Neolithic group present in the Trentino Alto Adige region (1977). It differs from other groups diffused in the Po Plain in the shapes and de-

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corations of pottery and, furthermore, in the presence of lithic and osseous industries characterised by a strong Mesolithic tradition.

The results of the analyses carried out on the Gaban rockshelter faunal remains indicate that, in the first levels with pottery, the economy was based mainly on hunting and gathering. On the basis of the stratigraphic data, the authors recognised a first phase of the Neolithic (also called the phase of 'potterisation'), and a second one, characterised by an increase in 'graffiti' and shapes with flat bottoms on the pottery, as well as the first presence of domesticated animals (caprovines and bovines)<sup>3</sup>. This group should have achieved the new economy through a long and slow process of interaction and acculturation (*Bagolini and Biagi 1977; Bagolini 1980*)<sup>4</sup>.

Recently, Perrin (2007; 2009), identified a chronological gap of about 500 years between the most recent Late Mesolithic occupation (Castelnovian) – c. 5500 calBC – and the earliest Gaban Group occupation – c. 5000 calBC – on the basis of <sup>14</sup>C dates for Gaban rockshelter (Tabs. 1, 2). Mainly on the basis of this hiatus, he criticised the hypothesis that the Gaban group could have been formed through an acculturative process from local Mesolithic communities.

The observations on the chronological gap are intriguing and should be certainly deepened. In fact, a new field campaign has been carried out to revise the stratigraphic relations in Gaban rockshelter and collect new samples in order to date the transition from the Mesolithic to the Neolithic. At the same time, many data tend to confute the new model proposed by Perrin, verifying the hypothesis of an adoption of the new economy by local groups as a gradual acculturative process which happened through interaction and exchange (*Bagolini and Biagi 1977; Bagolini 1980; Bagolini and Broglio 1985; Kruta 1982; Pessina and Tine 2008; Pedrotti 2001*).

In the last thirty years, the archaeological research carried out in the Adige Valley has shed light on a number of important archaeological sites. The Holocene colonisation of eastern Alpine valleys and mountainous parts has been reconstructed on the basis of these results. The Mesolithic inhabitation of the region was particularly intense in lowland rockshelters. Yet, hunters were fully adapted to the diversity of the Alpine ecosystems, and numerous sites have been attested at high altitudes and generally interpreted as seasonal camps for catching wild mountain caprids (*Capra ibex* and *Rupicapra rupicapra*) (*Bagolini et al. 1984; Broglio 1994*). Since the 6<sup>th</sup> millennium calBC, in tandem with improved

Site	Level	Cultural attribution	Date reference	Date BP	calBC (1σ – 68,2% confidence)	calBC (2σ – 95,4% confidence)	Bibliography
Gaban rockshelter (Trentino)	D2 D8 E	Late Mesolithic	KIA-10362 UtC-10453 KIA-10363	7283±38 7241±50 6968±41	6212–6091 6208–6052 5898–5786	6226–6066 6219–6021 5978–5745	<i>Improta et al. 1984</i>
Romagnano III rockshelter (Trentino)	AB 1–2	Late Mesolithic	R-1137 R-1137A R-1137B	7850±60 7500±160 7800±80	6801–6602 6506–6117 6746–6503	7029–6531 6651–6029 7023–6464	<i>Improta et al. 1984</i>
Pradestel rockshelter (Trentino)	D 1–3	Late Mesolithic	R-1148	6870±50	5835–5710	5878–5661	<i>Improta et al. 1984</i>
Vatte di Zambana rockshelter (Trentino)	3 5	Late Mesolithic	R-487a R-488 R-488a	7250±110 7540±75 7585±75	6225–6020 6467–6267 6558–6376	6381–5913 6560–6233 6595–6255	<i>Improta et al. 1984</i>

**Tab. 1. Dates from the main Castelnovian occupations of Trentino Alto Adige region<sup>5</sup>.**

<sup>3</sup> These data have been confirmed by the micromorphological analyses carried out by D. Angelucci, G. Boschian and S. Frisia on the archaeological remnant section. In the following field campaigns, the micro-morphological study will focus on the definition of the sediments formative processes, trying to single out abandoned or erosional levels. This work will be fundamental for reconstructing of a coherent picture of the archaeological evidences from the site.

<sup>4</sup> Today, thanks to the archaeological excavations carried out at the site of Lugo di Grezzana, we are able to confirm this subdivision of the Neolithic of Gaban rockshelter suggesting that the most recent phase could be dated around 4900–4700 calBC and is contemporaneous to the Square Mouthed Pottery Culture diffusion in the Po Plain (*Pedrotti and Salzani in press*).

<sup>5</sup> All the radiocarbon dates were calibrated using OxCal 4.1 program (*Bronk Ramsey 2001*).

Site	Level	Cultural attribution	Date reference	Date BP	calBC (1σ – 68,2% confidence)	calBC (2σ – 95,4% confidence)	Bibliography
Gaban rockshelter (Trentino)	D D2 D8	Early Neolithic – Gaban Group	BlN-1777 BlN-1777a BlN-1778	6030± 45 5750 ± 60 5990 ± 45	4991–4849 4686–4541 4940–4806	5045–4800 4723–4459 5000–4749	Bagolini, Biagi 1990
Romagnano III rockshelter (Trentino)	AA1-2 T4	Early Neolithic – Gaban Group	R-1136 R-781a	6480±50 6060±50	5485–5376 5035– 4855	5529–5330 5207–4804	Bagolini, Biagi 1990

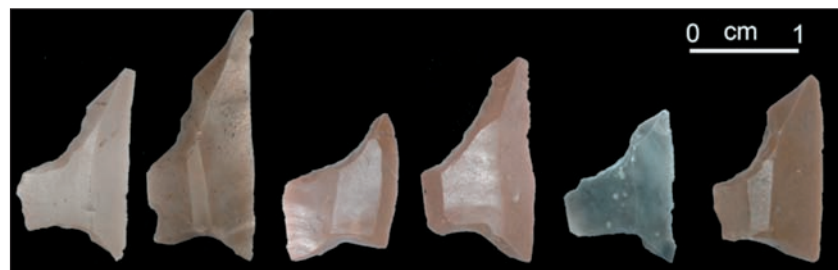
**Tab. 2. Dates from the main Early Neolithic occupations of the Trentino Alto Adige region which present Late Mesolithic and Early Neolithic levels<sup>6</sup>.**

climatic conditions, hunter-gatherer groups showed a tendency to exploit the lowland resources, particularly foraging in woodland and hunting birds, freshwater fish and small mammals. During this phase, an important shift is reported in the structure of the lithic industries, mostly represented by an increase in blade dimensions and the adoption of new hunting tools: flint trapezes and harpoons made from antler and bone (*Cristiani in press*). Some of the lowland rockshelters were colonised *ex novo*, while frequentation of mountain areas decreases. Among the faunal remains cervids are dominant (mostly *Cervus elaphus* and *Capreolus capreolus*), while ibex and chamois (*Capra ibex* and *Rupicapra rupicapra*) disappear from the archaeological record (Bagolini 1980; Lanzinger et al. 2001). All the lowland sites show a stratigraphical continuity between the Late Mesolithic and the Early Neolithic, and no interruption can be evidenced in the Adige valley occupation in the mid-6<sup>th</sup> millennium calBC when <sup>14</sup>C dates from different sites are compared (see Tab. 1, 2).

