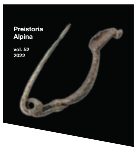

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Article

Intra-site spatial organization of a Mesolithic hunting camp: the open air site SA 42 Cresta di Siusi/Seiser Alm auf der Schneide (Dolomiti-Italy).

Klaus Kompatscher*[1], Nandi Maria Hrozny Kompatscher[1], Michele Bassetti[2]

[1] Leonardo da Vincistraße 15, 39100 Bozen, Italy
[2] CORA Società archeologica s.r.l., via Salisburgo 16, 38121 Trento, Italy

Keywords

- Dolomites
- Mesolithic open-air site
- Hunting camp
- Dwelling structure
- Post holes
- Combustion features

Summary

Aim of this work is to analyse the spatial organization in the open-air site SA42 located on the Siusi/Auf der Schneide ridge (2190 m.a.s.l.). Site SA 42 is a hunting camp specialized in the manufacturing of microliths. It is characterized by brief and repeated seasonal frequentations by Early Mesolithic hunter-gatherers and is dated between 8610 e 7077 cal BC (2 sigma).
Recorded within the living space are activities linked to fire use, knapping aimed at microliths production and the lithic retooling. The settlement comprises a dwelling unit and palisade-like structures, probably related to hunting and subsistence activities.

Parole chiave

- Dolomiti
- Sito all'aperto mesolitico
- Campo di caccia
- Struttura abitativa
- Buche per palo
- Strutture di combustione

Riassunto

Lo scopo di questo lavoro è analizzare l'organizzazione spaziale nel sito all'aperto SA42 situato sul crinale di Siusi/Auf der Schneide (2190 m s.l.m.). Il sito SA 42 è un campo di caccia specializzato nella produzione di microliti. È caratterizzato da brevi e ripetute frequentazioni stagionali da parte dei cacciatori-raccoglitori del Mesolitico antico ed è datato tra l'8610 e il 7077 cal BC (2 sigma).
All'interno dello spazio abitativo sono registrate attività legate all'uso del fuoco, alla scheggiatura finalizzata alla produzione di microliti e al loro rinnovamento. L'insediamento comprende un'unità abitativa e strutture simili a palizzate, probabilmente legate alle attività di caccia e di sussistenza.

* Autore per la corrispondenza:
klaus@klauskompatscher.it

Introduction

Within the Adige catchment area, Early Mesolithic human groups (Sauveterrian) peopled the alpine environment in the lower Holocene (Walker et al. 2012), namely in the Preboreal and Boreal chronozones. The density of early Mesolithic sites in this territory is considerably greater than that of the previous Palaeolithic Epigravettian groups. As demonstrated by the distribution of archaeological evidence, sites are located in the Adige valley bottom, in the piedmont areas and, above all, in areas around 2000 m a.s.l. The Mesolithic colonisation of alpine high altitudes is demonstrated by hundreds of sites discovered since the 1970s (Bagolini 1972; Bagolini et al. 1983; Bagolini & Dalmeri 1987; Broglio 1992; Cusinato et al. 2003; Cesco Frare & Mondini 2005; Fontana et al. 2009; Fontana et al. 2011; Fontana & Visentin 2016; Kompatscher & Hrozny Kompatscher 2007; Visentin et al. 2016).

However, while the valley bottom sites are almost exclusively rock shelters containing nearly complete Mesolithic sequences, the high altitudes ones are mostly open air. The latter are characterized by more or less densely clustered lithic finds with rare evidence of settlement features and no preservation of faunal remains. The incomplete preservation of the archaeological record is due to the to the intense erosion processes that characterised mountain areas during the Holocene or, at least, to absence of sedimentation. This implies that archaeological stratifications are often found in contexts close to the surface and, therefore, exposed to pedoturbation and post-depositional modification (Cavulli et al. 2011; Angelucci & Anesin 2012).

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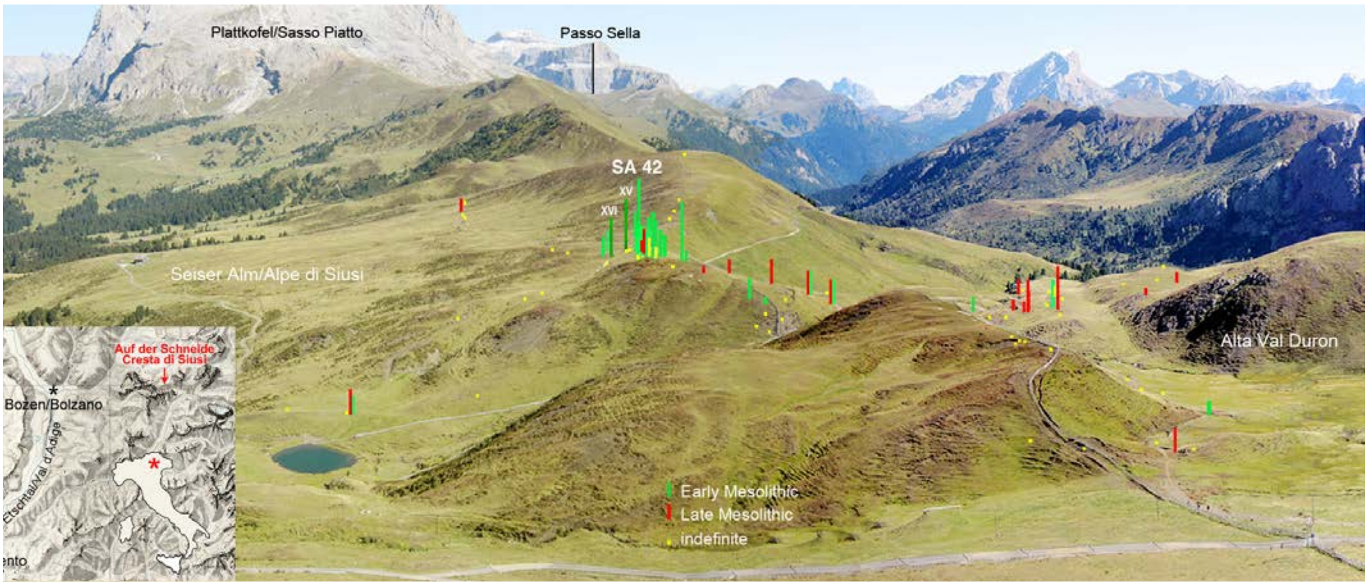


***Fig. 1**: View of Cresta di Siusi/Seiser Alm Schneid from west with the location of the site SA 42. / Veduta della Cresta di Siusi da ovest con la localizzazione del sito SA 42.*

Over the last decades, studies on high altitude Mesolithic sites in the Alps have witnessed great advances with special attention being devoted to settlement and mobility models (Grimaldi 2005; Kompatscher & Hrozny Kompatscher 2007; Cavulli & Grimaldi 2009; Fontana 2011; Fontana et al. 2011; Cornelissen & Reitmaier 2016; Fontana & Visentin 2016; Kompatscher et al. 2016; Visentin & Carrer 2017; Biagi et al. 2017). In contrast, the intra-site organization of hunting camps is still little studied. Only few sites have been excavated over large surfaces and with exact plotting of every lithic find in order to allow the internal organization of the site to be reconstructed (e.g.: Laghetti del Crestoso, Baroni & Biagi 1997).

Recently, this methodology has become common practice in the investigation of high-altitude sites (Fontana et al. 2012, 2017, 2018; Schäfer 2011; Kompatscher et al. 2016; Sangiorgi 2018).

The Siusi Ridge territory has been the object of several archaeological investigations.

In particular, investigations on the Siusi Ridge/Auf der Schneide were carried out by J.M. Moroder in 1980 (SAXV site), followed by Lunz's findings in 1981 (SAIII, SAXII, and SAXIII sites) (Lunz 1982; Lunz 1986), and systematic digs by the Geology Institute of the University of Ferrara (Lanzinger 1985). The SAXV and SAXVI sites, excavated respectively over 16 and 6 sq. m, were analysed using a typological approach (Broglio & Kozlowsky 1984) that links the relationship between tools/microliths and microburins/microliths to the functional nature of the site. This method has made it possible to define SAXV and SAXVI (whose tools/microliths ratio was calculated to be 87,8% e 91,0% respectively) as high specialized sites (hunting camp) where preparatory activity for microliths took place (Lanzinger 1985).

Intensive surface investigations carried out over several years within the framework of the project "Archaeological research into human settlement and use of the area in the early Holocene, Cresta di Siusi-Val Duron" authorised by the Archaeological Heritage Office of the Autonomous Province of Bolzano and the Archaeological Heritage Office of the Autonomous Province of Trento in the territory between the Siusi Ridge/Auf der Schneide and the head of the Duron valley, have allowed to identify 125 sites over an area of 1 sq. km. Based on this new data it has been possible to outline a settlement and mobility pattern for the Mesolithic hunter-gatherers groups, with some differences between the Sauveterrian and Castelnovian phases (Kompatscher et al. 2020) (Figure 1).

This article reports the results of the extensive excavation of the Mesolithic Sauveterrian site SA 42 on the Siusi Ridge/Auf der Schneide 2190 m.a.s.l.), a few metres to the west of the SAXV and SAXVI sites (Lanzinger 1985). The site was selected on the basis of surface investigation according to the following criteria: high concentration of artefacts (>355 artefacts/sq. m); b) high frequency of thermo-altered elements (55,2%); c) good preservation of the stratification (Kompatscher et al. 2020). The site SA 42 was investigated during five excavation campaigns, between 2015 and 2019 (Figure 2).

***Fig. 2**: View of the site SA 42 seen from the west. / Vista panoramica del sito SA 42 da ovest.*

Geomorphological framework

The ridge of Cresta di Siusi/Auf der Schneide is the watershed separating Alpe di Siusi/Seiser Alm to the north (province of Bolzano) and the Duron valley-floor to the south (province of Trento). It extends over 5 km in a west-easterly direction, from the slopes of the Denti di Terrarossa/Rosszähne (2653 m.a.s.l) to Jouf de Fascia (2304,7 m.a.s.l), through Passo Duron/Mahlknechtjoch (2187 m.a.s.l). It is bordered to the East by Sasso Piatto/Plattkofel (2964 m.a.s.l).

The site faces north and lies at the top of the Cresta di Siusi/Auf der Schneide (2190 m.a.s.l.). The slope consists of a lithostructural surface (homoclinal ridge) dipping northwards by about 15-25° (Kompatscher et al. 2020), formed by middle-Triassic volcanic rocks comprising pillow breccias and basaltic hyaloclastites (basalts and basaltic andesites) (Wengen formation, late Ladinian, Neri et al. 2007).

During the Last Glacial Maximum-LGM, 27,000-18,000 cal BP (Monegato et al. 2007; Borgatti et al. 2006, Ravazzi et al. 2014), glaciers covered the whole area, up to around 2300 m.a.s.l. In this period the glacier tongue, fed by the Catinaccio/Rosengartengruppe flowed north-eastwards through the Val Duron, splitting into two at Col de l'Agnel (Morandi 2013). During the Lateglacial period (18,000-11,600 cal BP, Ravazzi et al. 2007), the glacial flow began to shrink to the higher altitudes of the Val Duron. During the Late Glacial period, periglacial processes became increasingly significant. Reforestation (Pinus sylvestris, P. mugo, P. cembra, Larix decidua) occurred in the latter part of the Late Glacial (Heiss et al. 2005). At the onset of the Holocene, these forests grew over the stable slopes at a height above 1500 metres; in the early and mid-Holocene, they expanded upwards, perhaps due to climate conditions warmer than in the second part of the Holocene (Porter & Orombelli 1985; Magny & Haas 2004) and, specifically, due to hot, dry summers (Tinner & Theurillat 2003). The timberline reached 2000 metres during the rapid Preboreal warming (Tinner & Vescovi 2007; Drescher-Schneider 2009). Palaeoenvironmental reconstruction for the early Holocene indicates the presence of pioneer plants (Salix, Betula, Pinus mugo), later replaced by dense woods dominated by Picea, Larix and Pinus cembra (Soldati et al. 1997).

The present-day flat terrain of the site derives from modifications occurred during the first World War (1915-1918 in Italy). Along the ridge of Auf der Schneide/Cresta di Siusi an extensive trench was dug up by the Austro-Hungarian army. Soil and archaeological stratification are still exposed to erosive phenomena caused by intensive grazing. Erosion deepens particularly along the fence marking the border between the two provinces (Trento and Bolzano).

The archaeological deposit extends on a NNW-SSE direction for a length of about 10 metres and a maximum width of about 3 metres. To the west its limit is given by a rock outcrop elongated on a NNW-SSE direction.

Excavation method

A local reference system with Cartesian axes oriented N-S (y-axis) and E-W (x-axis) was employed. The origin of the 200E/100N coordinate grid corresponds to the geographical coordinates 46°29'54.08"; 11°39'24.88". Relative zero point was set at 2,192.0 metres above sea level.

Stratigraphic units are indicated with the initials 'SU' and 'SUs'. The excavation was carried out by dividing a 1-square metre grid into 9 quadrants, each measuring 33x33 cm, labelled with letters a to i. All lithic artefacts, independently from size, were plotted in space using relative Cartesian coordinates (x, y, z in cm). During excavation, the single artefacts (progressively numbered) were positioned photographically in every quadrant. Afterward, the images were digitally rectified and brought to scale using PhotoShop software version 12.1. In this way an orthophoto was obtained in which the relative coordinates of each artefact were calculated and then recorded in a spreadsheet. The relative height was measured with an optical level (Figure 3).

Stratigraphic surfaces were drawn at a scale of 1:10, sections and profiles at a scale of 1:5, both by hand and using othophotos. Surface morphology was visualized by manual interpolation of elevations with 1 cm equidistant contour lines.

All sediment was wet sieved using a 1 mm mesh sieve and later screened in the laboratory under stable light conditions.

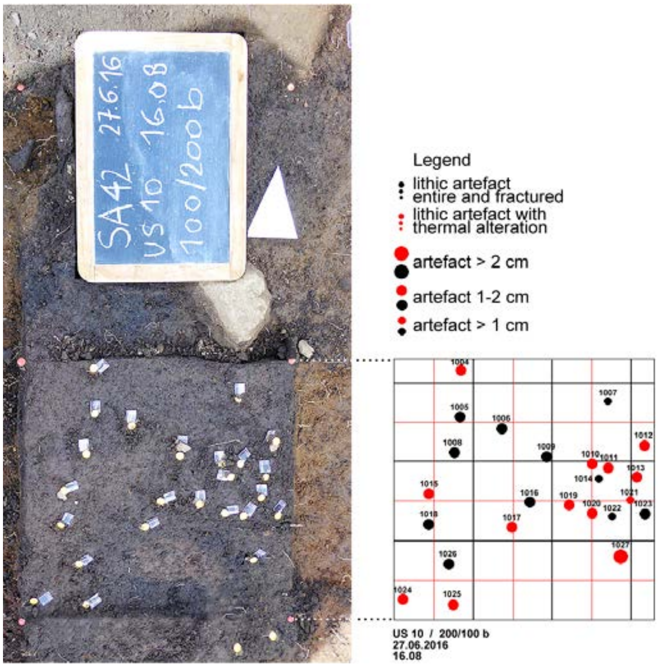


***Fig. 3**: Example of the transfer of recorded artefacts to the spatial distribution plan (square 200N/100E b, SU 10). / Esempio di pianta con distribuzione spaziale ottenuta sulla base dei manufatti registrati in fase di scavo (quadrato 200N/100E b, US 10).*

Stratigraphy and archaeological micromorphology

Soil horizons have been described according to the FAO guidelines (2006). The symbology for the soil classification and the definition of the horizons follow the criteria of Soil Taxonomy (Soil Survey Staff, 2014). Colors have been determined in the wet state and codified with the Munsell® Soil Color Charts (2000). The consistence of soil mass is determined in moist states.

In the field, the stratigraphic sequence was divided into units according to pedological and lithostratigraphic criteria (change in colour, texture, aggregation, consistency, pedological features, anthropogenic components and lower limit). The stratigraphic units identified (SU, from now on) were grouped into pedostratigraphic units[1] (PU, from now on) according to chronology (Tab. 1).

Preliminary, six thin sections have been analyzed: hearths SU 20, brazier SU 21 and SUs 83A and 94. Thin sections were prepared by the "Laboratorio Servizi per la Geologia" (Piombino, Livorno) according to the method proposed by Murphy (1986), by means of dehydration, vacuum impregnation, and cutting. The thin sections are 25 μm thick and are mounted on microscope slides (without coverslip) measuring 95x55 mm. Their analysis has been carried out with a Prior Scientific MP3500A microscope with polarized light at 20, 40, 100, and 400 magnifications. The description follows the criteria adopted by Stoops (2021) while for the interpretation the references are Stoops et al. (2018), Nicosia & Stoops (2017).

[2] A pedostratigraphic unit is a "buried, traceable, three-dimensional body of rock (or sediment) that consists of one or more differentiated pedologic horizons" developed in and overlain by "one or more formally defined lithostratigraphic or allostratigraphic units" (NACSN, 2005)

PU	SU	Soil horizon	Main characteristics	Lower boundary	Main formation processes
	8a-b	Aup	Mixed surface horizon with reworked aggregates (mainly SU 9)	Abrupt, irregular (erosive)	Intensive grazing, trampling (pathway)
top soil	1	2Op	Silt loam, black (10YR 2/1), strong granular fine structure, friable	Clear, smooth	Intensive grazing, cryoturbation
		2Ap	Silt loam, very dark brown (10YR 2/2), strong granular fine structure, friable	Clear, smooth	
		2Bjj	Silt loam, dark brown (10YR 3/3), primary strong granular fine structure and secondary moderate platy coarse structure, friable	Abrupt, smooth	
	1a	2C	Apedal sand	Abrupt, smooth (erosive)	Rill erosion
1	9, 11	3ABujjb1	Silt loam, very dark brown (10YR 2/2), primary strong granular fine structure and secondary moderate platy coarse structure, macrofauna infilled krotovinas-like burrows (US 85), friable	Clear, smooth	Soil forming (umbric epipedon), cryotur-bation (freeze-thaw action)
	40, 41	3ABujjb2	Silt loam lens, black (10YR 2/1), primary strong granular fine structure and secondary moderate platy coarse structure, very few coarse gravel, firm	Clear, smooth	
	12=38=62	3ABujjb3	Silt loam, black-very dark brown (10YR 2/1-2/2), primary strong granular fine structure and secondary moderate platy coarse structure, very few coarse gravel, firm	Abrupt, smooth	
	61	3Cjj	Loam lens, dark brown (10YR 3/3), strong platy fine structure, common coarse gravel, friable	Abrupt, irregular (erosive)	Sheetwash colluvium along to est side of bedrock outcrop, cryo-turbation (freeze-thaw action)
2	48	4Aujjb	Silt loam, black-very dark brown (10YR 2/1-2/2), primary weak prismatic medium structure and secondary moderate platy fine structure, common coarse gravel, few stones, firm	Abrupt, smooth	Soil forming (umbric epipedon), cryoturba-tion (polygonal soil)
	69	4Cu	Sandy loam lens, very dark brown (10YR 2/2), strong granular fine structure, friable	Abrupt, smooth	Sheetwash colluvium, anthropogenic sedi-ments, cryoturbation (convolution)
3	73	5Aujjb	Loamy sand lens, black-very dark brown (10YR 2/1-2/2), primary weak prismatic medium structure and secondary moderate platy fine structure, few charcoals fragments (<1cm), firm	Clear, smooth	Sheetwash colluvium from south area, soil forming, cryoturbation (freeze-thaw action)
4 - Fills (SU 99)	90	/	Sand with fine gravel lens, dark brown (7,5YR 2,5/3), strong granular medium structure, friable	Abrupt, smooth	Anthropogenic filling against the palisade (from SU 13)
	87	6Aub1	Sandy loam lens, dark brown (10YR 3/2-3/3), strong granular medium structure, silt loam pedorelicts, very dark brown-dark yellowish brown (10YR 3/3-3/4), friable	Clear, smooth	Anthropogenic filling of linear erosion (rill); refuse layers from east area (hearths)
	89	6Aub2	Sand lens, black (10YR 2/1-3/1), strong granular very fine structure, many charcoals fragments (<1cm), friable	Abrupt, smooth	
	93	6Aub3	Sand lens, black (2,5Y 2,5/1), strong granular fine structure, pedorelicts (<1cm) from SU 13, friable	Abrupt, smooth	
	94, 95	6Aub4	Sand lens, black (10YR 2/1), strong granular very fine structu-re, many charcoals fragments (<3cm), friable	Abrupt, smooth	
	96	6ABub	Loamy sand lens, very dark brown (10YR 2/2), primary weakly granular fine structure and secondary strong subangular blocky very fine structure, very few medium and coarse gravel with heat alteration, firm	Abrupt, smooth	
	92	6Bwb	Sand lens, dark brown (10YR 3/3), sandy, primary weakly gra-nular fine structure and secondary strong subangular blocky very fine structure, very few medium and coarse gravel, friable	Abrupt, smooth (erosive on UP 6)	
	74=75=76	7ABhsub	Sandy -sandy loam lens, very dark brown (10YR 2/2), strong very fine granular structure, very few medium and coarse gravel locally stones with silt capping, few charcoals fragments (<1mm), macrofauna infilled krotovinas-like burrows (US 85), friable	Abrupt, smooth (erosive)	Sheetwash colluvium from south area, soil forming, cryoturbation (freeze-thaw action)

4 - mesolithic stratifications	45		Silt loam lens, black (10YR 2/1), primary strong granular structure and secondary moderate platy coarse structure, very few medium and coarse gravel, firm	Clear, smooth	Anthropogenic activities, soil forming
	66		Sandy loam lens, very dark brown (10YR 2/2), primary strong granular fine structure, friable (humid), many charcoals fragments (<1cm), friable	Abrupt, smooth	Anthropogenic activities, soil forming
	67		Sandy loam lens, black (10YR 2/1), primary strong granular fine structure, friable (humid), many charcoals fragments (<1cm), friable	Abrupt, smooth	Anthropogenic activities, soil forming
	65C		Sandy loam lens, black (10YR 2/1), strong granular fine structure, many charcoals fragments (<1cm), friable	Abrupt, smooth (erosive on UP 5)	Anthropogenic activities, soil forming
	82a		Loamy sand lens, black (10YR 3/1), strong granular medium structure, very few medium and coarse gravel, friable	Abrupt, smooth	Colluvium of SU 82
	78=82		Loamy sand lens, black (10YR 2/1-3/1), strong granular medium structure, very few medium and coarse gravel, friable	Abrupt, smooth	Anthropogenic activities, soil forming
	83		Sand lens, black (10YR 2/1), sandy, strong granular medium structure, few charcoals fragments (<1cm), friable	Abrupt, smooth	Anthropogenic activities, soil forming
	83a, 99, 100		Sand lens, black (10YR 2/1), strong granular fine structure, many charcoals fragments (<1cm), friable	Abrupt, smooth	waste dumping, soil forming, cryoturbation
	77		Sandy lens, black (10YR 2/1-3/1), strong granular medium structure, very few medium and coarse gravel, few charcoals fragments (<1cm), friable	Abrupt, smooth	Anthropogenic activities, soil forming, cryoturbation (convolution)
	65D		Loamy sand lens, very dark brown (10YR 2/2), strong very fine granular structure, few charcoals fragments (<1cm), friable	Abrupt, smooth (interface)	Filling of shallow pit
	39 (hearth SU 20)		Silt loam lens, black (10YR 2/1), dominant charcoals (<3cm), primary strong crumb structure and secondary moderate platy coarse structure, macrofauna infilled large burrows , friable	Abrupt, smooth	Hearth, soil forming, cryoturbation
	10 (brazier SU 21)		Silt loam lens, black (5YR 2,5/1-2; 7,5YR 2,5/2) dominant charcoals (<3cm), primary strong crumb structure and secondary moderate platy coarse structure, macrofauna infilled krotovinas-like burrows, friable	Abrupt, smooth	Combustion features, soil forming, cryoturbation
5 (pre-mesolithic paleosol)	84	8BEb	Loamy sand, dark brown (7,5YR 3/2), apedal, friable	Abrupt, linear	Soil forming
	13	8Bhsb	Sand with fine gravel, dark brown-dark yellowish brown (10YR 3/3-3/4), strong subangular blocky fine structure, common medium and coarse gravel, common continuos organic matter coating on pedfaces and on coarse fragments, friable	Abrupt, wavy	
		8Bsb	From silt loam to sand with fine gravel, dark brown (7,5YR 3/2-3/3), strong subangular blocky fine structure, very few medium and coarse gravel, common dark reddish brown (5YR 3/2) fine iron mottles, friable	Abrupt, wavy	
	72	8Cr	Heterometric, clast supported with sandy matrix	Irregular, wavy	Regolith
	79	R	Basaltic hyaloclastite	/	Bedrock

***Tab. 1**: Field characteristics of main excavated units. In the Mesolithic stratification (PU 4) the numbering of the vertical subdivisions of the horizons is not indicated because there is often no direct overlap between the individual horizons. Artefacts are present with different frequencies in pedostratigraphic units 1-4 (see suffix u for master horizons). The relationships between the SUs are highlighted in the matrix in fig. 4. Thin herbaceous roots are present throughout the stratigraphic profile. / Descrizione delle principali unità di scavo. Nella stratificazione mesolitica (UP 4) non è sempre indicata la numerazione delle suddivisioni verticali degli orizzonti perché spesso non c'è sovrapposizione diretta tra i singoli orizzonti. Gli artefatti sono presenti con frequenze diverse nelle unità pedostratigrafiche 1-4 (vedi suffisso u per orizzonti master). Le relazioni tra le UU.SS sono evidenziate nel matrix in fig. 4. Radici erbacee sottili sono presenti in tutto il profilo stratigrafico.*

Analysis of the lithic assemblage

The lithic assemblage appears to be homogenous and fits in the techno-typological framework of the Adige Basin's Mesolithic; its analysis was carried out using the taxonomic system proposed by A. Broglio and S.K. Kozlowski (1984), whereas cores were classified according to the criteria proposed by E. Flor et al. (2011).

This study was based on the main categories: cores, blanks, retouched blanks (tools and microliths), microburins and indeterminable fragments. The blanks were divided into blades, bladelets, laminar flakes and knapping waste.

It should be clarified that a techno-typological study, as well as the comparison with lithic assemblages from other coeval sites, including raw material analyses, is beyond the scope of this paper and will be presented in a specific work in the future. To this regard, the present study only comprises a preliminary presentation of the main techno-typological characteristics of the lithic industry found at the site.

Spatial analysis of the lithic artefacts included all finds and took into account both their vertical and horizontal distribution. The exact positioning is provided for 4,897 artefacts recorded three-dimensionally during excavation, whereas the horizontal distribution of finds retrieved from sieving amounts to 15,390 artefacts, for a total of 20,287 to which 1101 artefacts from surface collection should be added.

Distribution maps were created of the different typological classes of both the plotted finds and the finds from sediment screening after sieving (microburins, microliths, tools, cores, lithic artefacts both entire and fractured and artefacts with thermal alteration). Single artefacts were entered on an Excel (16.16.27 version for Mac) database. They were also individually drawn, digitised and graphically represented with PhotoShop software version 12.1. The interpretation of the spatial distribution of the different classes of lithic artefacts was made according to an empirical-qualitative approach based on the comparison between the different distribution maps.

Radiocarbon datings

Thirteen ^{14}C-AMS dating operations were carried out on wood charcoal fragments sampled during excavation. Samples were analysed by the Centre for Dating and Diagnostics - CEDAD, Department of Mathematics and Physics "Ennio de Giorgi", University of Salento, Lecce (Italy). These data were then calibrated for calendar age applying OxCal v.4.4.4 (Bronk Ramsey, C. OxCal v.4.4.4 https://c14.arch.ox.ac.uk/oxcal/OxCal.html, 2021) using the IntCal20 atmospheric curve for the northern hemisphere (Reimer et al. 2020), with a probability 2 sigma (95,4%).

Stratigraphy

The stratigraphic sequence is briefly described in Table 1 while stratigraphic relations are shown in the matrix (Figure 4). The stratigraphic sequence has a maximum thickness of approximately 50 cm and develops from a parent material that results from weathering of the volcanogenic minerals composing the basaltic hyaloclastite (SU 79) (Wengen formation, late Ladinian) (for geological and geomorphological setting see Kompatcher et al. 2020).

In particular, the stratigraphic sequence following the pre-Mesolithic soil (PU 5), is a polycyclic soil (Duchaufour 1983) composed of four pedostratigraphic units (PU 1-4) and the current soil (top soil). These pedogenic bodies have developed on thin colluvial sediments, which are gradually involved in a new pedological cycle. The colluvial sediment is produced by the persistent weathering of the basaltic hyaloclastites outcropping in the area directly surrounding the site. Sedimentary inputs are often preceded by a small erosional event. At the macroscopic level, it has been observed that the most recent pedogenetic phases have interfered with earlier soils provoking a secondary aggregation.

The microtopographical conditions of the site favoured not only colluvial accumulation but also the accumulation of organic matter.

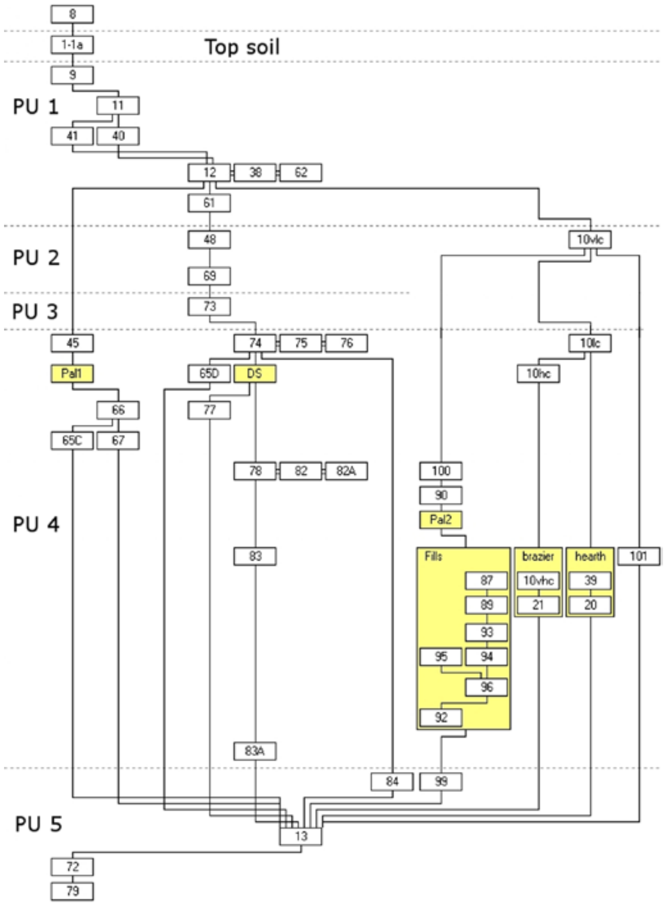


***Fig. 4**: Matrix of the main units (SUs) grouped in Pedostratigraphic Units - PU (left). DS: Dwelling Structure; Pal1: palisade 1; Pal2: palisade 2. / Matrix delle principali unità (UU.SS) raggruppate in Unità Pedostratigrafiche - UP (a sinistra). DS: struttura abitativa; Pal1: palizzata 1; Pal2: palizzata 2.*

Podzolic-type soils developed on these sediments, even if with a low degree of soil evolution. In Val Duron, similar profiles have been described and can be classified as Entic Podzols (IUSS Working Group WRB 2015) with typical OE-(AE)-Bhs-Bs-BC-C sequences (Sartori, Mancabelli 2009). Podzolization is the predominant pedogenetic process. In high alpine environment (Aberegg et al., 2009; Favilli et al., 2010), podzolisation is a natural outcome of soil development, following plant colonization of bare soil after glaciation. The alpine and subalpine area's podzols developed on acid substrates, under forest coverage made up of conifers and/or ericaceous shrubs, vegetation capable of producing a sufficient biomass of acid litter to spark off the podsolization process (Duchaufour 1998). The podsolization is a process that takes place in the presence of slightly humified organic substance. In these conditions, large amounts of humic acids are formed in the surface horizons that attack the clay minerals, releasing iron and aluminium ions that bind to the organic substance and migrate downward where they precipitate by virtue of their lower acidity. The diagnostic horizons are the impoverished horizon E (albic) and the deep horizon Bs (spodic), enriched with complex minerals of aluminium, iron or organic compounds (Bh) (SU 13). In particular, the pre-Mesolithic soil only preserves an intermittent transitional horizon BE (SU 84) (Figures 5, 6).

PU 5 is truncated by an interface that has removed the original organic superficial horizon. Channelled erosion phenomena (rill erosion) with SSW to NNE down-flow were observed in the northern sector of the excavation area (SU 99). The erosion shows a concave bottom and reaches 120 cm of width and 35 cm of depth.

The Mesolithic stratification (PU4) is formed by a sequence of organic lenses characterised by the presence of charcoal fragments and abundant lithic industry (Figures 7-10). The formation processes

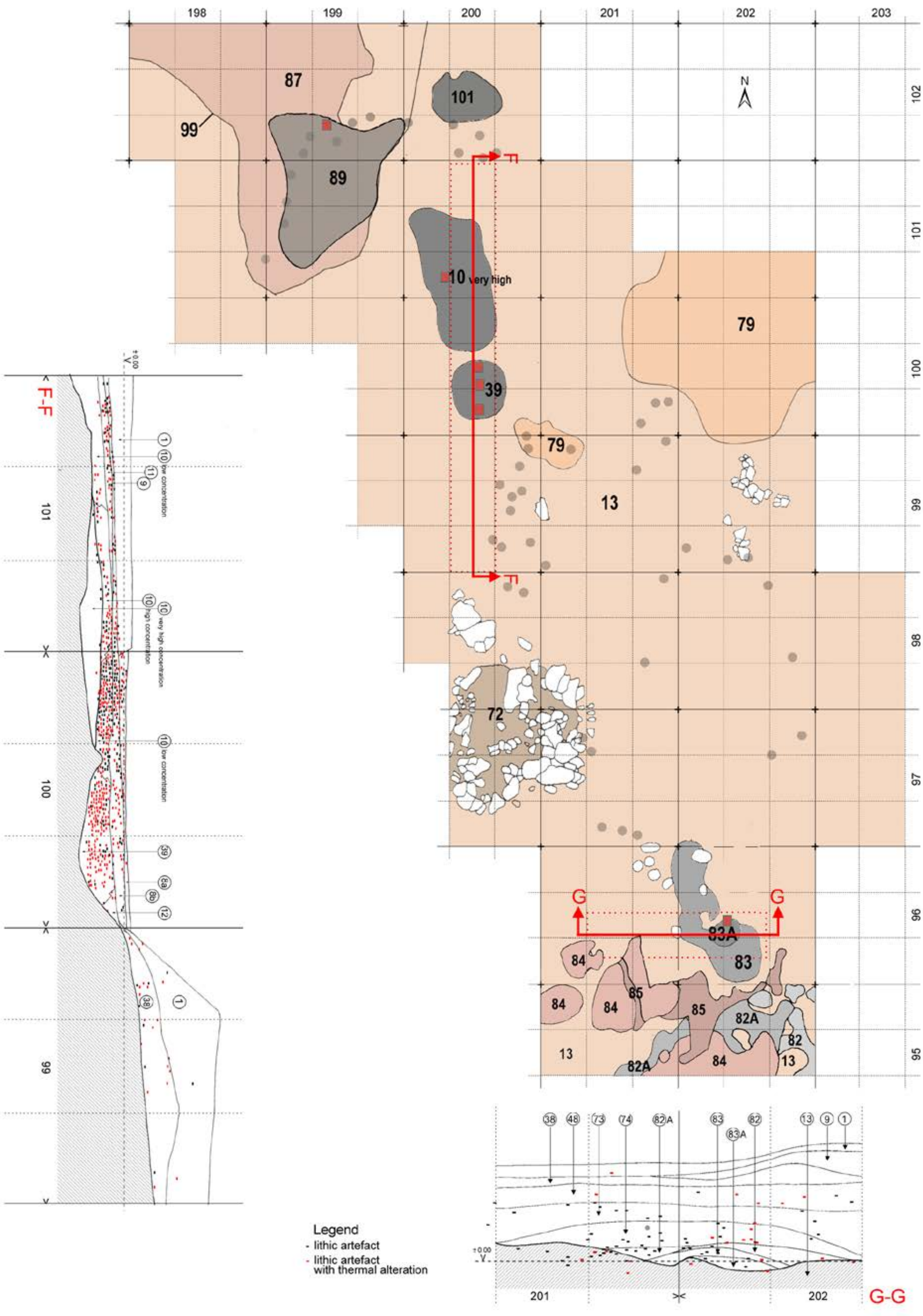


__Fig. 5__: Excavation area with the SUs 13, 72, 84, 99 (PU 5), 10 very high concentration, 39, 83, 83A, 84, 89, 101 (PU 4), 85 (bioturbation). Grey dots: localized post holes. Stratigraphic sections C-C ,D-D, E-E showing the vertical distribution of spatially registered artefacts within the dotted frames. Red rectangles: micromorphological samples. / Area di scavo con le UU.SS 13, 72, 84, 99 (UP 5), 10 concentrazione molto alta, 39, 83, 83A, 84, 89, 101 (UP 4), 85 (bioturbazione). Pallini grigi: buche di palo identificate. Sezioni stratigrafiche C-C, D-D, E-E che evidenziano la dispersione verticale dei manufatti registrati spazialmente e situati all'interno delle linee tratteggiate. Rettangoli rossi: campioni micromorfologici.