A barley seed found in a core made during a pollen sampling in the Isera peat bog (south of Rovereto – TN) gave a date of 5500–5300 calBC, suggesting that small farming communities might have co-existed with the local Mesolithic group in the Adige valleys at least since the middle 6<sup>th</sup> millennium calBC. Actually, it is not possible to hypothesise about the duration of these sites or about the reasons the first farmers/herders penetrated the Alpine valleys. On the basis of pottery types found, for example, in Gaban rockshelter, it is possible to stress that they came from the south (Pedrotti 2001).

The hypothesis of strong interaction dynamics between the

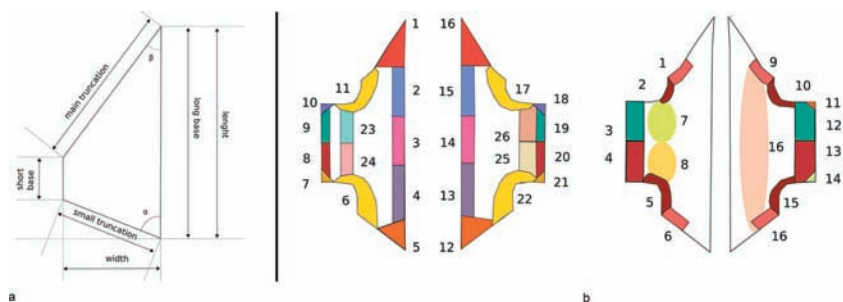
last autochthonous groups and the new farmers is demonstrated by several specificities in the material culture of these groups. Together with the introduction of new elements like pottery or, relating to the lithic industry, the burin of Ripabianca and the rhomboid, the persistence of a Mesolithic traditions is documented by continuity in the production of antler blade axes instead of polished stone ones. In the first Gaban groups, hard animal tissues (antler, tooth, bone) are preferred to clay in reproducing ‘symbols’ of the new ideology. The most original documentation of this topic is the ‘Gaban Venus’ a bone plaquette in the form of a female figure with arms just chalked out in a ‘hanger’ shape and ending with a pointed morphology (Fig. 2.a). This item is covered by a thick red ochre layer on the lower surface – with the exception of the hair – and on all the basal part of the upper surface up to the belt (see Fig. 2.a). The arms, hair and necklace style, and the representation of a vulva with a tree-like motif, suggest a connection of this symbolism with an agriculture cult (Gimbutas 1991; Guilaine 1994:309). The surface shaping technique<sup>7</sup> is characteristic of the Neolithic tradition (sandstone abrasion, Fig. 2.b1 and b5), while the raw material selection (a *Cervus elaphus* metatarsal) shows strong Mesolithic connections (Pedrotti 2001; 2002; Cristiani et al. in press). Microscopic examination has also revealed traits of a Palaeo-Mesolithic tradition in the modality of application of the colour (ochre) to the plaquette: the pre-



**Fig. 3. Some of the trapezes discussed in the paper.**

<sup>6</sup> All the radiocarbon dates were calibrated using OxCal 4.1 program (Bronk Ramsey 2001).

<sup>7</sup> The techno-functional analysis of the ‘Gaban Venus’ was carried out by one of the authors (E.C.).



**Fig. 4. a) Nomenclature used for trapeze description; b) system of polar coordinates. On the left: polar coordinates used for the position of use-wear traces; on the right: polar coordinates used for the position of residues.**

sence of a white limestone layer just above the bone blank constitutes the base for the ochre painting (Cristiani *et al. in press*). The same procedure has been found on some Epigravettian decorated stones recovered at the Dalmeri rockshelter (Marcesina plateau – Trento, Belli *et al. 2007*).

### An ‘integrated’ functional study of geometric microliths

#### a) Sampling the archaeological assemblage

The archaeological sample is comprised of 182 microliths (Fig. 3) from 10 spits, encompassing the period of the supposed Neolithisation process: spits 5 to 1 from the final Late Mesolithic layer E (N = 92 trapezes) and spits 10 to 6 from the very Early Neolithic layer D (N = 90 trapezes) excavated in sector IV. We decided to analyse trapezes from this sector, since this is the most reliable of the three excavated (III, IV and V) and it was not heavily disturbed by Neolithic and later pits. Furthermore, the study of the microliths from sector IV allowed us to have tight control over the stratigraphic sequence in this part of the shelter.

#### b) Methodology of use-wear analysis

The use-wear analysis was carried out integrating visual inspections, and low and high resolution observations. In particular, the trapezes were studied by means of a stereoscope Leica M12.5 with magnifications from 8 to 100x, and an incident light metallographic microscope Leica DC2500 with magnification from 50 to 400x. The cleaning procedures were carried out using alcohol and acetone only.

The homogeneity of the analysed tools and the scarcity of publications regarding use-wear traces on trapezes led us to refer to the article by Fisher *et al. (1984)* and to the wide scientific literature on the functional utilisation of points and microliths

(Dockall 1997; Fischer 1990; Kelterborn 2001; Lombard and Pargeter 2008; Odell 1978; Odell and Cowan 1986; Nuzhnyj 1989; 1990) in order to define the analytical criteria for our sample. The validity of diagnostic macrotraces as well as the applicability of a ‘common’ terminology to other non-trapezoidal microliths was evaluated during the analysis and some criteria were integrated and updated on the basis of the specific features of our sample. As an experimental comparison, the publications of Fisher *et al. (1984)*, Plisson and Geneste (1989) and O’Farrell (1996) were considered among others. The use-wear traces identified on the archaeological tools were plotted by means of a polar coordinate system (Fig. 4.b) (Van Gijn 1990). This method allowed us to evaluate the presence of recurrences in the location and distribution of the functional modifications.

#### c) Methodology of residue analyses

A multi-analytical, mostly non-destructive approach has been adopted for a complete characterisation of the archaeological residues.

As stated, optical microscopy (OM) observations of the microlithic specimens were carried out to visualise potentially interesting topographic features of the residues present on the surface of the materials.

Environmental scanning electron microscopy (ESEM) observations were conducted on some of the trapezes in order to better identify those details falling beyond the resolution of the optical microscope. The working principles of an ESEM allowed us not to use any conductive coating which would have otherwise been required in the case of conventional, *i.e.* high vacuum, scanning electron microscopy, owing to the insulating nature of our samples. In this way, any interference with the X-ray emission spectra from selected regions of the specimens was avoided. The X-ray spectra were collected with an Energy Disper-

Distal fractures	Impact fract.	Proximal fract.	distal+ prox. fract.	Hafting macro-traces	Hafting frictions, glossy, striations	MLIT
68	45	12	19	63	33	19

**Tab. 3. Location and types of macro and micro traces identified on trapezes from Gaban rockshelter.**



Red	Brown	Red + Brown	Total
10	10	7	27

**Tab. 4. Types of residues identified on trapezes from Gaban rockshelter.**

sive X-ray Spectroscopy (EDXS) system during the ESEM observations in order to obtain analytical data from selected regions of the investigated specimens. Subsequently, for the identification of the particular substances present in the residues, *in situ* Attenuated Total Reflection Fourier Transform Infra-Red (ATR-FT-IR) spectroscopy measurements were carried out on the same specimens already examined with other experimental techniques. Two different routes were followed for the identification of the characteristic lines present in the infra-red spectra: either FT-IR spectra resulting from the archaeological trapezes were compared with an available database and electronic sources, like the Internet site *www.irug.org*; or real reference standards were created using modern substances, possibly reproducing the residues. These substances were selected on the basis of archaeological or ethnographic data and palaeo-climatic information, with particular reference to the influence of local vegetation available for north-east Italy, and dating back to the early to middle Holocene period (Cattani 1992; 1994; Ombrelli and Ra-

vazzi 1996). Our set of standard references contained samples of beeswax, vegetal bitumen, animal glues from boiled bones, boiled tendons and boiled skin, vegetal bitumen mixed with beeswax, wood and pitch, and resins from various pines.

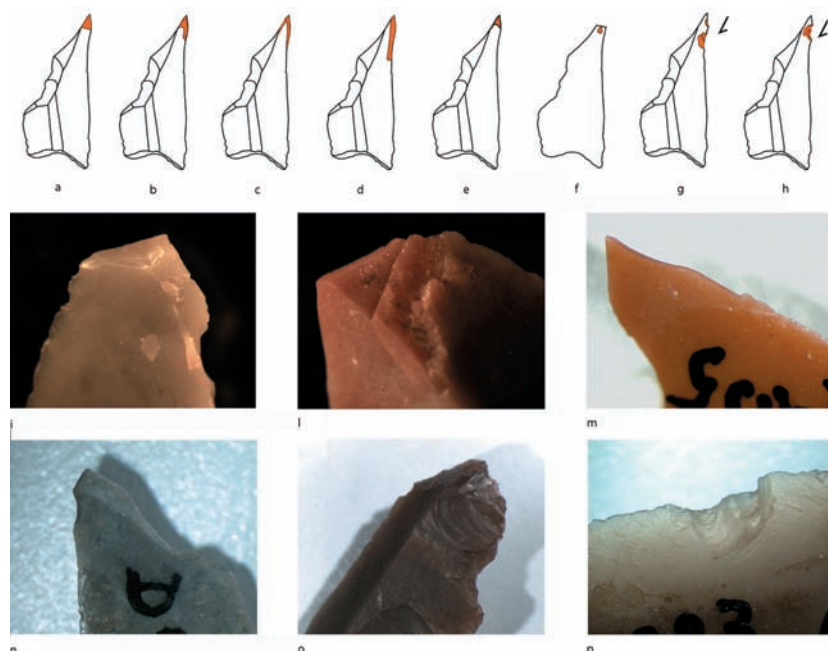
A polar coordinate recording a protocol similar to that used for the use-wear traces was used for the results obtained from the residues. In this way it was possible to evaluate the relationship between functional traces and the spatial distribution of residues.

## Results of the functional study

### a) Use-wear analysis

The trapezes show a generally good state of preservation, although thermal alterations and a glossy patina were identified on one third of the sample. The intensity of the post-depositional modifications did not limit the identification of use-wear traces, and it was always possible to observe macro-traces, given the general absence of mechanical alterations along the edges (such alterations were found in 10 cases only). Macro-fractures that occurred due to use were observed on the distal ends of 68 trapezes out of a total of 182. In particular, they are located in the area of the trapeze formed by the long truncation and the long base of the tool (Fig. 5) in sectors 1–16

of the polar coordinates system (Fig. 4.b). The 66 % (N = 45) of the recognised macro-traces represent typical impact fractures and were classified as impact scars, snaps, bending, burin-spall and spin-off fractures (Fisher *et al.* 1984). The remaining traces are not well developed or diagnostic of specific activities. No differences were identified in the nature of the distal fractures between the Mesolithic and Neolithic trapezes. Other types of macro-traces confirm the use of the trapezes as projectile points. Linear traces visible at low and high magnification were identified in 19 cases, often in connection with impact fractures (Figs. 6.a, d–e). They are located on both dorsal and ventral surfaces, and their orientation can be longitudinal and oblique.



**Fig. 5. Localisation and description of use-wear traces identified on the distal end of the trapezes (piquant triedre): a) snap fracture; b) bending-hinge fracture; c) languette fracture; d) burin-like fracture; e,f) spin-off fracture; g,h) invasive macro-detachments. Archaeological use-wear traces: i,l) bending-hinge fractures (i: 2x; l: 5x); m) languette fracture (4x); n) burin-like fracture (2.5x); o,p) invasive macro-detachments on the distal part of the long base (o: 2x; p: 2.5x).**

The superimposition of different micro-striations on the same microlith proves the recurrent use of the same projectile. Modifications related to hafting were identified on 63 trapezes (Fig. 7). They were observed both at low and high magnification and can be characterised by different appearance and location. In particular, bending-feather scars are mostly located on the short edge of the artefacts, and on the proximal part of the long edge (sectors 7–10 and 3–5 of polar coordinates system, Fig. 4b), while rectangular-trapezoidal scars are diffused on the short edge of the artefacts (sectors 7–10 of the polar coordinates system, Fig. 4b). Experimental literature data relate the former to contact with the binding used for hafting, and the latter to the insertion of the proximal part of the trapezes into a shaft (Rots 2003; 2008). A different category of hafting traces (Fig. 7. h–q) is represented by scars and fractures distributed on the basal wing of 31 artefacts (sectors 5 and 12 of the polar coordinates system, Fig. 4b). These fractures are often associated with very well developed micro use-wear traces, such as friction gloss, rounding, striations and bright spots that can be observed at high magnification. The latter were not identified among the post-depositional alterations, and for this reason their association with other types of use-wear

traces and experimental data in the literature (Rots 2003; 2008) were interpreted as produced by the insertion of a microlith into a shaft. A technological abrasion of the short edge, probably intended to improve attachment to the shaft, was observed on 10 trapezes (Fig. 7.b).

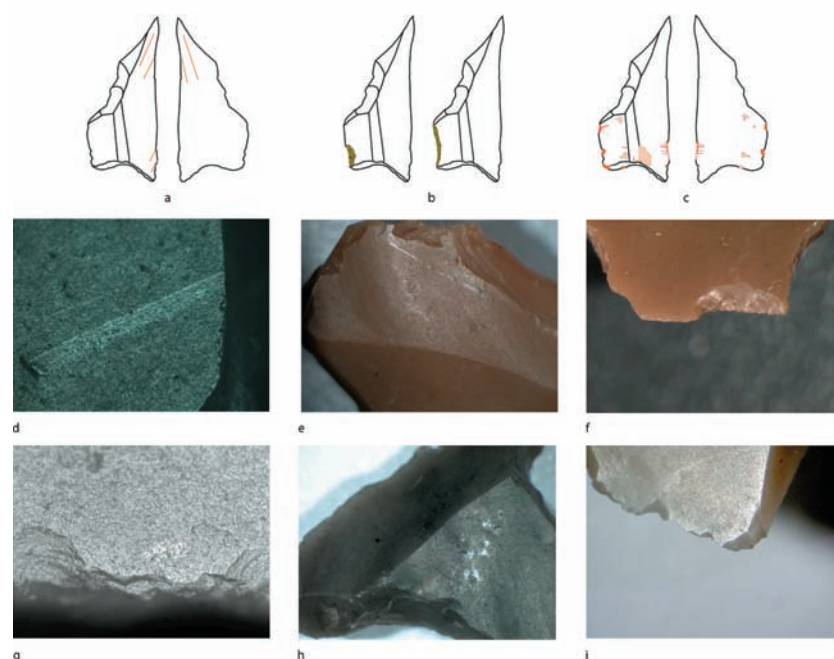
### **b) Microstructural characterisation and analytical data of residues**

Residues were identified on 27 lithic artefacts (Tab. 4). They were classified, according to their dominant colour, as 'red' and 'brown' residues (Fig. 8).