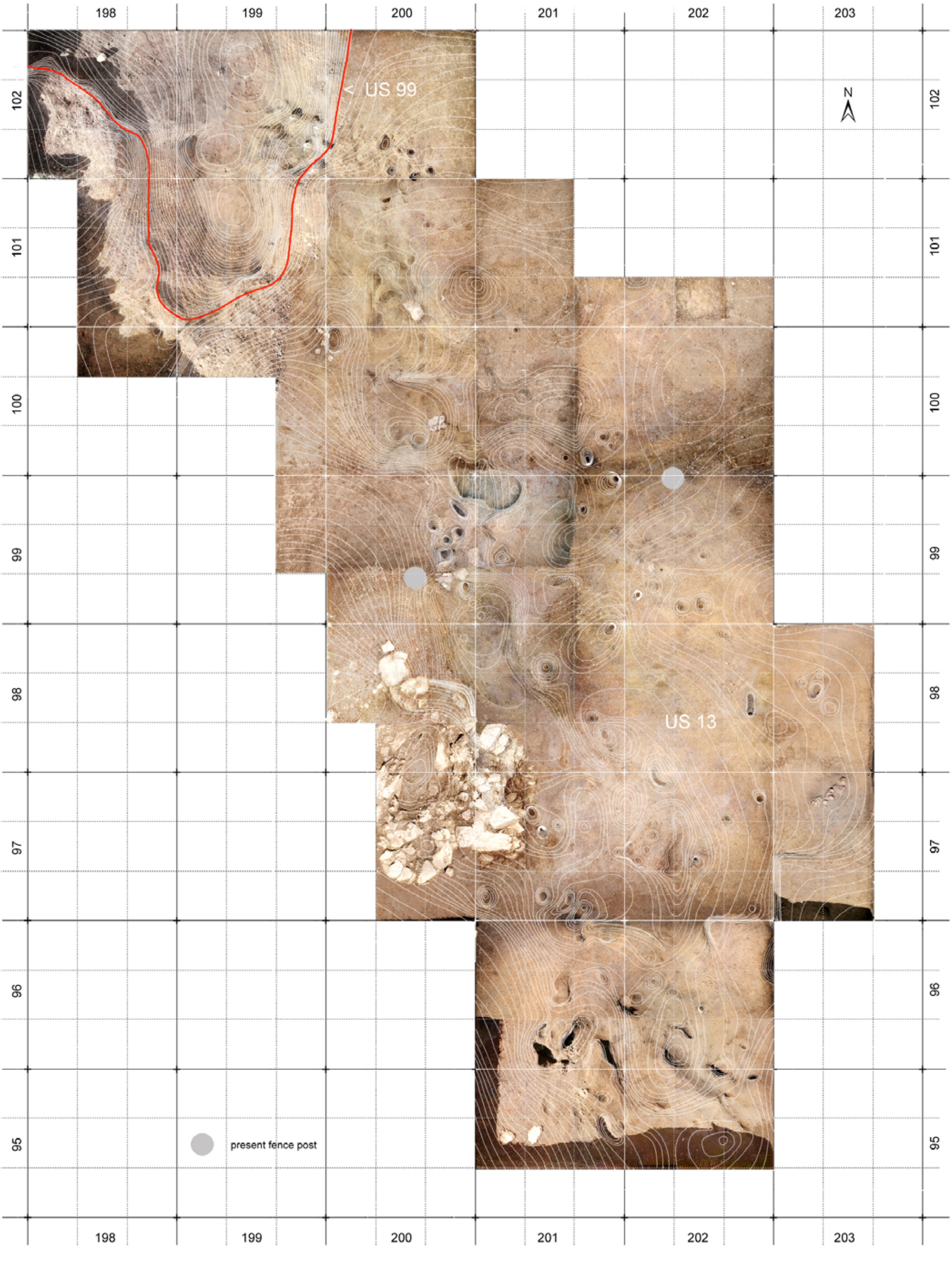


Fig. 6: Topview with contour lines (equidistance 1 cm) of SU 13 and erosion SU 99. / Visione zenitale con isoipse (equidistanti 1 cm) di US 13 e della depressione erosiva US 99

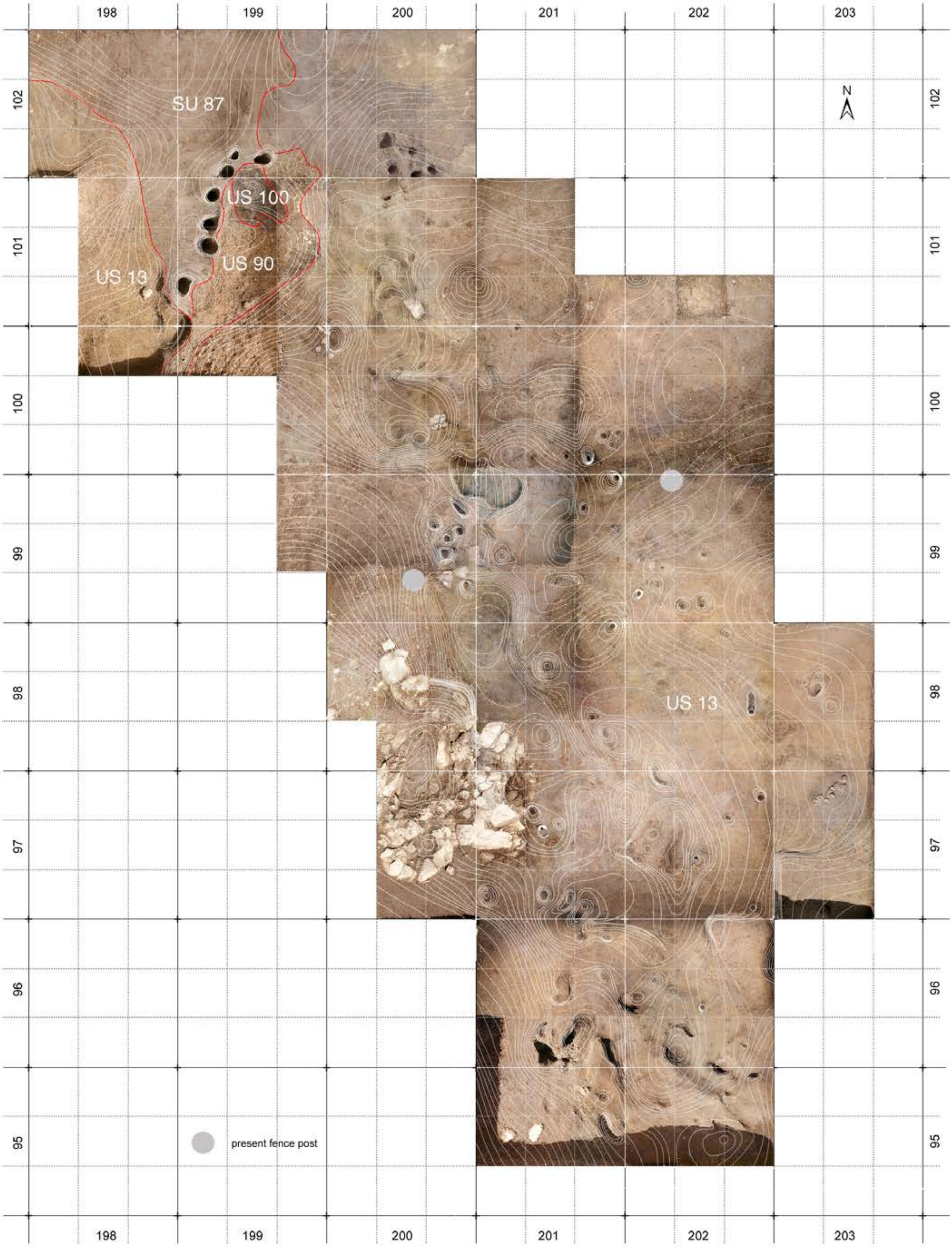


Fig.7: Topview with contour lines (equidistance 1 cm) of SU 13 with filling of the erosive depression (rill erosion) SUs 87, 90, 100 with postholes alignment. / Visione zenitale con isoipse (equidistanti 1 cm) di US 13 con il riempimento del solco erosivo UU.SS 87, 90, 100 con l'allineamento dei buchi di palo.

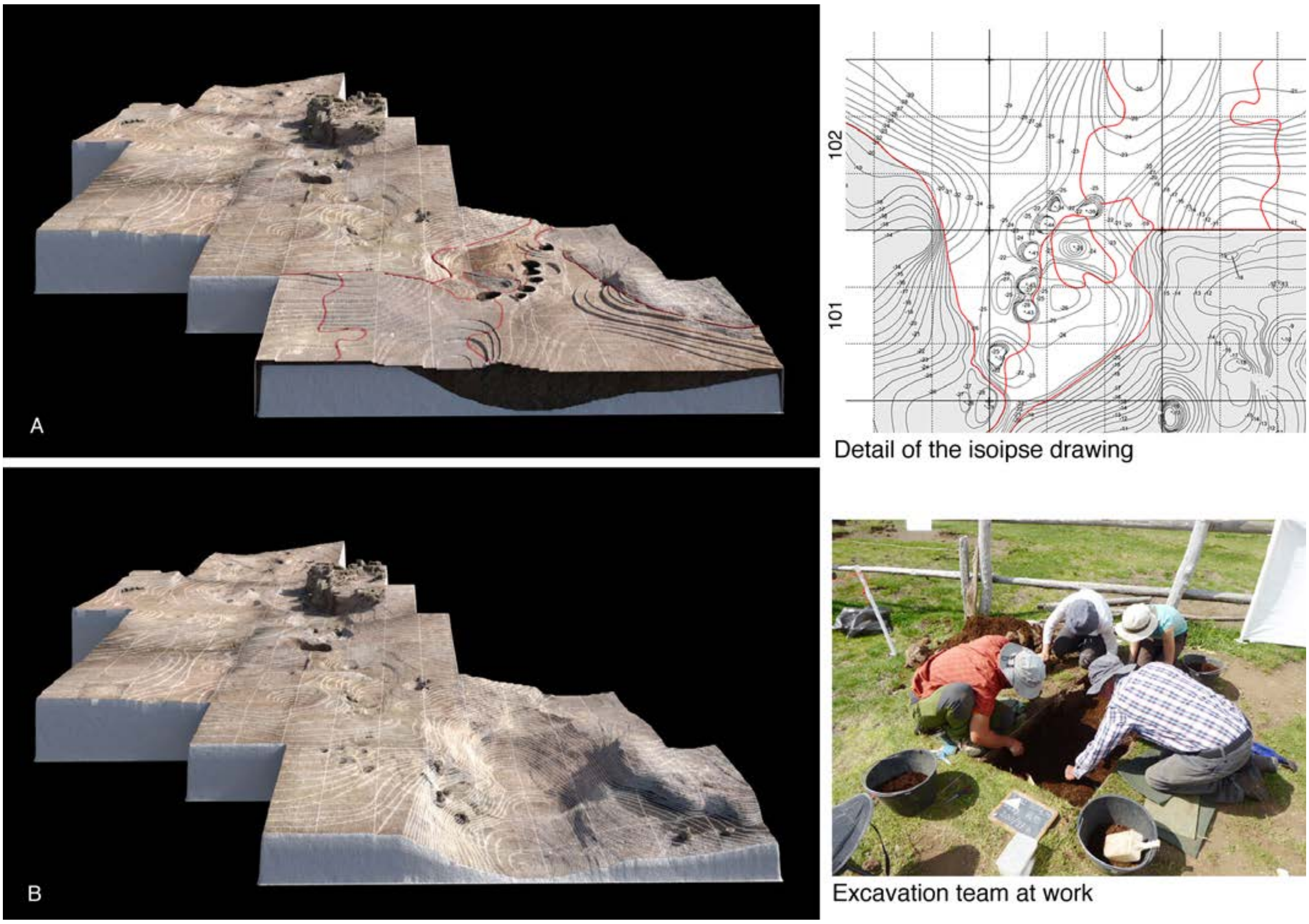


Fig. 8*: The 3D produced excavation area seen from the North (Realization visual4d Rendering& Multimedia, Rovereto). A: evident post holes alignment; B. erosive depression SU 99 subsequently filled by anthropogenic contributions. / Riproduzione 3D dell'area di scavo vista da nord (Realizatione visual4d Rendering&Multimedia, Rovereto). A: Allineamento di buche di palo; B. Depressione erosiva US 99 riempita successivamente da apporti antropici.*

of these units are mostly related to anthropogenic activities involving knapping and fire use.

They are sandy, loamy sand and silt loam sediments with a strong very fine granular structure. The thickness of each single unit is pluricentimetric and their lower boundary is abrupt, smooth.

The filling of SU 99 comprises a festoons stratification made up of concave-convex and sigmoidal shaped lenses. Its components and its inclined geometry indicate that for SUs, 93, 94, 95, 89, the sediments originated on-site from the East, namely from the area of combustion features SUs 20 and 21. While SUs 87, 92 and 96, have no charcoals and originated off-site, from the West side.

Overall, the sediment forming the different units is homogenous, with a massive structure, and is characterised by an admixture of sandy and sandy loam sediment with charcoal fragments scattered uniformly in the matrix in different percentages (5-10%). Medium and coarse gravel is less than 5% and is often characterised by heat alteration. In SUs 94 and 95, charcoals are up to 3 cm in size and show the highest concentration (44%) (Figure 11). All units are characterised by the presence of lithic industry, mostly clustered towards the E side.

The sequence has been interpreted as an intentional accumulation of sediments deriving from hearth dumps mixed with sediment from the occupation surfaces. The absence of stabilised surfaces (pedogenesis, trampling) shows that the filling of the linear erosive depression was relatively quick, happening certainly within the Mesolithic phase of frequentation. The post-holes cross the stratigraphic succession of SUs 87 and 89 (Figures 12-14) and are therefore later in date. Only the last sandy-gravely accumulation (SU 90) from SU 13 leans against the post-holes. SU 90 is therefore later and functional to the placement of the alignment of post-holes (SUs 88A-B-D-G-I-K-L). Finally, the filling sequence is covered by SU 10 (very low concentration), a charcoal scatter related to the SU 21 structure. The surface at the top of the filling (SUs 9, 10 very low concentration) is characterised by a high concentration of microburins testifying an in situ activity of microliths production (Figure 11, section g-g).

The Mesolithic sequence ends with SU 74=75=76. The latter are colluvial sandy-sandy loam lenses (sheetwash colluvium) with maximum thickness of about 12 cm, coming from the southern area (upstream). They are affected by cryoturbation phenomena, due to the formation of sorted coarse sand in the lower part of the clasts, and bioturbation with burrows of small mammals. The base of the unit is erosional.

PU 3 is a loamy sand colluvial unit (SU 73) coming from the upstream (south area), up to 10 cm thick, and characterised by cryoturbation (freeze-thaw action) (Figure 15).

PU 2 is formed at the base by a silty loamy colluvium coming from East (SU 69). Developed on this unit is an umbric epipedon (SU 48) with a maximum thickness of about 15 cm modified by cryoturbation phenomena and with a prismatic macrostructure. The basal interface is characterised by the presence of clasts from the alteration (weathering) of the rock outcrop to the W (Figures 15, 16).

PU 1 extends on a small colluvial lens (US 61) (sheetwash colluvium), loamy, which is deposited along the East side of the bedrock outcrop. This unit is covered by an umbric epipedon (SU 12=38=62) up to 20 cm thick, silty loam, characterised by cryoturbation (freeze-thaw action). The basal interface is marked by the presence of clasts from the weathering of the bedrock outcropping to the W (Figure 17).

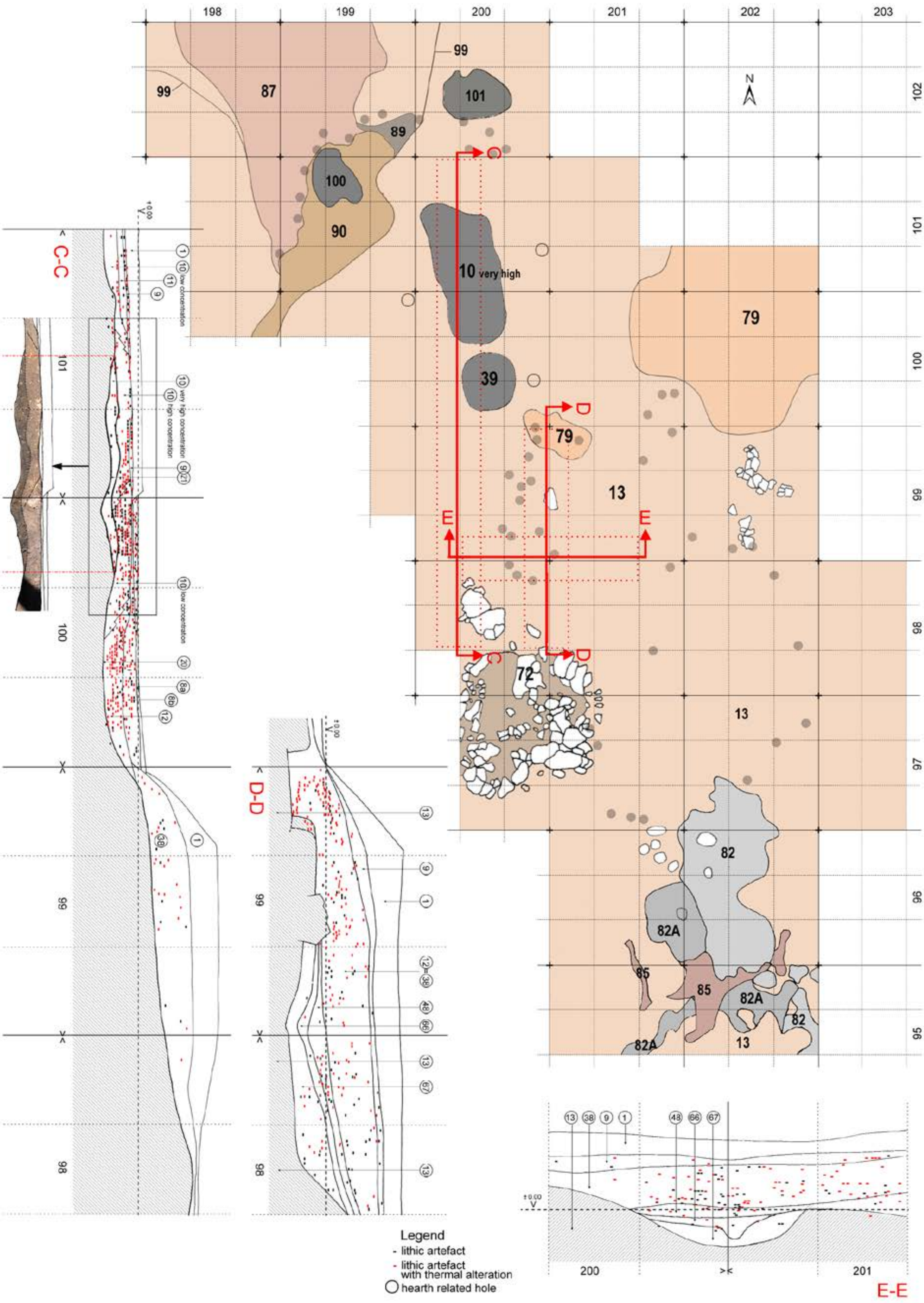


Fig. 9: Excavation area with the SUs 13, 72, 79, 99 (PU 5), 10 very high concentration, 39, 82, 82A, 87, 90, 100, 101 (PU 4), 85 (bioturbation). Grey dots: localized post holes. Stratigraphic sections F-F and G-G showing the vertical distribution of spatially registered artefacts within the dotted frames. / Area di scavo con le UU.SS 13, 72, 79, 99 (UP 5), 10 concentrazione molto alta, 39, 82, 82A, 87, 90, 100, 101 (UP 4), 85 (bioturbation). Pallini grigi: buche di palo identificate. Sezioni stratigrafiche F-F e G-G che evidenziano la dispersione verticale dei manufatti registrati spazialmente e situati all'interno delle linee tratteggiate.

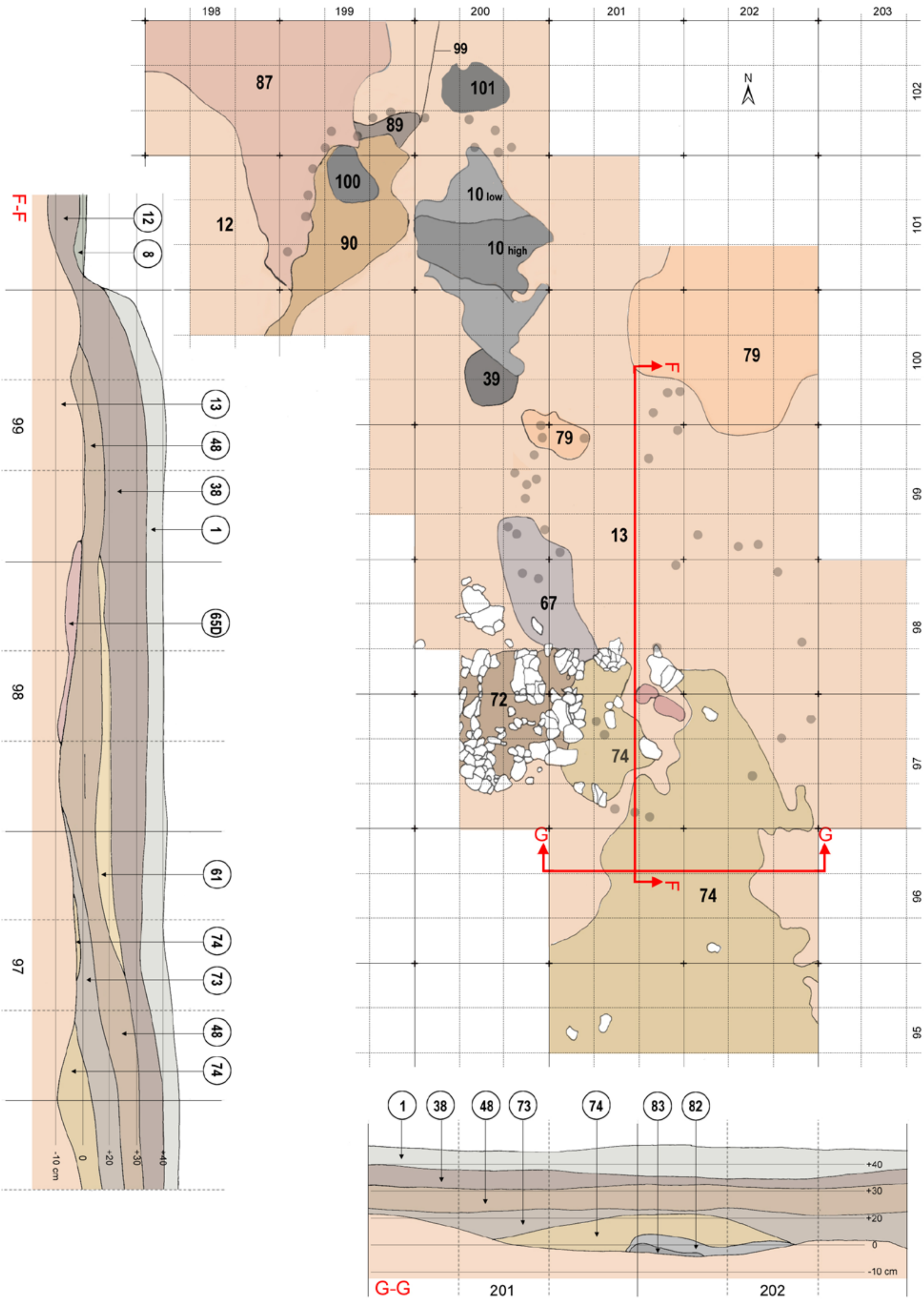


Fig. 10: *Excavation area with the SUs 13, 72, 79, 99 (PU 5), 10 high concentration and low concentration, 39, 65D, 67, 74, 79, 82, 82A, 85, 87, 89, 90, 100, 101 (PU 4). Grey dots: localized post holes. Stratigraphic sections F-F and G-G showing the corresponding SUs. / Area di scavo con le UU.SS 13, 72, 79, 99 (UP 5), 10 concentrazione alta e bassa, 39, 65D, 67, 74, 79, 82, 82A, 85, 87, 89, 90, 100, 101 (UP 4). Pallini grigi: buche di palo identificate. Sezioni stratigrafiche F-F e G-G che evidenziano le corrispondenti UU.SS.*

The diagnostic umbric horizon, present in UP 1 and 2, is defined by the World Reference Base for Soil Resources – WRB (IUSS Working Group WRB, 2015) as a dark-coloured mineral surface horizon at least 20 cm thick (or 10 cm if it is directly on a solid rock) characterized by an aggregate structure, a relatively high organic matter content and a low base saturation.

The formation of umbric horizon is favoured by the carbonate-free bedrock and by the climatic conditions occurring in the mountain areas (high amount of rainfall, low temperature). Therefore, this horizon is often identified in the soils of mountain areas (Balaceanu et al., 1987; Sanesi & Certini 2005; Bedrna 2009; Bedrna et al. 2009; Dlapa et al. 2010; Vasiliniuc et al., 2010; Chodorowski et al., 2012; Hudec & Hreško, 2013; Musielok et al. 2019; Jenčo et al. 2018).

Vegetation and climate are the joint influences at work and development of this profile is strongly dependent on the deposition of significant amounts of organic material with low base saturation on the soil surface. The occurrence of umbric horizons in young soils indicates that they can form relatively quickly, also being favoured in north-facing sites (Egli et al. 2010).

The formation of these horizons undoubtedly contributed to the preservation of the archaeological record. The umbric epipedon, in fact, becomes thicker when it encounters topographic depressions, as it is the case for site SA 42, and is favoured by specific climatic conditions. The soils here have a udic moisture regime (soil is not dry in any part for as long as 90 cumulative days per year), which ensures a good water availability during the vegetative cycle even in the case of soils with low water reserve. Furthermore, the cryic regime of soil temperature (mean annual temperature < 8°C with no permafrost) hinders the mineralisation of organic substance during some periods of the year and contributes to its accumulation.

The area is currently formed by high-altitude alpine grazing (Nardetum) (top soil). There are frequent degradation patterns caused by over grazing (Morandi 2013), with the formation of characteristic patterns from cross trampling and sheet erosion. The depth of the soil is medium in this area, and the main process is podzolization (Zilioli et al. 2011).

Finally, SU 8a-b, is the reworking of the stratification caused by trampling and intensive grazing, particularly along the border fence between the provinces of Trento and Bolzano. The unit extends for a maximum width of 1.30 metres in a E-W direction, has a maximum thickness of 3 cm, and affects the topsoil up to the roof of the Mesolithic stratification.

The installation of the fence between the two provinces in the 1980s triggered the erosion of the whole northern sector of the site, including the area of SUs 20 and 21 fire structures.

This erosion has caused a loss in the spatial representation of artefacts compared to the original distribution. In fact, the artefacts recovered on the surface in the area corresponding to these structures amount to 1101 and, thus, it can be inferred that the spatial clustering is underestimated compared to the original one. In contrast to this area, the portion south of the fence maintains an almost undisturbed stratification, only subject to post-depositional modifications that have reworked the position of artefacts mainly in a vertical sense (see also par. 3.6).

In the northern area, the original Mesolithic living floor is not extensively preserved, but only the fillings of the combustion features (SUs 10 and 39), part of their charcoal scatter (SU 10 low concentration and very low concentration) and the filling of the erosion (SU 99) were identified. While in the southern area the erosion had a smaller impact and it was possible to recognise lenses of living soil, even if limited in extension (SUs 65C-D, 66, 67, 77, 78=82, 83, 83A). It can be assumed that frequentation occurred on the organic horizon at the top of SU 13. For this reason, it was not possible to recognise exactly the starting level for the post holes related to the various structures identified (palisade 1-Pal1, dwelling structure-DS). On the other hand, the development of SUs 38 and 48 (umbric epipedon) made possible the preservation of the stratification by largely covering the original anthropic settlement units.

Archaeological micromorphology

A total of 6 thin sections were analysed, belonging to the SU 13 substrate, the combustion features SU 20, 21, 83A, and the dump unit SU 94 (Figure 5,) (Tab. 2).

***Tab. 2**: List of micromorphological samples. / Elenco dei campioni micromofologici.*

n.	Sample	coordinates	SUs
1	SA 42 US 10-13	200/101 - h	10vhc, 13
2	SA 42 US 39-1	200/100 - h	13, 39
3	SA 42 US 39-2	200/100 - e	13, 39
4	SA 42 US 39-3	200/100 - e	13
5	SA 42 US 83A	202/96 - e	83A
6	SA 42 US 94	199/102 - h	94

The soil predating the occupation had formed on the alteration products of the basaltic hyaloclastite (SU 79) (Wengen formation, late Ladinian) that make up the substrate of the site (SU 13). At the microscopic level, the coarse components comprise rock fragments, euhedral and subeuhedral clinopyroxene (augite) crystals, subangular particles of basaltic glass and palagonite. The groundmass is dominated by sand-size glassy particles made of palagonite, a primary product of the alteration of volcanic glass (sideromelane). The formation process of palagonite is still being defined, but many authors agree on a genesis from ambient-temperature microsolution-reprecipitation process of basaltic glass following submarine eruption (Stroncik & Schimcke 2002; Sedov et al. 2010). On thin section, the groundmass of SU 13 (UP 5, pre-mesolithic paleosol) has a light yellow colour and a very low refractive index. It can be divided into an optically isotropic, crystal free, concentrically banded variety (gel-palagonite) and a weakly to strongly anisotropic variety with a fibrous or granular structure (fibro-palagonite). The pedogenetic process further altered the volcanic glass into palagonite-like products by forming alteromorphic compounds (allophane and imogolite) that locally give an undifferentiated b-fabric to the crystallitic micromass (crystallytic b-fabric).

Microstructure is lenticular with an intrapedal granular structure and chito-enaulic related distribution pattern (chitonic-single spaced equal enaulic). The origin of the granular microstructure is most probably not to be attributed to intense mesofauna activity. As usually observed in Andosols (Stoops 1983; Stoops & Gérard 2004), i.e. soils that develop on volcanic sediments (Stoops et al. 2008), this microstructure seems to be rather related to the composition of the colloidal fraction that is resistant to freeze-thaw cycles and survives within the lenticular peds. In the 8Bsb horizon related to SU 13 (UP 5, pre-Mesolithic palaeosol), this phenomenon led to the formation of coatings on the coarse elements and of silty-clay capping with no specific orientation (Van Vliet-Lanoë 2010). Other characteristics specific to freeze-thaw phenomena, such as verticalised or uplifted stones and the formation of vesicular microstructure are absent or poorly represented. This absence may be due to the coarse texture of the parent material that gives good drainage to the soil.

In general, Holocene pedogenesis is influenced by freeze-thaw phenomena, leaching, strong accumulation of organic matter and biological activity.

Within the anthropogenic filling sequence of the erosive linear depression SU 99, SU 94 was analysed (Tab.2). Dumping is identified by complex packing voids and coarse/fine related distribution with fine material in the form of microaggregates interspersed with coarser (enaulic) components. This structure reflects the disaggregation and reworking of the original material taken from combustion features (probably SU 21 or SU 20). Freeze-thaw cycles are highli-

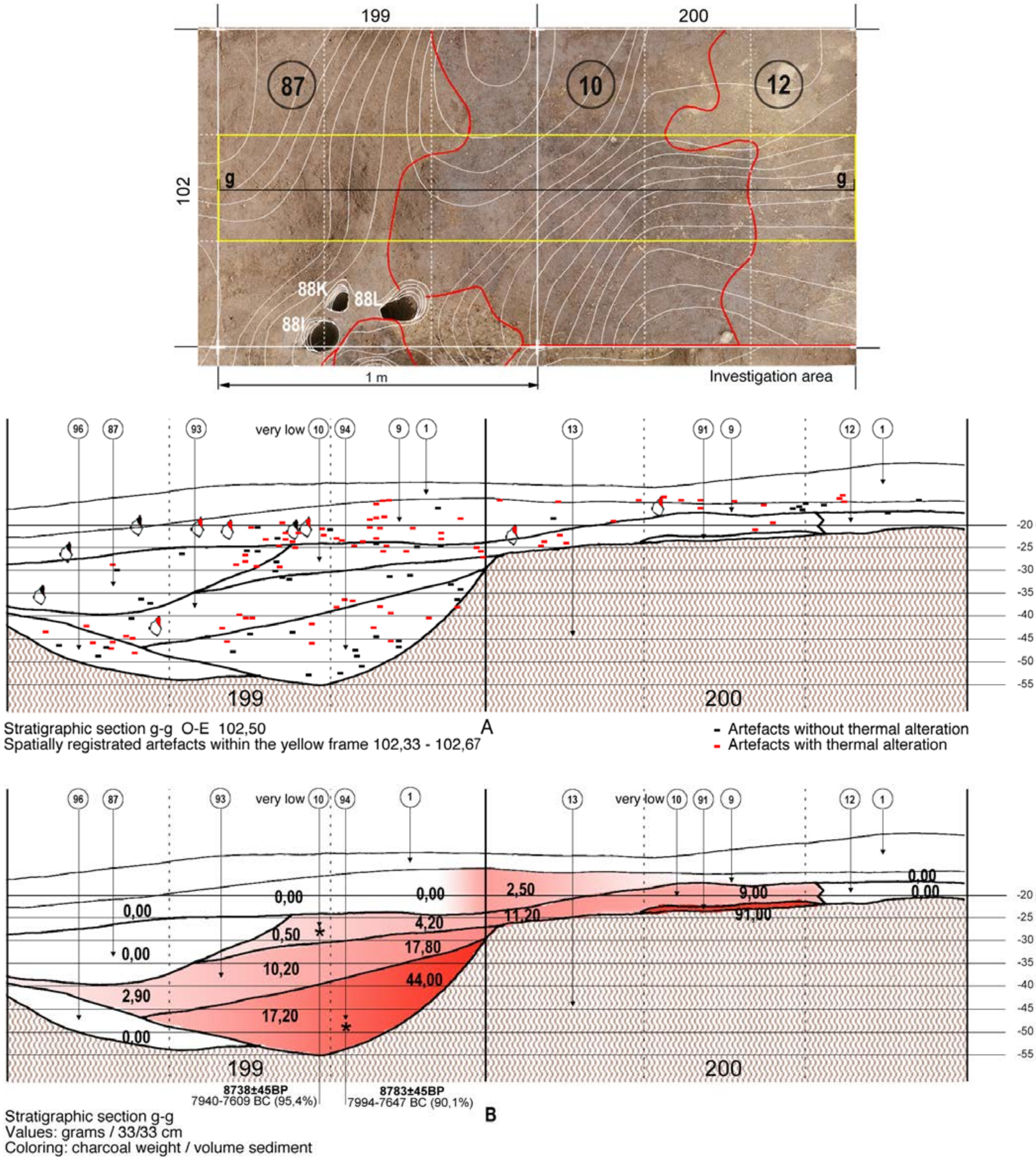


Fig. 11*: A: Vertical distribution of spatially recorded artefacts. B: vertical distribution of charcoals separated during sieving. / Dispersione verticale dei manufatti registrati spazialmente. B: dispersione verticale dei carboni identificati in fase di vaglio.*

ghted by a complex microstructure made up of crumbs with high porosity associated with lenticular peds and silt capping-like coating (Van Vliet-Lanoë 2010). The sandy fraction is composed of approximately 50% unaltered pale yellow glassy particles which stand against the thermally altered brownish to orange ones (see par. 3.4). This composition identifies heated sediment coming from hearths (probably SU 21).

Within combustion feature SU 21, the SU 10 very high concentration subunit was analysed including the upper few centimeters of the substrate (SU 13) (Tab. 2). The contact with the substrate is abrupt and no thermal alteration of the substrate or chromatic zonation or rubification effect is visible. The predominant coarse/fine related distribution is characterised by larger fabric units with random orientation and distribution patterns (subangular clinopyroxenes, palagonite and basaltic glass) in a brown silty-clay groundmass (porphyric single spaced).

The analysed sample contains a large quantity of charred remains. In particular, well-preserved coniferous wood charcoals, often centimetric in size, which at places reach up to 50% of the groundmass are present. They show random orientation and distribution patterns. Charcoals with holes of lignivorous insects, the occurrence of fungal hyphae and charred fungal sklerotium show that the wood

***Tab. 3**: Main micromorphological characteristics. / Principali caratteristiche micromorfologiche.*

Thin section	Units	Microstructure	Porosity	Coarse components	Fine material	Groundmass: c/f related distribution pattern	Groundmass: b-fabric	Organic Components	Pedofeatures
SA 42 US 10-13	10 vhc	Primary: granular (fine sand size), weakly separated and weakly developed; secondary:Lenticular highly separated and well developed with accommodating fine peds (<2 mm)	Accommodating planes, compound packing voids, few transpedal channel	Subangular clinopyroxenes (augite); subangular brownish to orange (70% sand fraction) and pale yellow palagonite (30% sand fraction), subangular brownish basaltic glass,	Brownish silty-clay	c/f63µm 30/80, double spaced equal enaulic/ single spaced porphyric	Stipple speckled locally undifferentiated	Abundant dark to opaque tiny particles <100µm (burnt organic matter) (30%), charcoal (25%, <1cm), polymorhic organic matter with tissue fragments (30%), charred fungal sklerotium, fresh roots residues	Top: silt coating on grains and charcoals. Bottom: brownish impure clay coating on coarse components and voids
	13	Primary: granular (medium to coarse sand size) moderately separated and well developed; secondary: lenticular poorly separated weakly developed with unaccommodating medium peds (2-5 mm)	Complex packing voids, planes	Subangular clinopyroxenes (augite); subangular yellow palagonite	Yellowish silty clay non crystalline components (allophane)	c/f63µm 20/80, chitonic -double spaced equal enaulic	Stipple speckled locally undifferentiated	Fresh roots residues	Silty clay coating on coarse components, link capping on aggregates
SA 42 39-1	39	Primary: granular (fine sand size), weakly separated and weakly developed; secondary:Lenticular highly separated and well developed with accommodating fine peds (<2 mm)	Accommodating planes, compound packing voids, few transpedal channel	Subangular clinopyroxenes (augite); subangular brownish to orange (30% sand fraction) and pale yellow palagonite (70% sand fraction), subangular brownish basaltic glass,	Yellowish and brownish silty clay	c/f63µm 30/80, double spaced equal enaulic/ single spaced porphyric	Stipple speckled locally undifferentiated	Abundant dark to opaque tiny particles <100µm (burnt organic matter) (20%), charcoal (15%, <1cm), polymorhic organic matter with tissue fragments (30%), fresh roots residues	Silt coating on grains and charcoals
SA 42 39-2; SA 42 39-3	13	Primary: granular (medium to coarse sand size) moderately separated and well developed; secondary: lenticular poorly separated weakly developed with accommodating medium peds (2-5 mm)	Complex packing voids, planes	Subangular clinopyroxenes (augite); subangular yellow palagonite	Top: orange to brownish silty clay. Bottom: yellowish silty clay	c/f63µm 20/80, chitonic -double spaced equal enaulic	Stipple speckled locally undifferentiated	Fresh roots residues	Silty clay coating on coarse components, link capping on aggregates
SA 42 US 94-3	94	Primary: crumb (medium to coarse sand size), moderately separated and well developed; secondary: lenticular platy highly separated and well developed with accommodating coarse peds (5-10 mm)	Complex packing voids, few transpedal channel	Subangular clinopyroxenes (augite); subangular brownish basaltic glass, subangular brownish to orange (50% sand fraction) and pale yellow palagonite (50% sand fraction)	Brownish silty-clay	c/f63µm 20/80, chitonic-single spaced equal enaulic	Stipple speckled locally undifferentiated	Charcoal (5%, <1cm), polymorhic organic matter with tissue fragments (10-30%), fresh roots residues	Non laminated silt capping and link capping on grains and aggregates, silt coating on grains and charcoals
SA 42 US 83A	83A	Primary: crumb (medium to coarse sand size), moderately separated and well developed; secondary: lenticular highly separated and well developed with accomodating coarse peds (5-10 mm)	Complex packing voids, few transpedal channel with fresh roots	Subangular clinopyroxenes (augite); subangular brownish basaltic glass (40% sand fraction) yellow palagonite (60% sand fraction)	Brownish silty-clay	c/f63µm 20/80, chitonic-single spaced equal enaulic	Stipple speckled locally undifferentiated	Charcoal (10%, <750µm), polymorhic organic matter with tissue fragments (5%), fresh roots residues	Non laminated silt capping and link capping on grains and aggregates, loose continuous microgranular infillings, silt coating on grains and charcoals