In all cases, residues were localised on the ventral or dorsal surfaces of the trapezes, in a position that, according to their orientation and relationship to the relevant use-wear traces, can be associated with the hafting zone (sectors 3–8 and 10–15 of the polar coordinates system, Fig. 4.b).

Optical micrograph in Figure 8.d shows an example of red residue on a flint trapeze (sample nr. 1261). The same spot is imaged in the ESEM micrograph shown in Figure 9.a. The X-ray spectroscopy analyses provide clear indications on the composition of these reddish residues. Figure 9.b shows the X-ray

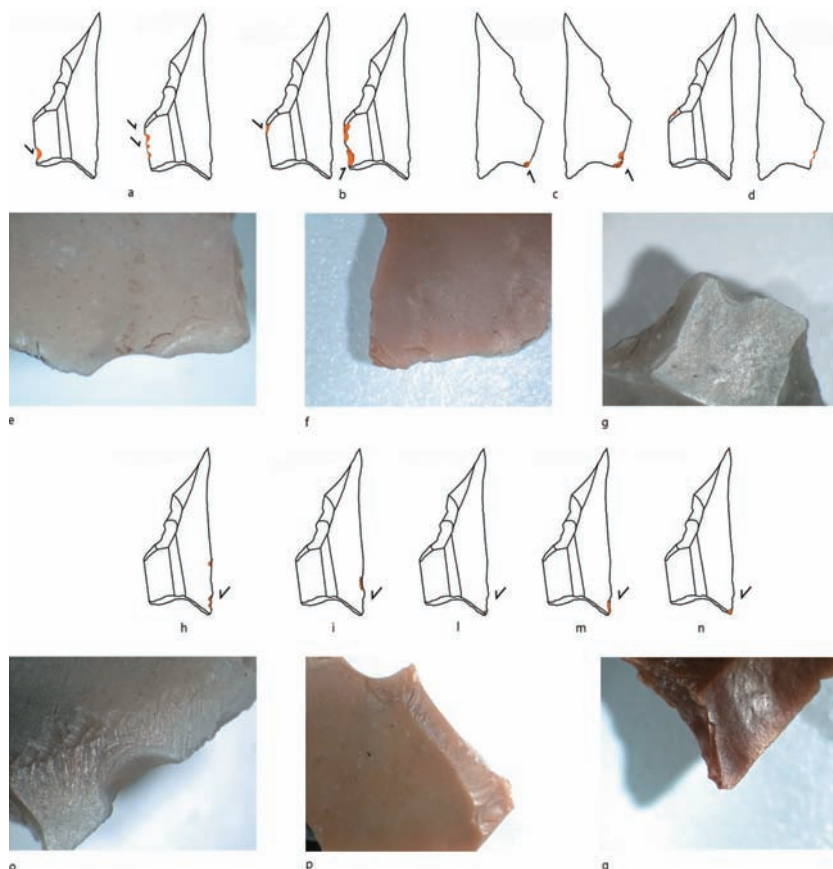
emission spectrum from the 'red' residue displayed in Figure 9.a. The characteristic emission lines indicate that in addition to the obvious contribution from the flint substrate ( $\text{SiO}_2$ ), the following majority phases seem to be present: haematite ( $\text{Fe}_2\text{O}_3$ ), calcite ( $\text{CaCO}_3$ ) and unidentified aluminosilicate phases, the latter being at least partly ascribable to a contamination from the burial ground and clay. The overall composition of the 'red' residue seems to be compatible with some kind of red ochre, in which the red pigment would be haematite, whereas calcite and possibly the other mineralogical phases certainly present in the mixture, would act as so-called white pigments. They were intentionally added to iron oxide not only to tune the intensity of the resulting colour, but also to improve



**Fig. 6. Localisation and description of technological and functional traces identified on the trapezes: a) MLITS (Micro Linear Striation); b) technological abrasion carried out on the short base of some trapezes; c) bright spots, glossy, striations and use-retouches related to hafting. Archaeological use-wear traces: d) MLITS photographed at high magnification (100x); e) a MLITS (3.2x); f) technological retouch of the short base (3.2x); g) bright spot photographed at high magnification (200x); h, i) bright spots related to hafting (h: 2.5x; i: 4x).**



**Fig. 7. Localisation and description of use-wear traces identified on the short base and wing (formed at the intersection of the small truncation and the long base) of the trapezes:** a) bending-feather use-retouches; b) half-moon bending-step use-retouches; c) trapezoidal-rectangular cone-step use-retouches. Archaeological use-wear traces: d) circular cone-feather use-retouches; e, f) trapezoidal-rectangular use-retouches on the short base (e: 5x; f: 5x); g) bending-feather use-retouch related to hafting (2.5x). Localisation and description of use-wear traces identified on the long base and the wing of the trapezes: h) bending-feather use-retouches; i) scalar use-retouches; l) bending-feather use-retouches; m) languette or burin-like fractures; n) snap fractures. Archaeological use-wear traces: o) bending-feather use-retouch on the proximal part of the long base related to hafting (4x); p) burin-like fracture localised on the short base (1.25x); q) languette fracture (2.5x).



the archaeological properties of prehistoric paint (Colombo 1995).

As for the 'brown' residues, such as that seen in the optical micrograph in Figure 8.a (sample nr. 1418), the relevant EDXS spectrum displays the presence of a particularly intense carbon characteristic line (Fig. 9.d), which can be taken as a preliminary indication of the probable organic nature of these residues. Indeed, the FT-IR spectrum in Figure 9.e confirms that the brown residual has a largely organic character due to the presence of the typical absorption bands corresponding to the C-H stretching at 2919  $\text{cm}^{-1}$  and 2850  $\text{cm}^{-1}$  (boxed in the Figure).

From a comparison of the FT-IR spectra of the reference materials with that of the 'brown' residue, the best match is the FT-IR spectrum of the mixture of natural bitumen and beeswax (Fig. 9.f).

Results obtained by integrating use-wear and residue data suggest a hafting procedure as depicted in Figure 10. As it is shown, on the basis of the nature and the distribution of the functional traces, trapezes were probably used with the *piquant-trièdre* as

the pointed end of the arrow (Fig. 10.a, b) as well as lateral barbs (Fig. 10.c).

Up to now, the analytical results are inconclusive regarding the nature of the material into which the trapezes were hafted. Neither the hypothesis of a wooden arrow shaft, nor a bone point can be excluded, even considering that both retaining materials have been shown through archaeological research (Dal 2003).