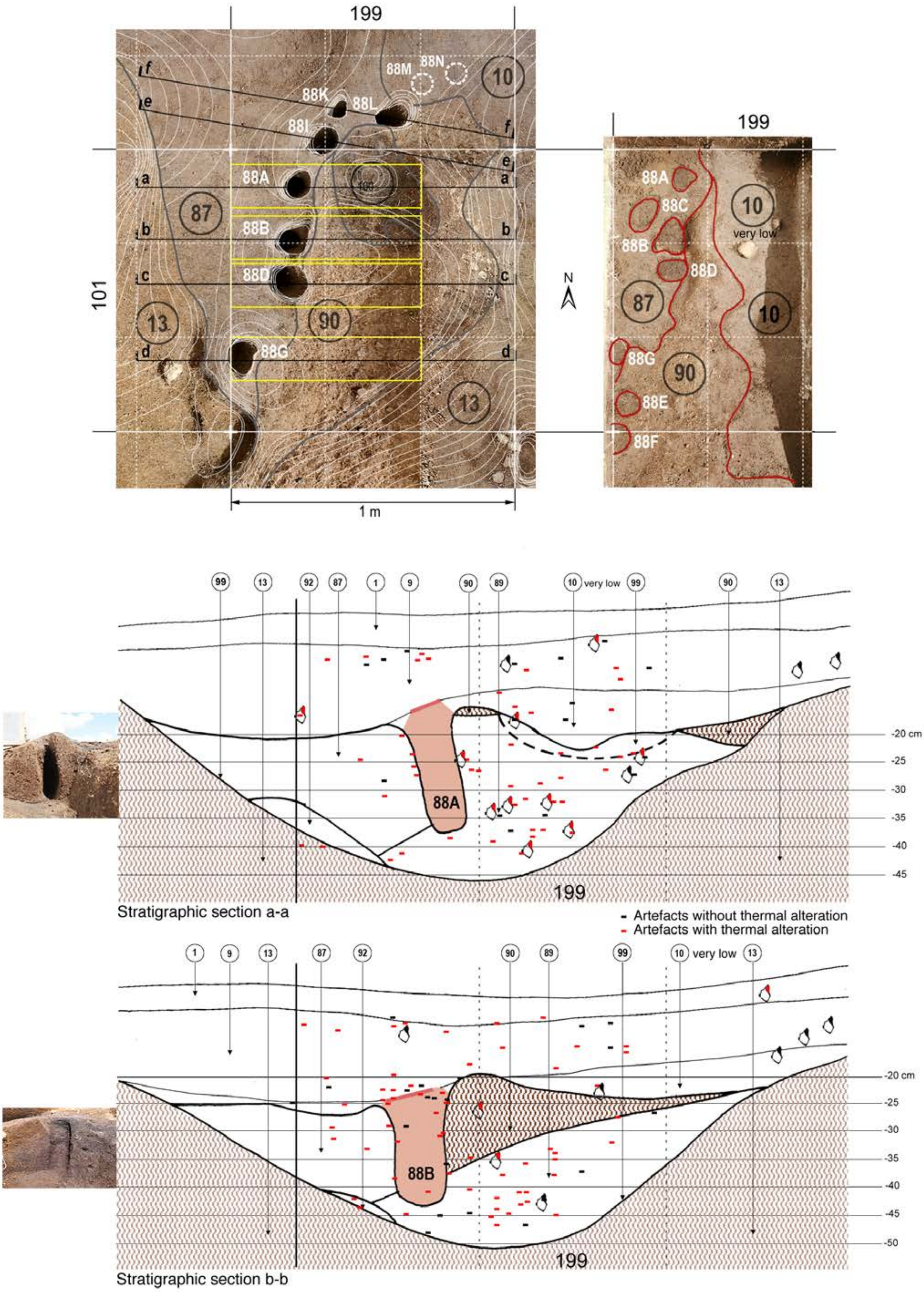


Fig. 12: , Stratigraphic sections: vertical distribution of plotted artefacts within the yellow frames corresponding to SUs 88A, 88B. / *Sezioni stratigrafiche: dispersione verticale dei manufatti registrati spazialmente e situati all'interno delle linee gialle corrispondenti alle UU.SS 88A, 88B*

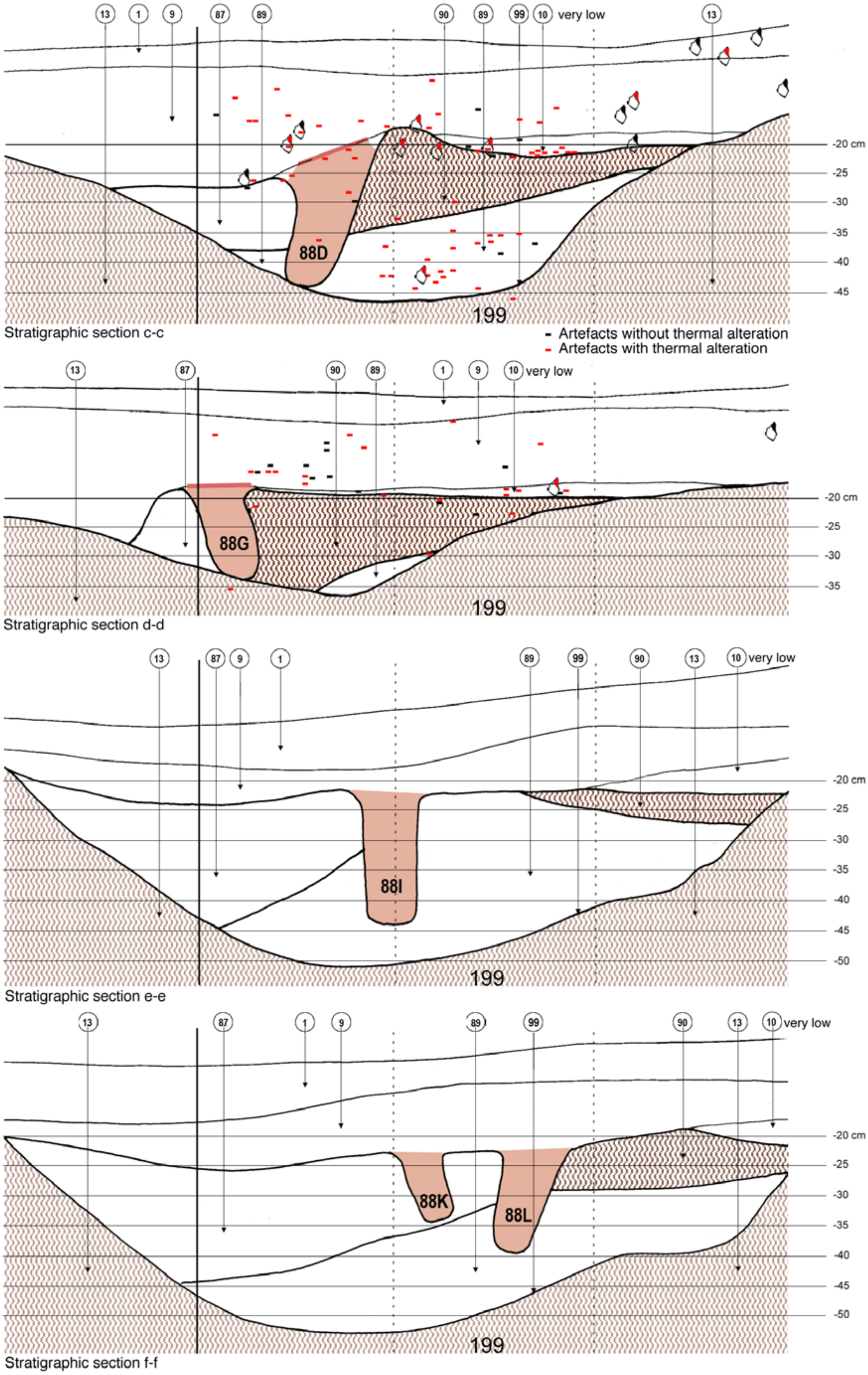


Fig. 13: Post holes stratigraphic sections SUs 88D, 88G, 88I, 88K, 88L e vertical distribution of plotted artefacts within the yellow frames corresponding to SUs 88D, 88G. (see fig. 12) / Sezioni stratigrafiche dei buchi di palo UU.SS 88D, 88G, 88I, 88K, 88L e dispersione verticale dei manufatti registrati spazialmente situati all'interno delle linee gialle UU.SS 88D, 88G. (vedi fig. 12)

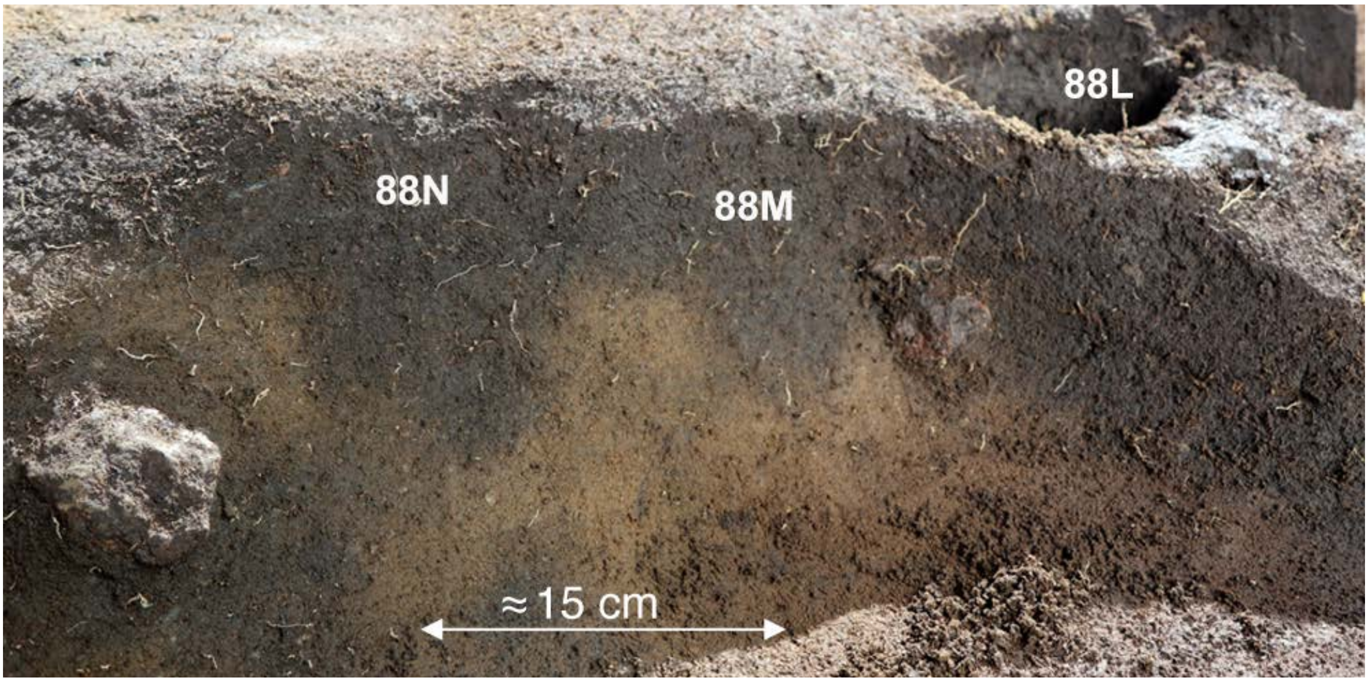


***Fig. 14**: Detail of the cross section through the post holes SUs 88M, 88N. / Dettaglio della sezione trasversale dei buchi di palo UU.SS 88M, 88N.*

employed as fuel is exclusively partly decomposed coniferous wood probably gathered from the ground . Phytoliths from the combustion of herbaceous plants were not observed. Charcoal fragments of smaller size (<1mm) show evidence of deterioration by humification after combustion, such as a rounded shape and an internal cell structure combined with opaque outer rim.

Some opaque masses of extremely vesicular appearance were identified and interpreted as wood tar or fat-derived char fragments, which may result from a pyrolysis process under reducing conditions.

Micromass is formed by abundant dark to opaque tiny particles (<100µm) (30%), tabular and blocky in shape, that can be interpreted as vegetal tissue fragments associated with microcharcoal. Among the burnt components are glassy mineral particles (palagonite) varying in colour from brownish to orange. They account for 70% of the sandy fraction against the light yellow unaltered palagonite of the SU 13 substrate. The turning in colour is presumably caused by varying degrees of thermal alteration of the glass particles (Figure 18a-b).

The well-developed lenticular microstructure as well as the leaching of impure clay coating on coarse components and voids, concentrated on the basal interface, fit in the dynamics of frost affected soils (Van Vliet-Lanoë 2010).

To summarize, although postdepositional processes (cryoturbation, biological activity, ash dissolution under acidic conditions) have diminished the possibility of understanding the function of the SU 21 combustion structure, it is still possible to state that the charcoal found in this structure is in a secondary position, i.e: it was taken from an external hearth and placed as embers in the pit together with sediment. Furthermore, the presence of unburnt (yellow) glassy granules could indicate the addition of sandy sediment taken from the substrate SU 13 during the different activity phases of the structure.

The combustion temperature reached by the orange and brown volcanic glass particles cannot be determined without dedicated experiments to analyse their mineralogical changes. Reddening of the iron-bearing soils and sediments is due to the oxidation of Fe^{2+} to Fe^{3+} and/or to the loss of water in iron hydroxides and, in this regard, experiments have demonstrated that the onset of reddening occurs at approx. 250 °C, (Berna et al. 2007) and weak reddening features are visible at 600 °C (Röpke & Dietl 2017). However, the maximum temperature reached must have been below 1200 °C, which corresponds to partial basalt melting (Baitinger & Kresten 2012). At this temperature, vitrification and partial melting begins (Röpke & Dietl 2014) and such phenomena have not been observed in our thin sections.

We hypothesise that fire was not lit in this structure and that it was rather used as a brazier. According to Beeching and Gasco's definition, a brazier is a hollow structure, generally small, where burnt residues are concentrated away from the place of production. SU21 perfectly fits this definition. Structures interpreted as braziers but also preserving thermally altered stones were individuated in the Mesolithic sites of Roc de Dourgne (Fontanès-de-Sault) (Beeching & Gasco 1989), Choisy-au-(Oise) (Valentin & Ducrocq 1993) e Saint-Louis (Geay, Charente-Maritime) (Foucher et al. 2000). The use of these structures simultaneously to the hearths made it possible to infer that their function was related to food cooking (Foucher et al. 2000). Structure SU 21 is comparable with the "Mesolithic pit hearths" (Huisman 2019). Those pits are characterized by a carbonaceous filling but lack rubification and their function is still strongly debated (Crombe et al. 2015; Huismann et al. 2020). More accurate information about the function of SU 21 may come from the taphonomic study of its charcoals and by a comparison with those of hearth SU 20 (Henry, Théry-Parisot 2014).

From hearth SU 20, the filling SU 39 and the contact with the SU 13 interface were analysed. The micromorphological characteristics of the filling) are very similar to those of SU 10 very high concentration, except for a lower presence of burnt components in the groundmass, including brownish and orange glassy mineral particles representing only 30% of the sandy fraction.

In addition, the combustion substrate at the roof of SU 13 was recognised. This is characterised by weak rubification and by the concentration of abundant burnt organic matter particles. In particular, a gradual change in the colour of the glassy crystals from yellow, typical of unaltered SU 13 crystals, to brownish, around the contact with SU 39, can be observed from the bottom upwards.

During excavation, SU 83A (Tab. 2) was interpreted as a hearth. Microscopic analysis leads to relate this unit to a hearth dump. This mostly because of the absence of a combustion substrate. This unit is characterized by the low concentration of charcoal fragments (10%) and by the presence of a sandy fraction composed mainly of glassy particles with no thermal alteration (60%) (Figure 18c). In general, micromorphological characteristics of this unit are like those of SU 94, i.e: the filling of the SU 99 erosional depression. Also in

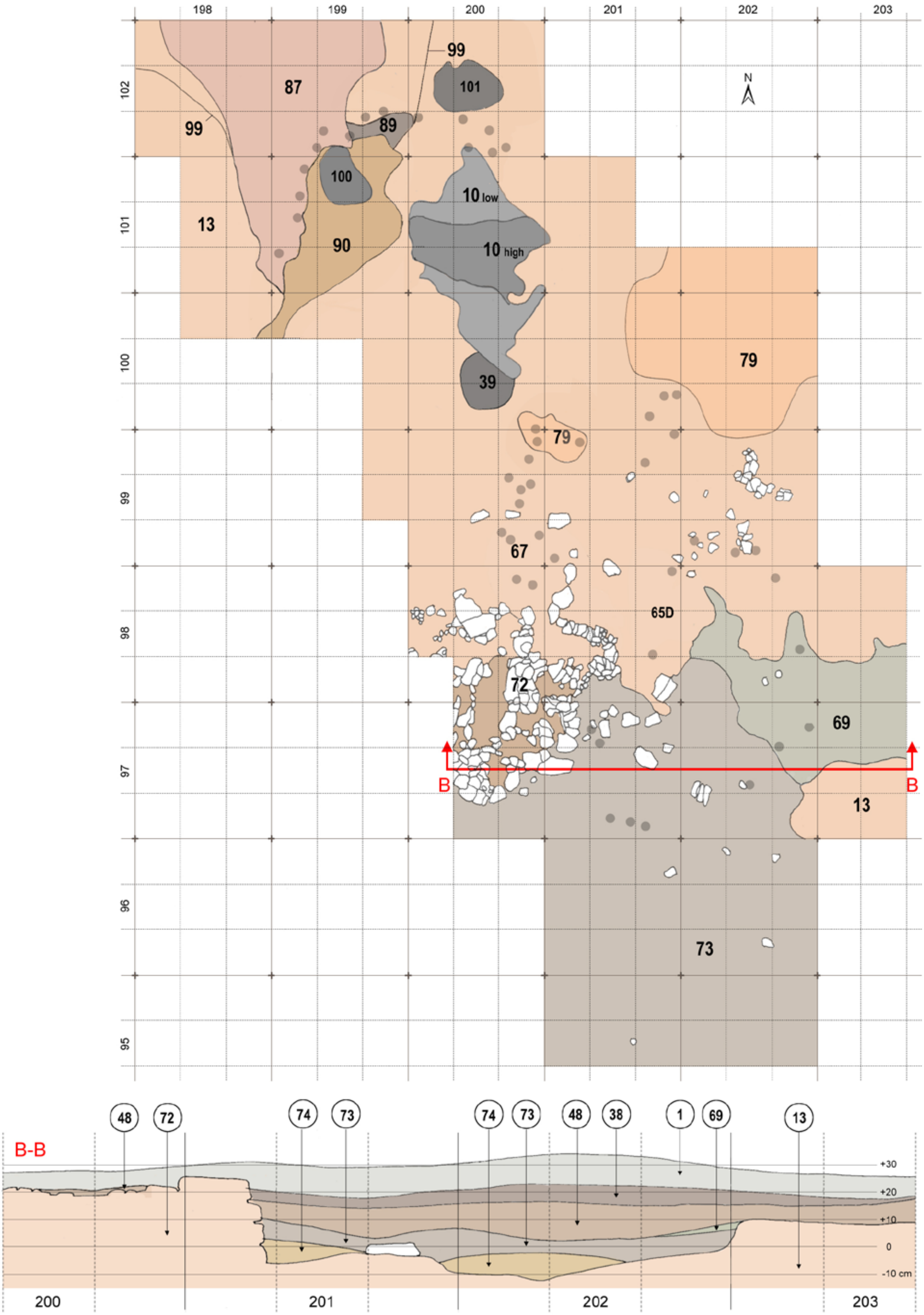


Fig. 15: Excavation area with the SUs 13, 72, 79, 99 (PU 5), 10 high concentration and low concentration, 39, 87, 89, 90, 100, 101 (PU 4), 73 (PU 3), 69 (PU 2). Grey dots: localized post holes. Stratigraphic sections F-F and G-G showing the corresponding SUs. / Area di scavo con le UU.SS 13, 72, 79, 99 (UP 5),10 concentrazione alta e bassa, 39, 87, 89, 90, 100, 101 (UP 4), 73 (UP 3), 69 (UP 2). Pallini grigi: buche di palo identificate. Sezioni stratigrafiche F-F, e G-G che evidenziano le corrispondenti UU.SS.

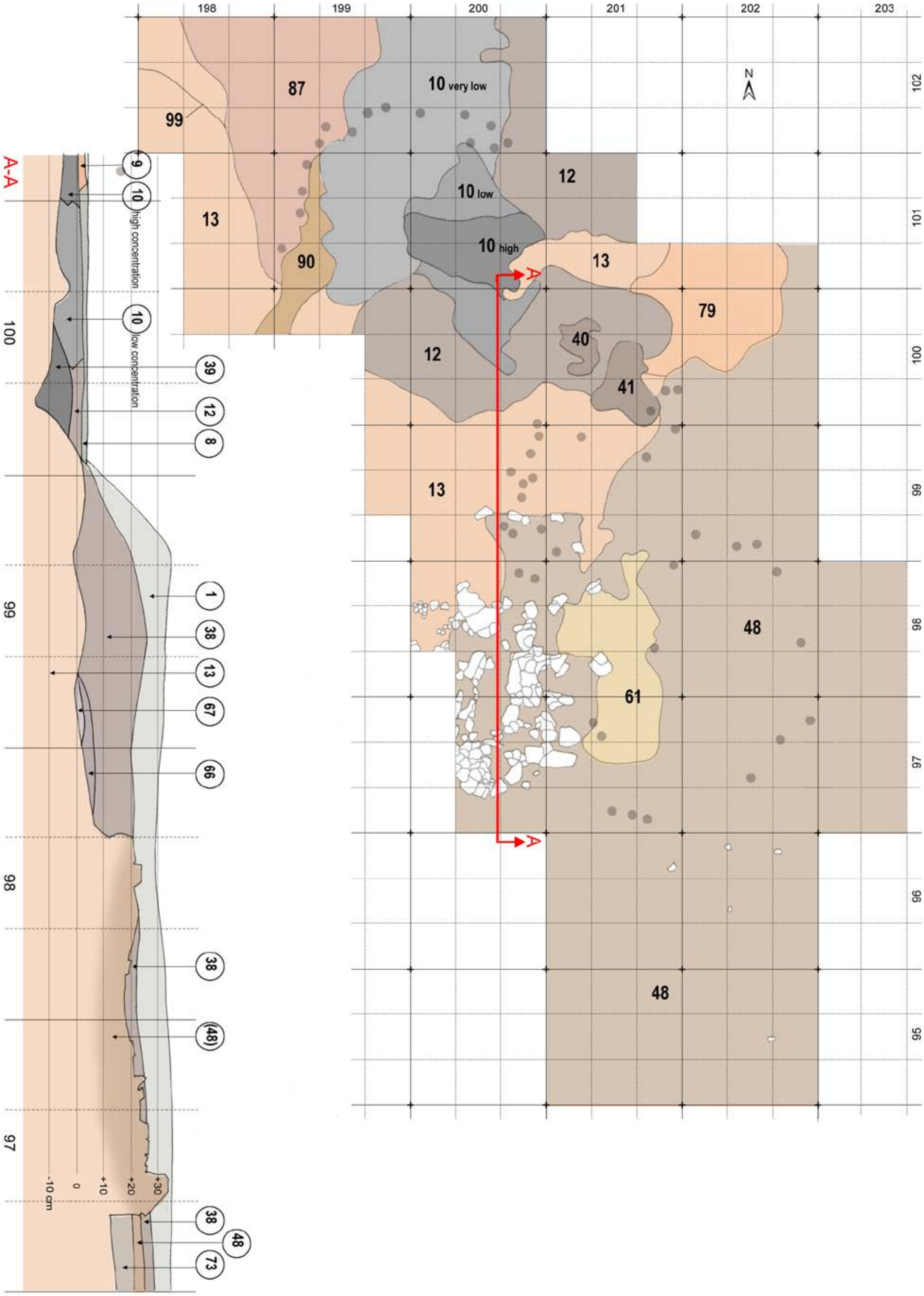


Fig. 16: Excavation area with the SUs 13, 79, 99 (PU 5), 10 low concentration and very low, 87, 90 (PU 4), 48 (PU 2), 12, 40, 41, 61 (PU 1). Grey dots: localized post holes. Stratigraphic section A-A showing the corresponding SUs. / Area di scavo con le UU.SS 13, 79 (UP 5), 10 bassa e molto bassa concentrazione, 87, 90 (UP 4), 48 (UP 2), 12, 40, 41, 61 (UP 1). Pallini grigi: buche di palo identificate. Rettangoli rossi: campioni di suolo; Sezioni stratigrafiche A-A che evidenziano le corrispondenti UU.SS.

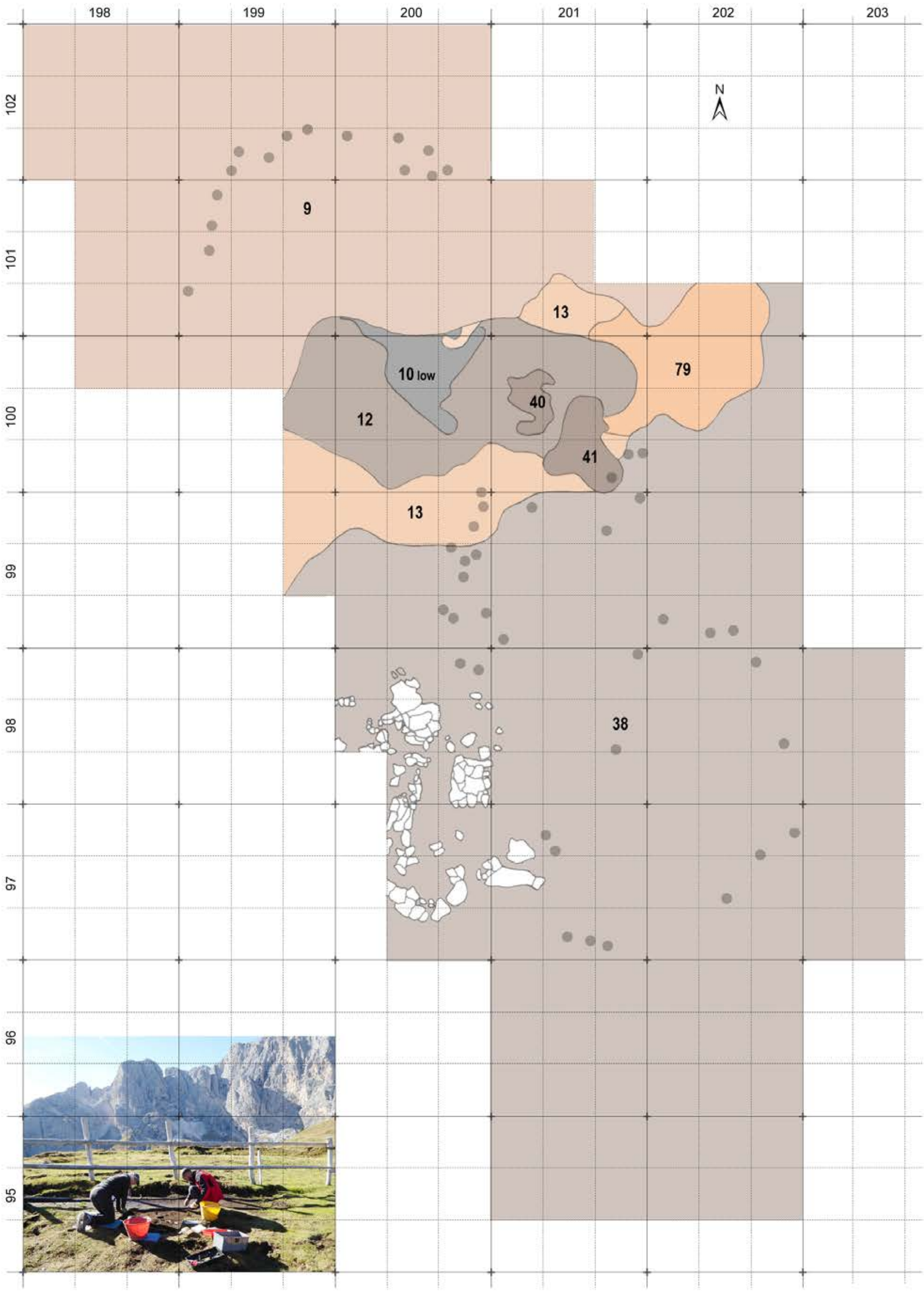


Fig. 17: Excavation area with the SUs 13, 79 (PU 5), 10 low concentration (PU 4), 9, 12, 38, 40, 41 (PU 1). Grey dots: localized post holes. / Area di scavo con le UU.SS 13, 79 (UP 5), 10 bassa concentrazione (UP 4), 9, 12, 38, 40, 41 (UP 1). Pallini grigi: buche di palo identificate.

this case, the post-depositional processes are due to freeze-thaw cycles, which result in a complex microstructure consisting of high porosity crumbs associated with lenticular ped and silt capping-like coatings (Van Vliet-Lanoë 2010) (Figure 18d).

Post holes

A total of 49 post holes were recorded. Most of the holes are circular depressions with a depth between 2 and 23 cm and have been interpreted as 'impressions' left by wooden posts (post-pipes). All the structures lack the typical 'packing' of the supporting posts. Their morphometry, the content of the filling and the stratigraphic relationships rule out their interpretation as bioturbation (burrowing or roots) phenomena, a type of evidence which was in other cases well recognized and isolated during excavation (Figures 20-21).

Their filling is always characterised by a sediment with higher organic content than the embedding unit and their presence was ascertained also on the SU 13 substrate. In the sections (Figures 12-14, 22-23), the starting level of the post hole is highlighted with a red line. The fillings of 25 holes contained the remains of burnt wood and in three of them (SUs 45, 50, 51) fragments of branches, were also documented. Wood charcoals from 18 post holes were identified by the ARCO Cooperativa di ricerche archeobiologiche, Laboratory of Archaeobiology of the Musei Civici di Como. Represented species are almost exclusively larch (Larix decidua), spruce (Picea excelsa) and Scots pine/mountain pine (Pinus sylvestris/mugo, the two species cannot be distinguished based on wood anatomy) and stone pine (Pinus cembra) (Tab. 4).

The post holes in the central area of the site (palisade1 - Pal1)

Two groups are recognisable: the first one consisting of 14 holes (SUs 45/1, 45/2, 49, 50, 51, 52, 53, 63, 64b, 64f, 64e, 64f, 64c, 64d) is elongated in a N-S direction for a length of 115 cm; the second one consisting of 5 pits (SUs 70A, 70B1, 70B2, 70B3, 70E) is approximately 40 cm E from the northern limit of the first group. The depth of the holes ranges from 2.5 to 6.5 cm and their diameter varies from 4 to 12 cm (Tab. 3). In plan, they are circular to elliptical in shape, the walls are flared, mostly with a V- and U-shaped profile. Incline with respect to the vertical is most of the times between 80° and 90°. Fragments of branches with a diameter of 14 mm, 31 mm and 21 mm respectively have been found in the fillings (SU 45, SU 50, SU 51) (Figs. 21, 22).

They can be interpreted as related to a lattice made from conifer branches for protection against the wind (wind break). The wind also today constantly blows from the NNW. Ethnographic comparisons also suggest a possible use for drying the hunted animals during the period of permanence at the site (Binford 1978, 1980, 2002).

The post holes in the southern area of the site (dwelling structure - DS)

The set of post holes recorded in this area forms an ellipse with a long axis, oriented NE-SW, approx. 2.30 long, and a short axis measuring 1.35 m. A total of 15 post-holes are recognisable (SUs 70C, 70D, 70G, 70F, 71C1, 71C2, 71D, 71E, 71F, 71G, 71H, 71I, 71K, 71L), varying in depth from 2.5 to 6.5 and in diameter from 3.5 to 11 cm. The shape of the pits ranges from circular to elliptical, with a concave bottom and flared walls with a generally V- and U-shaped profile (Figures 21-23). Incline is comprised between 57° to 90° (Tab. 3). It is considered reasonable to interpret this group of post-holes as the trace of a dwelling structure, such as a tent or hut. The reconstruction only considered the recorded post holes; other shallow topographical depressions were not included.

According to this hypothesis, the shelter must have been constructed by inserting curved conifer branches into the ground as to form a dome-shaped interlaced dwelling structure. No fire lighting activity is documented within the dwelling structure. Small spaces devoid of lithic artefacts are recognisable inside the perimeter, which could represent covered areas or sleeping areas. The opening was hypothesised to be to the NW where there is a significant cluster of microburins. The space in front of the 'entrance' is limited to the NW by palisade 2 and to the W by the rock outcrop.

To the south of the hut, there is a knapping area mainly specialised in the production of blades, bladelets and flakes, documented by the significant number of cores and by the cluster of artefacts unaltered by fire and generally big sized. This area is also well protected from the wind by both the small relief created by the rock outcrop and the barrier formed by the dwelling structure.

	SU	mean diameter	depth	vertical > 80°	oblique < 80°	charcoal	wood				^{14}C datings
Northern aera	88A	7,0	23,0	85°							
	88B	9,0	20,5	88°							
	88D	9,0	24,0		75°						
	88G	8,0	16,0		72°						
	88I	8,5	22,0	90°							
	88K	6,0	12,0		72°						
	88L	8,0	18,0		74°						
Central aera	45/1					+	⊠			Carbonized piece of wood Ø 14 mm	
	45/2					+					
	45/3					+					
	49	5,0	12,0			+	⊠	⊡			
	50	4,0x12,0	9,0		63°	+	▲	⊠	⊡	Carbonized piece of wood Ø 31 mm	8013-7740 BC cal
	51	4,0	8,0	84°	80°	+	⊠	●	◆	Carbonized piece of wood Ø 21 mm	
	52	5,5	11,0	84°		+	⊠				
	53	6,0	9,0	86°		+	⊡				
	63	5,0	5,0	90°		+	⊠	⊡	□		
	64B		3,5			+	⊡	□			
	64C	6,0	10,0		60°	+	▲	⊠			
	64D		2,0			+	⊠				
	64E	9,0	7,0		79°						
	64F	5,0	6,0		78°						
	70A	5,0	7,5	85°		+					
	70B1	6,0	8,0	90°		+	▲	⊠			
	70B2	4,5	6,0	90°							
	70B3	10,0	11,0		65°	+					
	70E	7,0	11,0	82°		+	▲	△	⊠		8572-8311 BC cal
Southern area	70C	7,0	6,5		67°	+	▲				
	70D	7,0	6,0		67°						
	70F	5,0	3,5	85°							
	70G	11,0	4,0		70°	+	▲	△	⊠		7585-7445 BC cal
	70H	6,0	4,0	82°							
	71C1	4,0	4,5	85°							
	71C2	8,0	5,5	90°		+	▲				
	71D		5,0			+	▲	△	⊠		7476-7125 BC cal
	71E	7,0	5,5		57°						
	71F	4,0	2,5	90°							
	71G	3,5	3,5		75°						
	71H	10,0	5,5	90°		+					
	71I	7,0	5,0	90°		+					
	71K	10,0	5,0	90°		+					7787-7568 BC cal
	71L	10,0	4,0	85°		+					

▲	Picea excelsa	△	Larix decidua	▲△	Picea/Larix	⊠	Pinus sylvestris mugo
⊡	Pinus cembra	□	Pinus n.d.	◆	Conifero	●	Latifolia

Tab. 4: Morphometric characteristics of post holes and associated plant macro-remains. / Caratteristiche morfometriche delle buche di palo e macroresti vegetali associati.

The post holes in the north-west area of the site (palisade 2 - Pal2)

Nine post holes have been recorded in this area. The traces identified in this part of the excavation area have a varied typology. In particular, 6 post holes are regularly arranged and aligned in a NNE-SSO direction (SU 88A-B-D-G-I-K) for a length of 1 m, while the seventh, at the N end, is offset by 15 cm to he E, forming a right angle (SU 88L) (Figures 12, 13).Unlike the other holes identified in the southern and central area (palisade 1), these are deeper, show a cylindrical profile with a concave bottom and sub-vertical walls, a circular diameter of 6 to 9 cm and a maximum depth varying from 12 to 23 cm (Tab. 3). Incline varies from 72° to 90°. A further alignment of 2 shallow holes (SUs 88M-N) is located immediately E of SU 88L.

The post holes were dug from the top of the anthropogenic filling sequence of the SU 99 erosional channel (SU 87), which contains dumps probably originated from the combustion features SUs 20 and 21 (see paragraph 3.4). The E side of the palisade is marked by the anthropic soil spreading SU 90, which probably had a structural function.

In the filling of these holes the charred remains are quite scarce and consist of isolated tiny fragments associated with a few lithic artefacts.

The structure as a whole may have been used as a vertical wooden frame for processing hunted animals and/or as a wind-breaker.

A further clustering of 5 shallow holes of uncertain interpretation is located in quadrants 200/102 h-i.

Combustion features

The term "combustion features" refers to any features in an archaeological site that contains the physical evidence of fire (charcoal, ash, heated sediments etc., Mallol et al. 2017).

SU 21 is a shallow excavation dug at the top of SU 13. Burnt residues fill this depression. Its shape is irregularly elliptical, the bottom is flat, slightly undulating and the walls inclined. The long axis is 100 cm in length and is oriented along a NNW-SSE direction, the short axis is 50 cm, the maximum depth 10 cm. It is unclear whether the elongated shape derives from a single excavation phase or from a remaking of the structure over time.

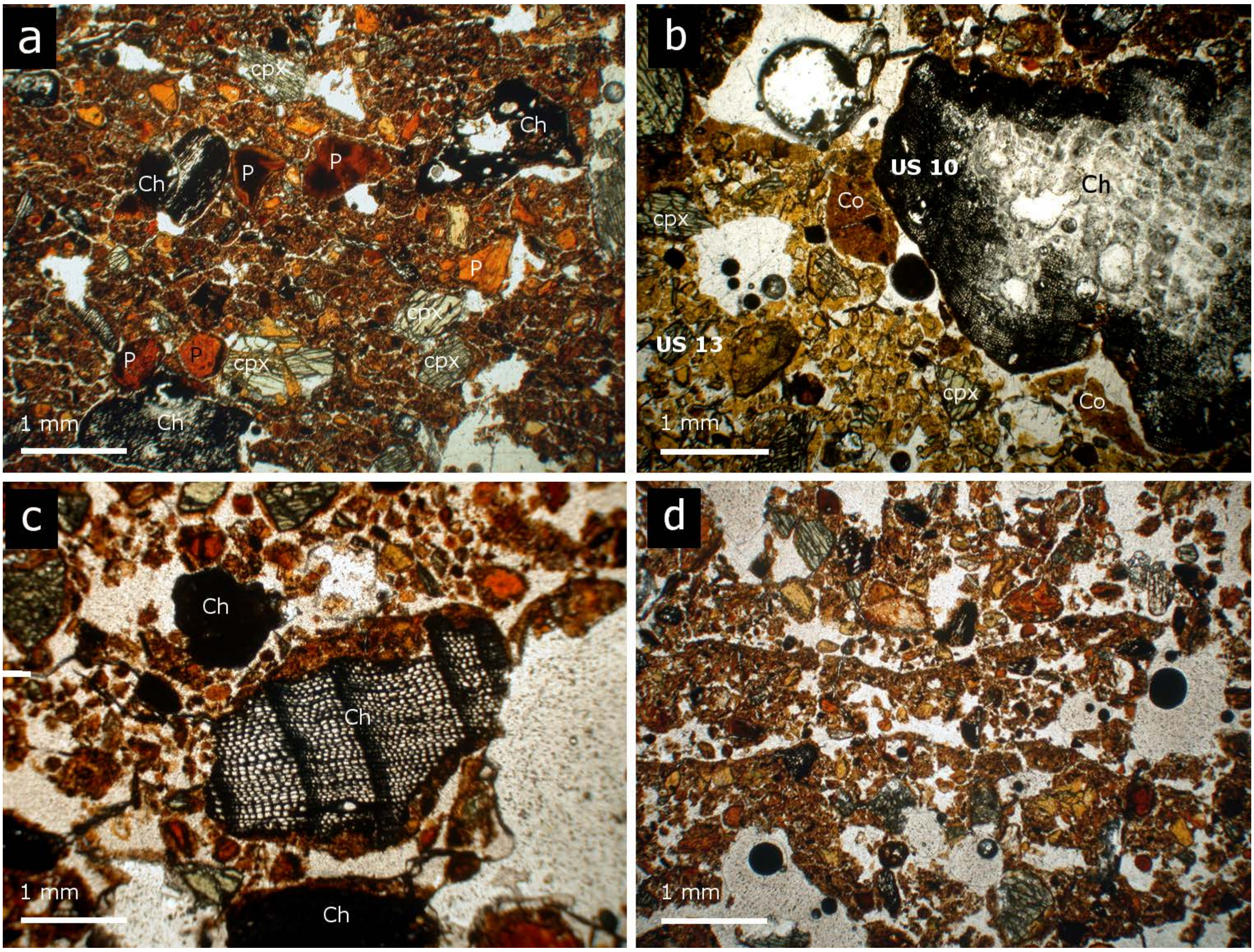


Fig. 18: a) Micrograph from SU 10vhc (SA42 US 10-13, PPL, plane-polarized light, 20X). Brownish silty-clay granular microstructure with coarse components (cpx: clinopyroxenes; P: subangular brownish to orange palagonite, Ch: charcoal). b) Micrograph from top of US 13 and bottom of SU 10 vhc (SA42 SUs 10-13, PPL, plane-polarized light, 20X). Yellow granular microstructure with coarse components from SU 13 (cpx: clinopyroxenes). Charcoal fragments from SU 10 (Co: impure clay coating containg dark to opaque tiny particles). c) Micrograph from SU 83A (SA42 US 83A, PPL, plane-polarized light, 20X). Charcoal fragments with silt coating (Ch). d) Micrograph from SU 94 (SA42 US 94-3, PPL, plane-polarized light, 20X). Lenticular microstructure. / a) Micrografia di US 10vhc (SA42 US 10-13, nicols paralleli, 20X). Microstruttura granulare limoso-argillosa brunastra con componenti grossolani (cpx: clinopirosseni; P: palagonite subangolare da brunastra ad arancione). b) Micrografia del tetto di US 13 e della base di US 10vhc (SA42 US 10-13, nicols paralleli, 20X). Microstruttura granulare giallastra con componenti grossolani in US 13 (cpx: clinopirosseni). Frammenti di carbone in US 10 (Co: rivestimento di argilla impura contenente minuscole particelle da scure a opache). c) Micrografia di US 83A (SA42 US 83A, nicols paralleli, 20X). Frammenti di carbone con rivestimento limoso (Ch). d) Micrografia di US 94 (SA42 US 94-3, nicols paralleli, 20X). Microstruttura lenticolare.