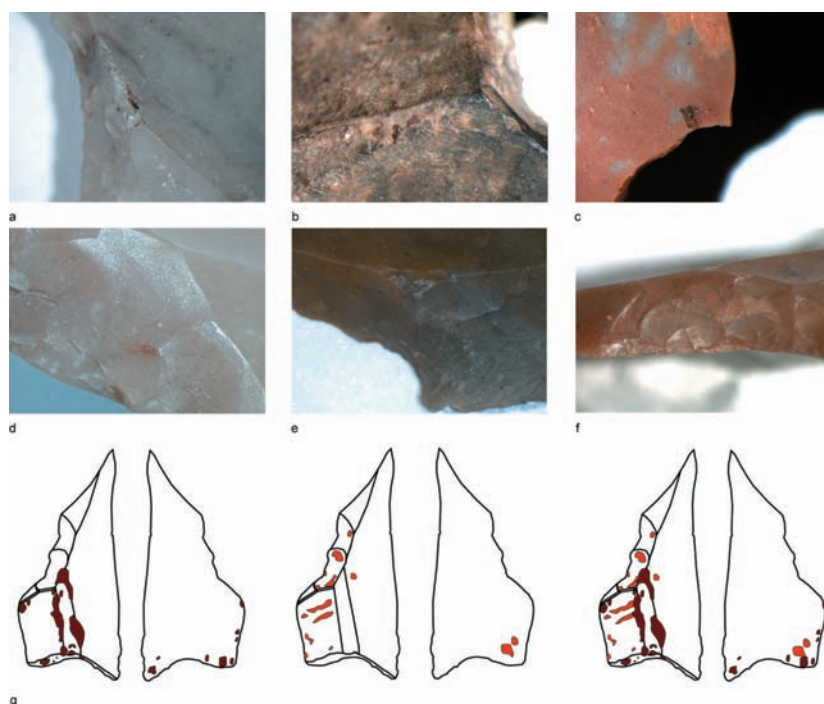
### Between tradition and innovation in the Adige Valley

The results of the functional analysis show that the trapezes from Gaban rockshelter constitute a highly specialised type of tool used in hunting. This homogeneity relates both to the Mesolithic and Early Neolithic layers, and it seems that it was not affected by the morphological and dimensional differences between the two periods identified through technological analysis.

Considered separately, the functional data available on the microliths give us a partial vision of the eco-

nomie and social dynamics of the last hunters and the first Neolithic groups of the Adige Valley. A comparison of the results of functional analysis with technological aspects of the lithic industry and faunal remains will better define the scenario of early-middle Holocene adaptations in the region.

The functional data on the trapezes integrate and confirm what has already been pointed out in relation to raw material acquisition and the lithic technology at Gaban rockshelter (Perrin 2007). In particular, the analysis of cores and tools from layer E (Castelnovian) and layer D (Neolithic) indicated “the existence of two distinct industries that show a clear convergence from both the technological and typological points of view” (Perrin 2007:117). The available data for Gaban rockshelter show that no substantial difference can be found in the lithic technology in the layers referring to the Late Mesolithic and Early Neolithic: the strategies of lithic acquisition are identical, as well as the blade *débitage* (characterised by indirect percussion and pressure), the faceting of blades and bladelet striking platforms, the presence of a ‘common’ toolkit (carried out on flakes produced during the blade operational sequence) and, finally, the use of the same modality of trapeze production (the so-called microburin technique). The diversity in the Early Neolithic industry at Gaban rockshelter can be synthesized as the use of a single striking platform seen in the Neolithic cores, the production of bigger and more asymmetrical trapezes and the introduction of new tool types, such as burins on lateral notch called burin of Ripabianca and the rhomboids (Perrin 2007). As many authors have underlined, these differences do not represent elements of a technological differentiation of lithic production between the last hunter-gatherers and the first Neolithic groups. Analogous considerations emerged after typological, technological and morphometrical analysis of the lithic industries from other important sites of the Adige Valley (in particular, Romagnano III and Pradestel rockshelters, Bisi et al. 1986).



**Fig. 8. Archaeological residues: a, b, c) macro-photos of brown residues (a: 3.2x; b: 4x; c: 4x); d, e, f) macro-photos of brown residues (d: 10x; e: 2.5x; f: 4x); g) distribution of brown and red residues. The drawing on the right shows the distribution of both red and brown residues and their perfect match on the trapezes.**

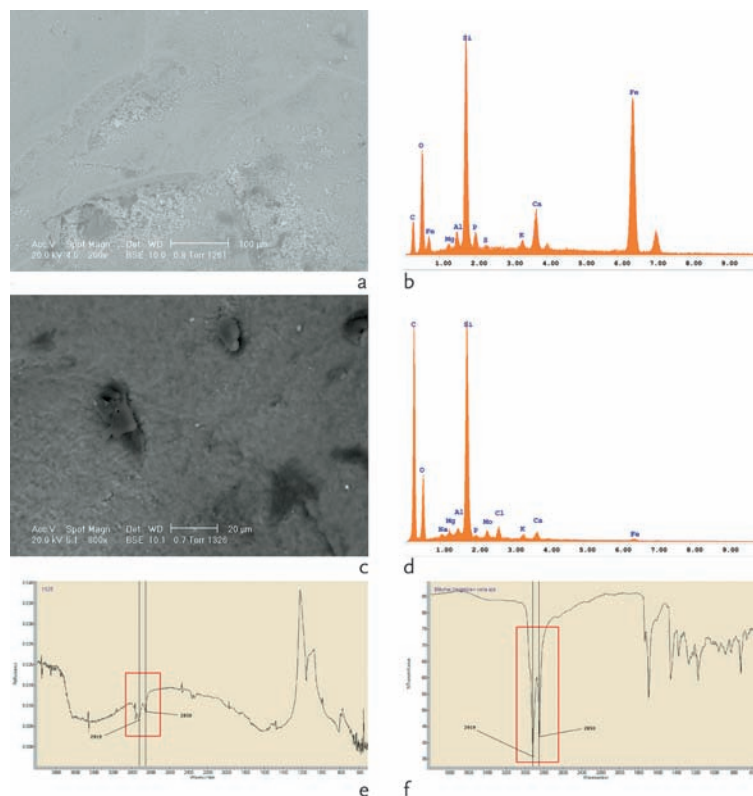
Therefore the Mesolithic-Neolithic sequence of the region seems to have been a continuous phenomenon at least in terms of modalities of flint-knapping and geometrical microliths use.

Furthermore, the analysis carried out on the residues on the trapezes provides new clues to understanding the dynamics of the acquisition of a Neolithic economy in the Adige Valley. The use of a specific glue produced by mixing beeswax and bitumen, and the use of ochre in the hafting of these microliths seem to be features of a regional tradition which could probably be traced back to end of the Late Glacial period. In fact, the use of beeswax is known since the end of the upper Palaeolithic from the Dalmeri rockshelter (Marcesina Plateau, Trento) (Belli et al. 2007), since this material constitutes part of the recipe used to fix the decoration on the numerous painted stones found at the site. Bees products (not only wax, but also propolis) were among the grave goods in the Epigravettian burial at Villabruna in the Cison Valley (Venetian Alps) (Aimar et al. 1994), and were also found in the Castelnovian burial at Mondeval de Sora<sup>8</sup> (Fontana 2006).

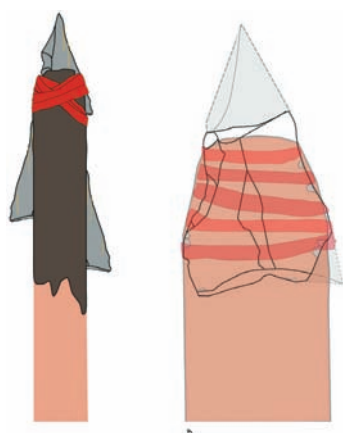
Regarding the ochre, the analysis carried out on the residues from the Gaban rockshelter has verified the

<sup>8</sup> In particular, an amount of resin and propolis was found as a grave good (Fontana 2006).