The filling, SU 10, is made up of burnt residues comprising charcoal mixed with silty loam sediment. Flints and charcoals are coated with amorphous organo-mineral compounds (chelates) leached from the profile during the podzolisation process. This phenomenon is responsible for the exceptional preservation of big-sized charcoals.

The lack of an internal stratigraphy shows that the features are reworked. Reworking is mostly due to cryoturbation and dissolution of the ash in acidic conditions (Friesem at al. 2014), and by bioturbation which tends to make the profile homogenous. The redistribution of burnt residues over an area of more than one metre to the N and about 60 cm to the W (SU 10 low and very low concentrations) can be caused not only by run-off but also by anthropic reworking (sweeping and dumping, trampling) (Miller et al. 2010, Mentzer 2014, Mallol et al. 2017).

SU 10 lenticular filling was divided during excavation into four subunits based on the relative frequency of charcoals in the sediment: SU 10 very high concentration (20-30%), SU 10 high concentration (10-20%), SU 10 low concentration (5-10%) and SU 10 very low concentration (<5%).

SU 10 very high concentration is located at the base of the filling, directly in contact with the SU 21 interface. It is 5 cm thick maximum and contains no lithic industry. Limited convolutions caused by cryoturbation (2-3 cm) are present at the top; SU 10 high concentration is found at the top of the filling. It is 5 cm thick maximum and is affected by faunalturbation; SU 10 low and very low concentration subunits represent charcoal dispersion outside the structure. Their maximum thickness is 10 cm. The lateral transition between the last three microfacies is heteropic and gradual. These differentiations are an example of 'mixed burned deposits' (Sherwood 2008) with an increasing degree of reworking of the burnt residues as one moves away from the SU 21 structure (Mentzer 2012).

A spared 5-6 cm wide septum of SU 13 separates the SU 21 cut, to the north, from that of hearth SU 20. This residue would appear to confirm the coexistence of the two structures. SU 20 is a hearth of the so-called cuvette type (simple open hearth, Mallol et al. 2017), without a stone perimeter. It has a diameter of 60 cm and a depth of 15 cm, a U-shaped profile with flared walls and a concave bottom. Its filling is identified as SU 39 and comprises mainly burnt residues. The sediment is silty loam with charcoals (15%) evenly distributed along the profile (Figure 19).

Small charcoal spots represent another typology of combustion feature. They could be waste dumping (Mallol 2014), i.e. heterogeneous deposits of burned materials mixed with other debris, or occasional fires of limited size lit on the living floor which left no evidence of rubification. They are found especially in the southern area (SU 83A) and in the northern one (SUs 100, 101). They appear as elliptical lenses with a diameter of approximately 40 cm and a thickness of a few centimetres. Burnt residues comprise wood charcoals up to 1 cm in diameter embedded in a sandy matrix. Flints and coals are coated with amorphous organo-mineral compounds created by the process of podzolisation.

Two small clusters of heated flints with a diameter of 20 cm were recognised during data processing at the E and SE of hearth SU 20 and were interpreted as single sweeping and dumping of the hearth itself.

Lithic assemblage

Analyses of the lithic industry showed an overall typological homogeneity that allowed the site to be attributed to the Middle Sauveterrian. This chronological attribution is also precisely confirmed by radiometric dating.

A total of 21,393 lithic artefacts were analysed, including knapping products and by-products, retouched blanks and cores, of which 20,287 were retrieved in the excavation.

Of these, 4,897 have been plotted and 15,390 were recovered from sieving (Tab. 5). 1,101 artefacts collected on surface during the different years of research were excluded, as they could not be positioned in space (Kompatscher et al. 2020).

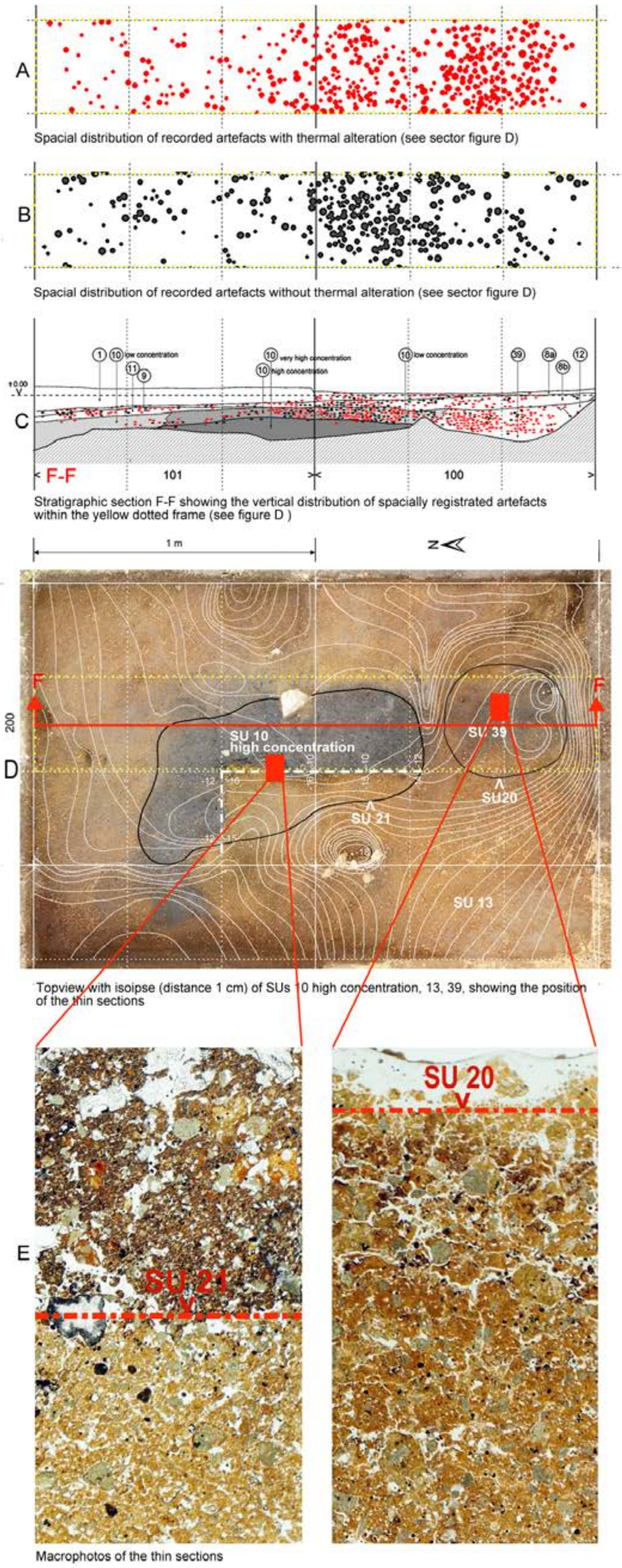


Fig. 19*: A) Spatial distribution of thermo-altered artefacts; B) unaltered artefacts; C) vertical distribution of artefacts; D) surfaces of the SU 20 hearth and SU 21 brazier with 1 cm contour lines; E) thin sections macrograph n. 1 and 3 (see tab. 2). / A) Distribuzione spaziale dei manufatti termoalterati; B) manufatti non termoalterati, C) dispersione verticale dei manufatti; D) superfici del focolare US 20 e del braciere US 21 con isoipse (equidistanti 1 cm); E) macrografie delle sezioni sottili n. 1 e 3 (vedi tab. 2).*

The plotted lithic assemblage was classified according to the largest size of the single artefacts into elements smaller than 1.0 cm (No. 2,365), from 1.0 up to 2.0 cm (No. 2,117) and larger than 2.0 cm (No. 415). The percentage of heat altered artefacts is very high and reaches 56.65%.

For what concerns lithics recovered from sieving, they were also divided according to the dimensional criteria described above. However, considering that very small artefacts were not easily identifiable while excavating, a fourth category was added, comprising dimensions of less than 0.5 cm. In summary: elements smaller than 0.5 cm (No. 8,464), elements from 0.5 to 1.0 cm (No. 6,044), elements from 1.0 to 2.0 cm (No. 859) and elements larger than 2.0 cm (No. 23).

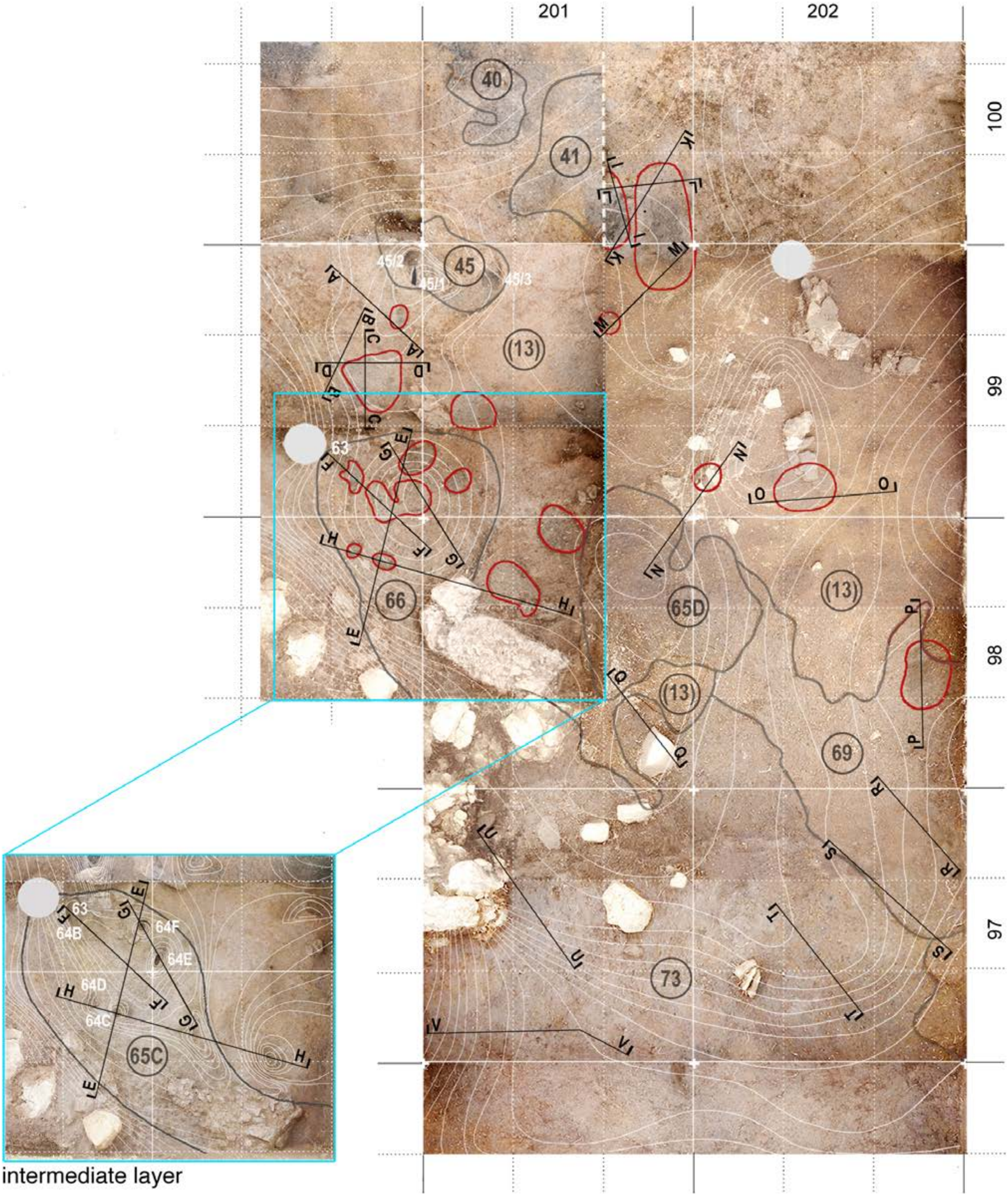


Fig. 20: Surface with visible charcoals spots (red lines) which indicate the presence of underlying post holes. Additional holes are identified with white numbers and the respective sections that pass through the holes are marked with letters. / Superficie con evidenti concentrazioni di carboni (linee rosse) che indicano la presenza di sottostanti buche di palo. Ulteriori buche sono identificate con numeri bianchi e le rispettive sezioni che attraversano le buche sono evidenziate con lettere.

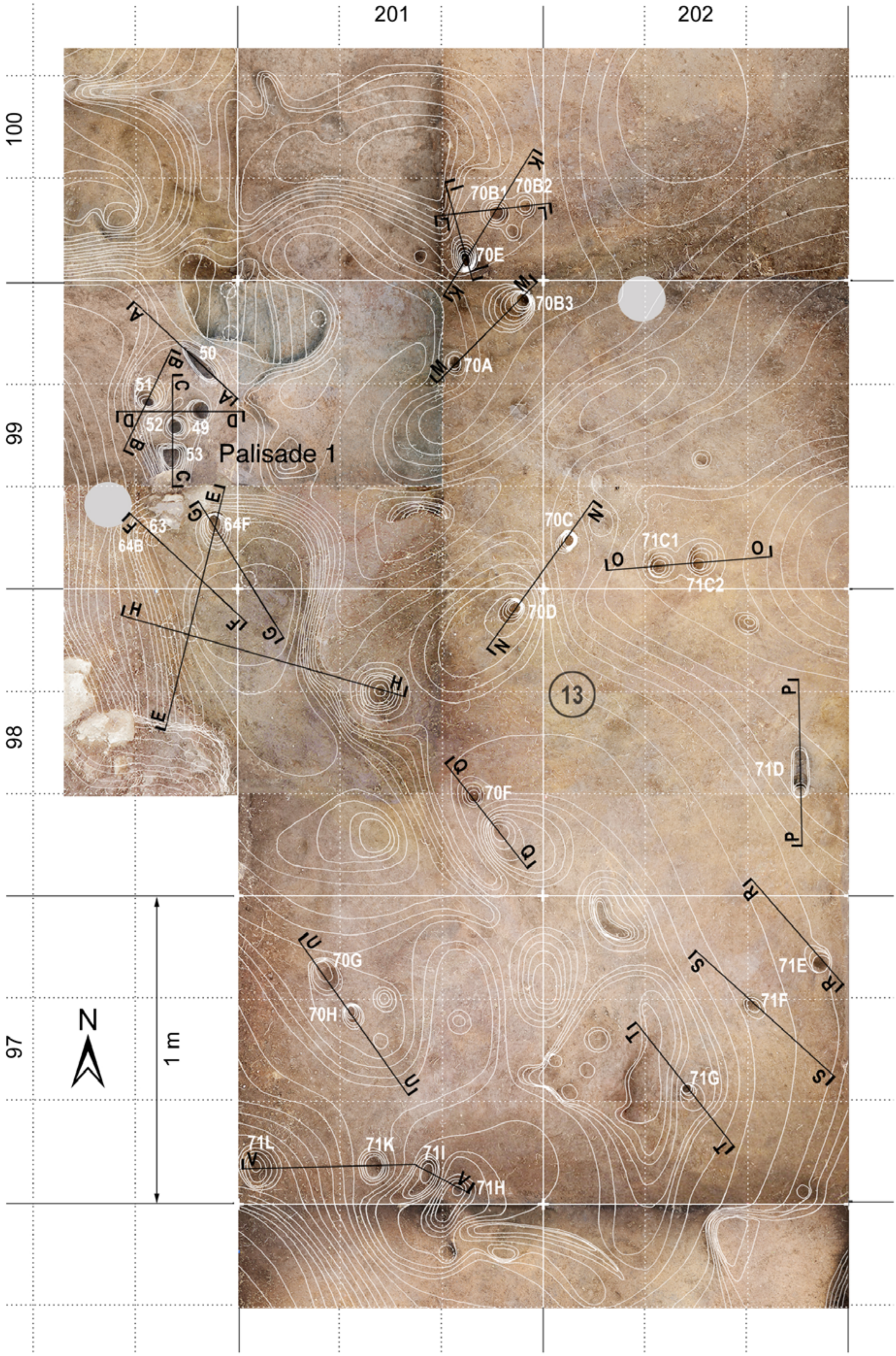


***Fig. 21**: Part of SU 13 showing post holes identified during excavation (white numbers). The respective sections that pass through the holes are marked with black lines. / Parte di US 13 nella quale si evidenziano buche di palo identificate in fase di scavo (numeri bianchi). Le rispettive sezioni che attraversano le buche sono evidenziate con linee nere.*

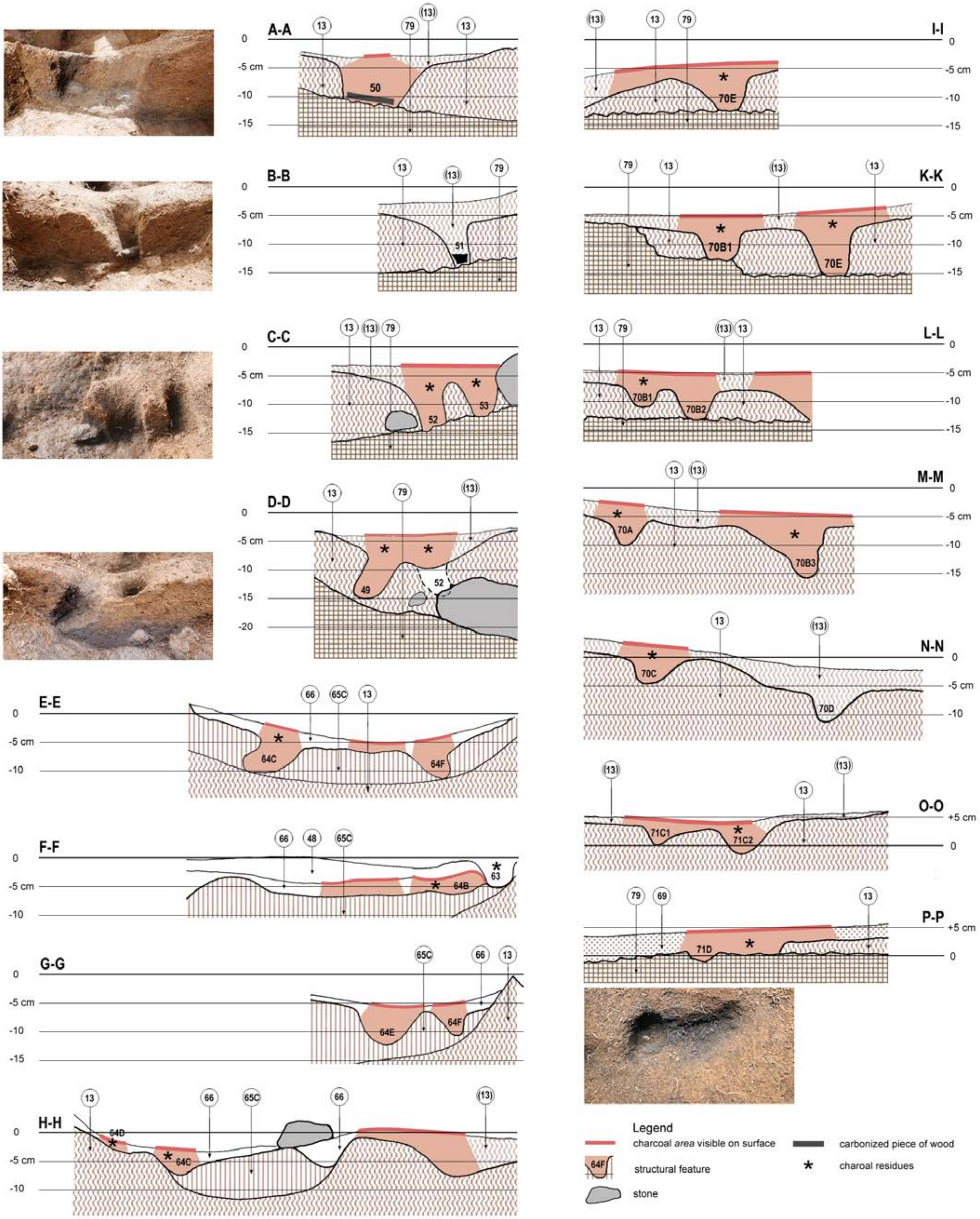
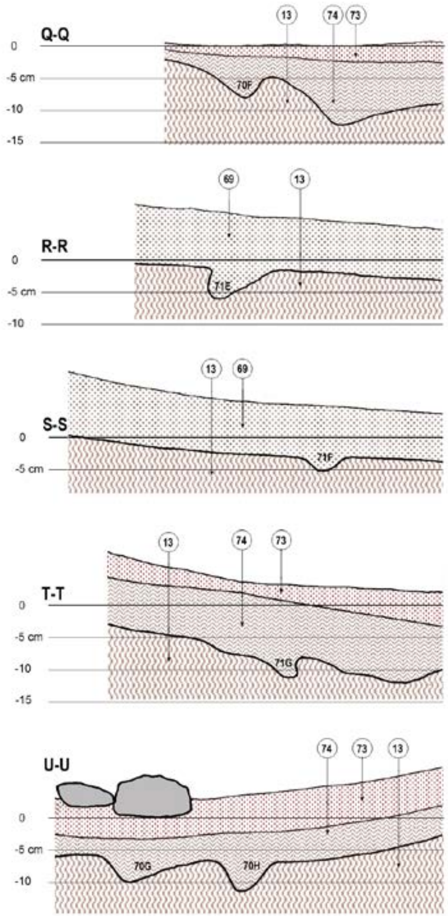


Fig. 22: Tranversal sections through the located post holes discovered in the excavation (A-A:P-P). / Sezione trasversale dei buchi di palo scoperti in fase di scavo (A-A:P-P).