**Fig. 9.** a) ESEM micrograph showing a higher magnification view of the 'red' residue on sample nr. 1261 (stereo-photo: Fig. 8.f); b) EDXS spectrum obtained from 'red' residue. In addition to the characteristic lines of the flint substrate ( $\text{SiO}_2$ ), the presence of haematite ( $\text{Fe}_2\text{O}_3$ ), calcite ( $\text{CaCO}_3$ ) and unidentified alumino-silicate phases can be inferred from the other X-ray peaks; c) ESEM micrograph showing a higher magnification view of the 'brown' residue on sample 1418; d) EDXS spectrum obtained from a 'brown' residue on sample 1326 (see stereo-photo: Fig. 8.a); e) FT-IR spectrum obtained from 'brown' residue; f) FT-IR spectrum obtained from the mixture of beeswax and natural bitumen, prepared as a reference standard to identify the unknown organic phases in the 'brown' residues.



aesthetic/symbolic value of this element, since no trace of it has been recognised in the physical-chemical composition of the mastic. Excluding its functional efficiency in a hafting system<sup>9</sup>, it is possible that ochre might have been used to dye the bindings used to fix the trapezes to the shaft. As for the beeswax, it is comparable to other Late Glacial and Mesolithic sites in the region. Furthermore, the use of red bindings has been suggested for the hafting of Epi-



**Fig. 10.** Reconstructions of the use of the trapezes a) trapeze position as an element of a composite arrowhead. The yellow lines represent MLIT distribution and orientation on the trapezes; b) use of the trapeze as a single distal point. Note the localisation of the main traces (distal fracture and lateral macro-detachments).

gravettian bone points at Dalmeri rockshelter and, at the same site, coloured threads were also used to attach ornaments (shells and red deer canines, *Cristiani in press*). It could not be accidental that, at the same site, red ochre dye on leather had been processed using both lithic and osseous tools (as testified by the use-wear analyses results – *Lemorini et al. 2006 and Cristiani 2007*). Traces of contact with minerals (iron oxides?) have been found in association with hafting traces at the Epigravettian occupation of the Val Lastari site on the Cansiglio Plateau (Venetian Alps) (*Ziggiotti 2007*). In the Adige Valley, the use of ochre has been suggested for the suspension of *Columbella rustica* ornaments found in the Mesolithic as well as the Neolithic layers of most of the lowland rockshelters (with no differences between the two occupations) (Fig. 11).

This practice constitutes an additional element of a Palaeo-Mesolithic tradition among the Neolithic communities of the Adige Valley, and supports what has already been suggested for the 'Gaban Venus'.

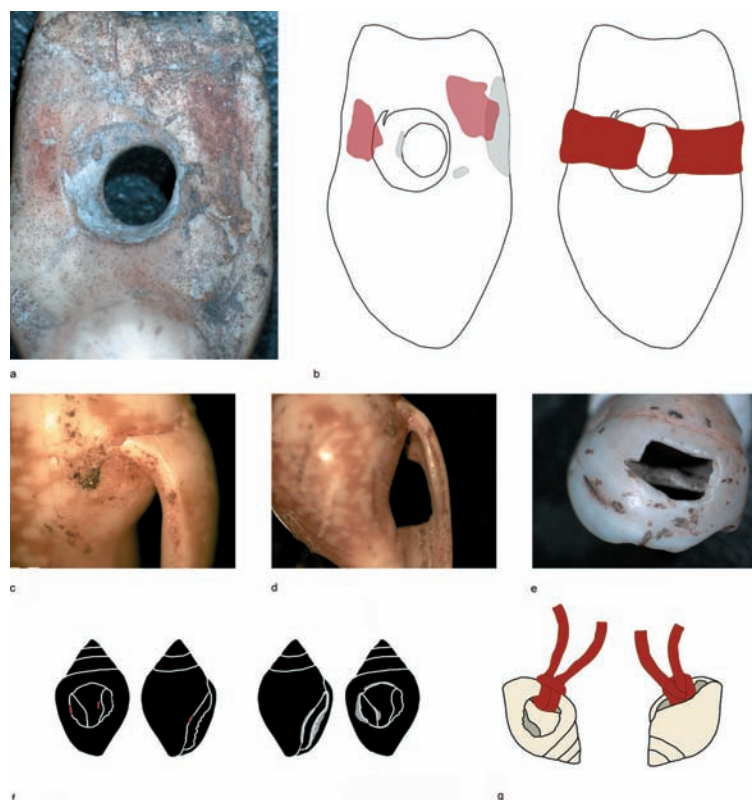
## Conclusion

Our analysis confirms a continuity of functional choices connected with the use of geometric microliths between the Castelnovian and the Early Neolithic at Gaban rockshelter. Some aesthetic aspects, not di-

<sup>9</sup> The use of ochre for hafting has been documented in other prehistoric contexts (*Lombard 2007*).



**Fig. 11. Epigravettian and Mesolithic ornaments from north-east Italy: a) Red deer canine showing ochre residues from Dalmeri rockshelter (2x); b) residues and use-wear traces distribution on the red deer canine and reconstruction of the modality of its suspension; c,d) ornaments on *Columbella rustica* showing ochre residues from Gaban rockshelter, Neolithic levels (c: 4x; d: 2.5x); e) ornament on *Theodoxus fluvialis* showing ochre residues from Pradestel rockshelter, Castelnovian levels (2.5x); f) distribution of residues (red) and use-wear traces (gray) on the *Columbella rustica* ornaments from the main Adige Valley rockshelters (both Mesolithic and Neolithic levels); g) reconstruction of the modalities of *Columbella rustica* suspension at Pradestel and Gaban rockshelters.**



rectly related to the utilisation of the tools (in particular, the use of ochre in their hafting modalities), probably have their roots in previous periods and constituted, since Late Glacial times, a distinctive regional pattern. Such a pattern seems to confirm hypotheses of socio-economic transformations within local Mesolithic groups at the end of the 6<sup>th</sup> millennium calBC (already suggested by *Bagolini and Biagi 1988*). This feature does not characterise Neolithic communities newly formed at the south of the Adige Valley. For example, at the Lugo di Grezzana site (Lessini Mountains, Verona), which can be attributed to the Early Neolithic Fiorano Culture (5500–4800 calBC), the functional analysis carried out on the whole assemblage of lithic trapezes documents homogeneity in the use of these microliths and the absence of the aesthetic traits (ochre) that we have demonstrated to be a characteristic feature of the Palaeolithic and Mesolithic traditions of the Adige

Valley region. What we have presented up to now clearly demonstrates that at the beginning of the 5<sup>th</sup> millennium calBC these Mesolithic local communities had adopted and translated into their own language a specific ideological knowledge that they had learned from the Neolithic groups. We hope that the results of the research in progress will provide new data to deepen the scenario of the Mesolithic and the Early Neolithic interactions and dynamics in the Adige Valley.

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## REFERENCES

- AIMAR A., ALCIATI G., BROGLIO A., CASTELLETTI L., CATTANI L., D'AMICO C., GIACOBINI G., MASPERO A., PERESANI M. 1994. Les Abris Villabruna dans la Vallée du Cismòn. *Preistoria Alpina* 48: 227-254.
- BAGOLINI B., BIAGI P. 1977. Le più antiche facies ceramiche dell'ambiente padano. *Rivista di Scienze Preistoriche XXXII: 1-2*: 219-233.
1985. Balkan influences in the Neolithic of Northern Italy. *Preistoria Alpina* 21: 49-57.
1988. The first neolithic chipped stone assemblages of northern Italy. In J. S. Kozłowski (ed.), *Chipped stone industries of the early farming cultures in Europe*. Archeologia Interregionalis. Warsaw University. Warsaw: 423-448.
- BAGOLINI B. 1971. Considerazioni preliminari sull'industria litica dei livelli neolitici di Romagnano (Trento) (scavi 1969-1970). *Preistoria Alpina* 7: 107-133.
1980. *Introduzione al Neolitico dell'Italia settentrionale nel quadro dell'evoluzione delle prime culture agricole europee*. Bollettino della Società Naturalisti 'Silvia Zenari' Suppl. 9. Grafiche Editoriali Artistiche Pordenonesi. Pordenone.
1980. *Il Trentino nella Preistoria del mondo alpino*. Dagli accampamenti sottoroccia alla città quadrata. Trento.
1987. Vallée de l'Adige. Naissance des premières communautés paysannes dans un territoire alpin. In Guillaume J., Courtin J., Roudil J.-L. & Vernet J.-L. (eds.), *Premières communautés paysannes en Méditerranée occidentale*. Actes du Colloque International du C.N.R.S., Montpellier, 26-29 avril 1983. U.I.S.P.P., C.N.R.S., Paris: 445-459.
- BAGOLINI B., BROGLIO A., LUNZ R. 1984. Le Mésolithique des Dolomites. *Preistoria Alpina* 19: 15-36.
- BAGOLINI B., BIAGI B. 1990. The radiocarbon chronology of Neolithic and Copper Age of northern Italy. *Oxford Journal of Archaeology* IX (1): 1-23.
- BELLI R., FRISIA S., GIALANELLA S., DALMERI G., BENEDETTI L., ZADRA M., ARMELLINI C. 2007. Red painted stones from Riparo Dalmeri: a methodological approach to palaeoclimatic reconstruction. In C. D'Amico (ed.), *Atti del IV Congresso Nazionale AIAR, Pisa, 1-3 febbraio 2006*. Patron Editore Bologna. Bologna: 15-24.
- BISI F., BROGLIO A., DALMERI G., LANZINGER M., SARTORELLI A. 1986. Les bases mésolithiques du Néolithique ancien au sud des Alpes. Chipped Stone Industries of the Early Farming Cultures in Europe. *Archeologia interregionalis*. Warsaw-Cracow: 381-422.
- BOKELMANN K. 1991. Duvensee, Wohnplatz 9. Ein praborealzeitlicher Lagerplatz in Schleswig-Holstein. *Offa* 48: 75-114.
1994. Frühboreale Mikrolithen mit Schriftungspech aus dem Heidrnoor im Kreis Segeberg. *Offa* 51: 37-47.
- BORGIA V. 2007. Functional analysis of the backed tools coming from the Gravettian layers 23 and 22 of Paglicci Cave (Foggia, Italy). In L. Longo and N. Skakun (eds.), *Prehistoric Technology 40 years later*. BAR International Series 1783. Archaeopress. Oxford: 109-120.
- BROGLIO A. 1990. Man and environment in the Alpine Region (Palaeolithic and Mesolithic). *Preistoria Alpina* 26: 61-69.
1994. Le Mésolithique des Dolomites. *Preistoria Alpina* 28: 311-316.
- BRONK RAMSEY C. 2001. Developments of the radiocarbon calibration program OxCal. *Radiocarbon* 43 (2A): 355-363.
- CATTANI L. 1992. Prehistoric environments and sites in the Eastern Alps during the Late Glacial and Postglacial. Proceedings of the International Colloquium 'Human Adaptations to the Mountain Environment in the Upper Palaeolithic and Mesolithic'. *Preistoria Alpina* 28(1): 61-70.
- CILLI C., GIACOBINI G., GUERRESCHI A. 2001. Le mobiliere funéraire de la sépulture mésolithique de Mondevale de Sora (Belluno, Italie), Atti del XIV Congresso dell'Unione Internazionale des Sciences Préhistoriques et Protohistoriques, Liège, 3-8 septembre 2001. ULG, Université de Liège.
- CLARK R. 2000. *The Mesolithic hunters of the Trentino. A case study in hunter-gatherer settlement and subsistence from northern Italy*. BAR International Series 832. Archaeopress. Oxford.
- CLARK J. G. D. 1954. *Excavations at Star Cam An Early Mesolithic Site at Seamer near Scarborough, Yorkshire*. Cambridge University Press. Cambridge.
- COLOMBO L. 1995. *I colori degli antichi*. Nardini editore, Fiesole.
- CRISTIANI E. 2008. Analisi funzionale dei manufatti in materia dura animale del Riparo Dalmeri (Altopiano della Marcesina, Trento). *Preistoria Alpina* 43: 259-287.

- in press. Aggiornamento dei manufatti in materia dura animale dal Riparo Dalmeri (TN). Inquadramento morfologico ed analisi tecno-funzionale. *Preistoria Alpina* 44.
- in press. Osseous artefacts from the Mesolithic levels of Pradestel rockshelter, (north-eastern Italy): a morphological and techno-functional analysis. *Preistoria Alpina* 44.
- CRISTIANI E., GIALANELLA S., PEDROTTI A., ARTIOLI in press. La 'Venere' su osso dai livelli neolitici del Riparo Gaban: analisi archeometriche Proceedings of the IIPP meeting held in Trento in October 2007.
- CROMBE P., PERDAEN Y., SERGANT J., CASPAR J. P. 2001. Wear Analysis on Early Mesolithic Microliths from the Verrebroek Site, East Flanders, Belgium. *Journal of Field Archaeology* 28 (3/4): 253-269.
- DAL H. 2003. Et komplet pileskaft med tvaerpil og kaerv. *Nachrichtenblatt Arbeitskreis Unterwasserarchäologie* 10: 41-42.
- DALMERI G., GRIMALDI S., LANZINGER M. 2000. Il Paleolitico e il Mesolitico. In M. Lanzinger, F. Marzatico, A. Pedrotti (eds.), *Storia del Trentino. La preistoria e la Protostoria*. Il Mulino. Bologna: 37-110.
- DOCKALL H. E. 1997. Wear Traces and Projectile Impact: A Review of the Experimental and Archeological Evidence. *Journal of Field Archaeology* 24: 321-331.
- FINLAYSON B. and MITHEN S. 1997. The Microwear and Morphology of Microliths from Gleann Mor. In H. Knecht (ed.), *Projectile Technology*. Plenum Press, New York: 107-129.
- FISCHER A. 1990. Hunting with Flint-Tipped Arrows: Results and Experiences from Practical Experiments. In C. Bonsall (ed.), *The Mesolithic in Europe*. Papers Presented at the Third International Symposium, Edinburgh 1985. John Donald Publishers, Edinburgh: 29-39.
- FISCHER A., VEMMING HANSEN P. and RASMUSSEN P., 1984. Macro and Micro Wear Traces on Lithic Projectile Points. Experimental Results and Prehistoric Examples. *Journal of Danish Archaeology* 3: 19-46.
- FONTANA F. 2006. La sepoltura di Mondeval de Sora (Belluno). Complessità sociale e modalità insediative. In F. Martini (ed.), *La Cultura del Morire nelle società preistoriche e protostoriche Italiane*. Studio interdisciplinare dei dati e loro trattamento informatico, Istituto Italiano di Preistoria e Protostoria, Firenze: 269-292.
- GIMBUTAS M. 1991. *The Civilization of the Goddess*. Harper. San Francisco.
- GUILAINE J. 1994. *La Mer partagée. La méditerranée avant l'écriture 7000-2000 avant Jésus-Christ*. Hachette. Paris.
- KELTERBORN P. 2000. Analysen und Experimente zu Herstellung und Gebrauch von Horgener Pfeilspitzen. *Jahrbuch der Schweizerischen Gesellschaft für Ur- und Frühgeschichte* 83: 37-64.
- KOZŁOWSKI S. K. & Dalmeri G. 2000. Riparo Gaban: the Mesolithic layers. *Preistoria Alpina* 36: 3-42.
- KRUTA V. 1992. *L'Europa delle origini*. Rizzoli, Milano.
- IMPROTA S., PREITE MARTINEZ M., PETRONE V., TURI B. 1984. <sup>14</sup>C Datings of three Mesolithic Series of Trento Basin in the Adige Valley (Vatte di Zambana, Pradestel, Romagnano) and comparisons with Mesolithic Series of other Regions. *Preistoria Alpina* 19: 245-254.
- LEMORINI C. ROSSETTI P., CUCINATO A., DALMERI G., KOMPATSCHER M. and KOMPATSCHER K. 2006. L'analisi delle tracce d'uso e l'elaborazione spaziale: il riconoscimento di un'area specializzata nel sito epigravettiano di Riparo Dalmeri, livelli 26b e 26c (Trento). *Preistoria Alpina* 41: 171-197.
- LOMBARD M. 2007. The gripping nature of ochre: The association of ochre with Howiesons Poort adhesives and Later Stone Age mastics from South Africa. *Journal of Human Evolution* 5: 406-419.
- LOMBARD M. and PARGETER J. 2008. Hunting with Howiesons Poort segments: pilot experimental study and the functional interpretation of archaeological tools. *Journal of Archaeological Science* 35(9): 2523-2531.
- LONGO L. and ISOTTA C. L. 2007. Trapezi simmetrici concavi: ricostruzione tecnologica e ipotesi di utilizzo dei complessi del Neolitico antico. *Rivista Scienze Preistoriche LVII: 103-112*.
- MALMER M. P. 1969. *Die Mikrolithen in dem Pfeil-fund von Loshult*. Särtryck ur Meddelanden från Lunds Historiska Museum. Lund.
- NISBET R. 2008. Wood use and agriculture at Villandro/Villanders (Bolzano/Bozen, Alto Adige/South Tyrol): the charred remains from Mesolithic to Middle Ages. *Atti della Società per la Preistoria e Protostoria Friuli-Venezia Giulia XVI: 75-131*.
- NUZHNYI D. 1989. L'utilisation des microlithes géométriques et non géométriques comme armatures de projectiles. *Bulletin de la Société Préhistorique Française* 86 (3): 88-96.



1990. Projectile damage on Upper Palaeolithic micro-liths. Use of bow and arrow among Pleistocene hunters in Ukraine. *Aun* 14: 113–124.
- ODELL G. H. 1978. Préliminaires d'une analyse fonctionnelle des pointes microlithiques de Bergumermeer (Pays-Bas). *Bulletin de la Société Préhistorique Française* 75 (2): 37–49.
- ODELL G. H. and COWAN F. 1986. Experiments with Spears and Arrows on Animal Targets. *Journal of Field Archaeology* 13: 195–212.
- O'FARRELL M. 1996. *Approche technologique et fonctionnelle des pointes de la Gravette: une analyse archéologique et expérimentale appliquée à la collection de Corbiac (Dordogne, fouille F. Bordes)*. Mémoire de DEA, Université de Bordeaux.
- OMBRELLI G. and RAVAZZI C. 1996. The late Glacial and Early Holocene. Il Quaternario. *Italian Journal of Quaternary Sciences* 9: 2.
- OSHIBKINA S. V. 1989. The Material Culture of the Veretye-type Sites in the Region to the East of Lake Onega. In C. Bonsall (ed.), *The Mesolithic in Europe*. Paper Presented at the Third International Symposium, Edinburgh 1985. John Donald Publishers, Edinburgh: 402–413.
- PEDROTTI A. 1998. Il gruppo Gaban e le manifestazioni d'arte del primo neolitico. In Pessina A., G. Muscio (eds.), *Settemila anni fa il primo pane*. Catalogo della Mostra, Udine: 125–131.
2001. Il Neolitico. In M. Lanzinger, F. Marzatico, A. Pedrotti (eds.), *Storia del Trentino La Preistoria e la Protostoria*. Il Mulino, Bologna: 119–181.
- PEDROTTI A. 2002. The Neolithic Age in Trentino Alto Adige. *Preistoria Alpina* 34: 19–25.
- PEDROTTI A., SALZANI P. in press. La transizione culturale tra il Neolitico antico e il neolitico medio nel sito di Lugo di Grezzana (Verona). In E. Mottes (ed.), *Vasi a bocca quadrata. Evoluzione delle conoscenze, nuovi approcci interpretativi*. Atti del convegno Riva del Garda, 13–15 maggio 2009, Provincia Autonoma di Trento.
- PERRIN T. 2007. Nouvelles réflexions sur la transition Mésolithique récent – Néolithique ancien l'abri Gaban (Trento, Italie). *Preistoria Alpina* 41: 89–146.
2009. New perspectives on the mesolithic/neolithic transition in northern Italy. In S. McCartan, R. Schulting, G. Warren, P. Woodman (eds.), *Mesolithic Horizons. Vol. II*. Oxbow Books, Oxford and Oakville: 514–519.
- PESSINA A., TINÈ V. 2008. *Archeologia del Neolitico. L'Italia tra il VI e il IV millennio a.C.* Carrocci. Roma.
- PLISSON H., GENESTE J. M. 1989. Analyse technologique des pointes à cran solutréennes du Placard (Charente), du Fourneau du Diable, du Pech de la Boissière et de Combe Saunière (Dordogne). *Paléo* 1: 65–105.
- ROTS V. 2008. Hafting traces on flint tools. In L. Longo, N. Skakun (eds.), *Prehistoric technology 40 years later*. BAR International Series 1783. Archaeopress, Oxford: 75–84.
2003. Towards an understanding of hafting: the macro- and microscopic evidence. *Antiquity* 77: 805–815.
- RUSSEL C. P. 1992. *Firearms, traps, & tools of the mountain men*. University of New Mexico Press. Albuquerque.
- Van GIJN A. 1990. *The wear and tear of flint. Principles of functional analysis applied to Dutch Neolithic assemblages*. Analecta Praehistorica Leidensia 22. Faculty of Archaeology, Leiden University. Leiden.
- ZIGGIOTTI S. 2008. The complexity of an Epigravettian site viewed from use-wear traces. Insights for the settlement dynamics in the Italian eastern Alps. In L. Longo and N. Skakun (eds.), *Prehistoric Technology 40 years later*. BAR International Series 1783. Archaeopress, Oxford: 131–140.