Carbonized wood branches SU 50, SU 45, SU 51

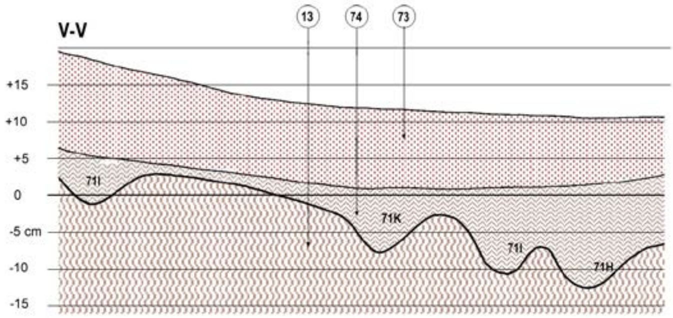


***Fig. 23**: Tranversal sections through the located post holes discovered in the excavation (Q-Q:V-V). / Sezione trasversale dei buchi di palo scoperti in fase di scavo (Q-Q:V-V).*

RETOUCHED ELEMENTS			**505**
Cores	Tools	armatures	microburins
34	22	98	351
NON RETOUCHED ELEMENTS			**4392**
blades	bladelets	laminar flakes	blanks
47	292	121	3932
SIEVING PRODUCTS			**15390**
Cores	Tools	armatures	microburins
0	0	130	395
THERMAL ALTERATION			
43,4%		56,6 %	
RAW MATERIAL			
Maiolica	Scaglia variegata	Scaglia rossa	Rock crystal
56,6 %	20,7 %	20,9 %	1,8 %

***Tab. 5**: Computation of the lithic assemblage. / Calcolo del complesso litico.*

***Fig. 24**: Cores, Semi-tournant reduction method (1-13). / Nuclei, Modalità di sfruttamento semi-tournant (1-13).*

Cores

The category of blanks used to produce artefacts comprises 34 cores. The largest number of cores can be ascribed to the semi-tournant method (no. 13) (Figure 24), the facial reduction method (no. 11) (Figure 25), the peripheral reduction method (no. 8) and finally the edge reduction method (no. 2) (Figure 26) (Flor et al. 2011). The phases of débitage management have been indicated with arrows on the recognizable removals on each artefact.

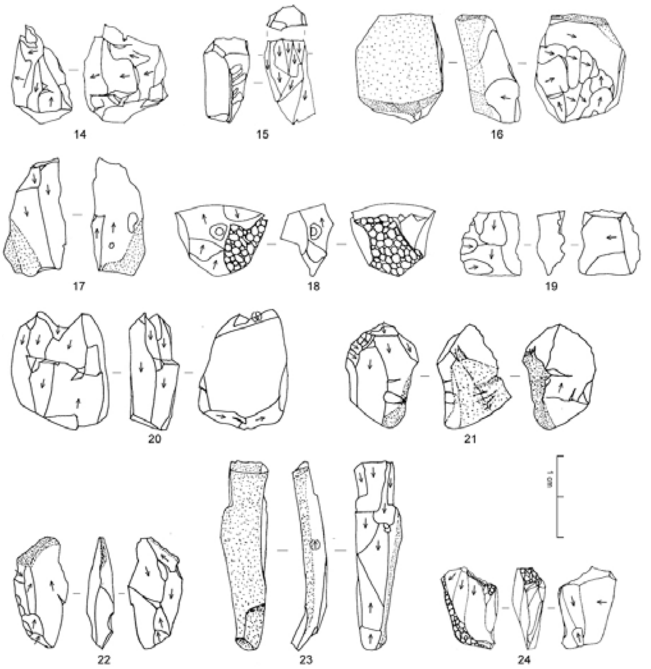


***Fig. 25**: Cores: Facial reduction method (14-24). / Nuclei, Modalità di sfruttamento frontale (14-24).*

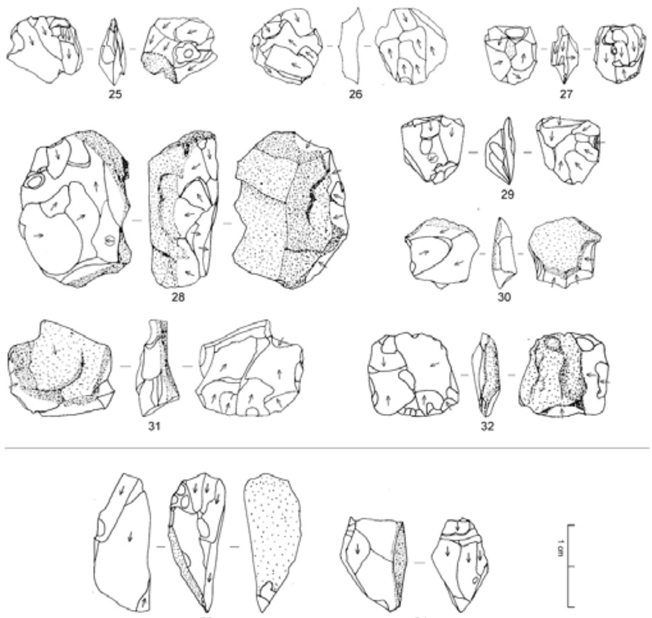


***Fig. 26**: Cores: Peripherical reduction method (24-32), on edge reduction method (33, 34). / Nuclei, Modalità di sfruttamento periferica (24-32), modalità di sfruttamento su spigolo (33, 34).*

Unmodified blanks

From a typological point of view, the most common artefacts recovered in the excavation are undoubtedly débitage products (unmodified blanks) such as blades (No. 47), flakes (No. 292), laminar flakes (No. 121), along with flakes, indeterminable elements and elements smaller than 1 cm (No. 3,932) for a total of4,392 items.

Out of a total of 4,897 knapping products, only 2% show cortex on more than 50% of their surface and can be attributed to the initial phase of cortex removal. It can be supposed that, in a high-altitude settlement such as Site SA 42, most of the blanks introduced had already been prepared for knapping. The fragmentation degree of the unretouched lithic artefacts is very high (88%). This is probably related to the opportunistic management of the available raw material, but it cannot be ruled out that some of the fragments are the result of deliberate fracturing and not of post-depositional effect.

Finally, it is interesting to observe the numerical superiority of flakes (No. 4,053) with respect to blades and bladelets (No. 339).

Retouched blanks - Tools

Various authors agree that in Mesolithic sites the tool group is predominantly related to subsistence activities (Lanzinger 1985; Bagolini & Dalmeri 1987). At site SA42 little representation of this category, both quantitatively and qualitatively, suggests instead that it was quite an irrelevant product in the management of a camp highly specialised in hunting activities. Considering the small number of end-scrapers (No. 3), burins (No. 1), scrapers (No. 1), truncated pieces (No. 3) and retouched elements (no. 15), subsistence activity appears to be of secondary importance (Figure 27).

Microliths

A distinctive feature of Early Mesolithic highly specialised hunting sites is the very high occurrence of hypermicrolithic artefacts.

***Fig. 27**: Tools: burin (1), endscraper (2, 3, 4), scraper (5), truncation (6, 7) retouched bladelets (8, 9), retouched blades (10-17), retouches flakes (18-22). / Strumenti: bulino (1), grattatoio (2,3,4), raschiatoio (5), troncatura (6, 7), lamelle ritoccate (8, 9), lame ritoccate (10-17), schegge ritoccate (18-22).*

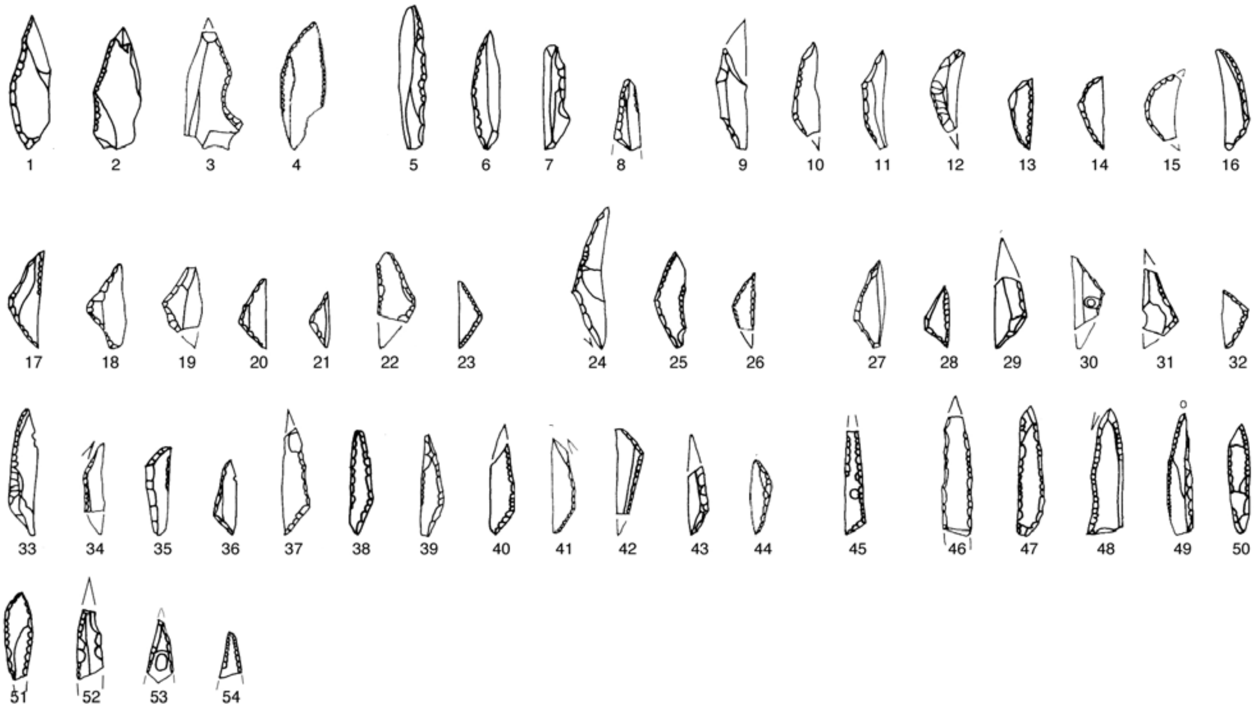


***Fig. 28**: Microliths: pointed flakes (1-4), backed points (5-8, segments (9-16), short isoscles triangles (17-23), long isoscles triangles (24-26), short scalene triangles (27-32), long scalene triangles (33-44), long scalene triangles with short base (45) double backed points (46-54). Scale 1:1. / Armature: punte (1-4), punte a dorso (5-8), segmenti (9-16), triangoli isosceli corti (17-23), triangoli isosceli lunghi (24-26), triangoli scaleni corti (27-32), triangoli scaleni lunghi (33-44), triangoli scaleni lunghi con base corta (45), punte a doppio dorso (46-54). Scala 1:1.*

Most of the microliths were produced using small bladelets, laminar flakes and fragments of various kind. The morphology of the blank, which does not determine the final shape of the microlith, requires extensive modifications by means of retouches that are often very invasive and modify the contour of the blank (Lanzinger 1985). In the five excavation campaigns, 98 microliths, both whole and fragmented, were found and spatially positioned. Summed to elements recovered from sieving (No. 130), many of which were of hypermicrolithic size, they amount to 228 artefacts. This assemblage comprises: points on laminar flake (no. 17), backed points (no. 42), segments (no. 23), triangles (no. 95), double-backed points (no. 23), fragments of unclassifiable microliths (no. 28).

Their frequency can be precisely compared with the Middle Sauveterrian ratios of Riparo Romagnano III. In particular, the category of triangles is divided as follows: short isosceles triangles (No. 18), long isosceles triangles (No. 8), short scalene triangles (No. 7), long scalene triangles with a long base (No. 59) and long scalene triangles with a short base (No. 3). Only two anomalies should be noted: both the high number of long-based scalene triangles and the very low incidence of long-based scalene triangles with short bases are in sharp contrast to the values found in the excavation of Romagnano III (Broglio & Koszlowsky 1984) and Galgenbühel (Wierer 2008) (Figure 28). This difference may be due to the different subsistence strategies of the valley floor and high mountains sites (eg. Romagnano, Galgenbühel).

Particularly interesting is the number of microliths with respect to that of tools with 91.20 %, a figure that corresponds with the values found for the adjacent SA XV site (87,80%) (Lanzinger 1985).

Microburins

The functional specialisation of the site for hunting activities is attested by the significant presence of microburins. On site production is testified by the presence of 351 elements recorded during excavation to which a further 395 from sieving and 67 from surface collection can be added.

The analysis shows a clear disparity in the ratio of these artefacts to microliths, 3.27/1. This suggests that the majority of the microliths was exported. This figure also coincides with SA XV site where the ratio reaches 3.40/1 (Lanzinger 1985).

Refitting

The refitting study of the lithic assemblage did not give any positive result. The absence of refits is believed to be due to the specific technique of microlith making (Lanzinger 1985) as well as to the very little number of tools and to the high percentage of artefacts altered by fire in all lithic categories (56.65%).

Analysing the archaeological record, neither significant traces of trampling were found on the edges of the artefacts, nor is there a significant occurrence of pseudo-retouches due to post-depositional processes. The high percentage of fractured artefacts is, therefore, to be ascribed to both the production dynamics and to the rehafting and retooling of the hunting weaponry.

Lithic raw materials

The lithotypes employed at the site during the Mesolithic frequentation were traced back, by means of macroscopic analysis, to the Jurassic and Cretaceous Southern Alpine carbonate formations (Cavulli & Grimaldi 2009). They belong to the Maiolica, Scaglia Variegata Alpina and Scaglia Rossa formations. These have a rather wide distribution in the eastern sector of the South Alpine region, where they form the most recent sedimentary cover of a pelagic selciferous succession (Bertola 2011; 2014).

The most represented formation is the Maiolica (56.6%), followed by the Scaglia Rossa (20.9%) and the Scaglia Variegata Alpina (20.7%). There is little presence of rock crystal (1.8%), a fairly common mineralisation within the crystalline basement outcropping in the Central Alps. Artefacts made from the local Buchenstein Formation are rare (0.2%).

Almost all the lithic raw materials come from 1a southern direction, mainly from the southern Pre-Alps (Maiolica and Scaglia Rossa, Scaglia Variegata Alpina), while the use of raw material coming from the north (rock crystal) is occasional.

Spatial analysis - Plotted artefacts

Distribution maps were made for 4,897 lithic artefacts plotted during excavation over an area of 24 m2. The overall spatial distribution of artefacts from all stratigraphic units and their relationship with the identified features provide important information for the reconstruction of the functional and logistical organisation of the camp during the various occupation phases at the site (Figure 29). The lithic artefacts in the investigated area are distributed quite homogeneously along a belt following a NNW-SSE direction. The scatter is limited to the WSW by the bedrock outcrop while to the NNW it is limited by the NNE-SSW oriented erosion (SU 99) which was artificially filled during occupation. As it can be seen in the spatial distribution map, this natural morphology must have limited the expansion of the settlement towards W and N. The occupied area was thus located within a slight depression few tens of centimetres deep, a kind of sheltered area that could host the dwelling ensemble. Several lithic clusters are visible, especially in the area of the SUs 20 and 21 features. A lithic cluster is found along palisade 1, while smaller clusters can be recognized along the palisade 2 alignments of post holes, where the scatter of artefacts is clearly limited to the W by this structural alignment. Over the remaining surface, the scatter of artefacts gradually diminishes and disappears towards the E and W limits of the excavation.

Thermally altered lithic artefacts are mainly clustered in the area of hearth SU 20 and in the upper portion of the filling of SU 21 feature (SU 10 high concentration). Burnt elements account for almost all the lithics in the area of hearth SU 20. Other smaller clusters can be found in quadrants 100/201 d-e and 99/20 a. The 'barrier effect' created by palisade 2 (SUs 88A-B-D-G-I-K-L) is particularly evident. The largest artefacts also cluster in this area.

In the post holes it can be noted the presence of large quantities of thermally altered lithic industry (56.65%) and charred wooden remains. A similar situation was found at the nearby SAXV and SAXVI sites with 49% of thermally altered lithics (Lanzinger 1985). In contrast, in the other Sauveterrian sites on the Ridge, the occurrence of thermally altered artefacts is considerably lower (5-22%) (Kompatscher et al. 2020). This made it possible to hypothesize that the area was affected by a fire which would have involved the settlement at the time of its abandonment by the Mesolithic people. Further investigations will be necessary to verify this inference.

Microlithic armatures

Microlithic armatures are distributed across the whole excavation surface, with small clusters around SUs 20, 21, 100. The position of the individual microliths may reflect not only the place of production, but also several other activities such as arrows assembly or renewal and the post-hunting operation processes. The recognition of specific concentrations suggest a limited post-depositional scattering effect.

Finally, microliths could have been reused for other activities that cannot be specifically identified within the site (Figure 30). To better define the areas where the microliths were manufactured, it is essential to take into account the areas with a high density of microburins; these areas were identified mainly in correspondence of the hearth SU 20, 21 and of the possible dwelling structure (see par. 3.3.2).

Microburins

Microburins are easily recognisable due to their distinctive shape. They are the category of artefacts with the largest number of occurrences in the excavation (tab. 4). As mentioned above, their spatial distribution within the settlement allows to gain some clues as to the activity areas used for the projectiles manufacturing. In order to give microliths the desired shape it is necessary, in a first phase, to remove the proximal and sometimes also the distal part of the bladelet or lamellar flake. By removing the ends, the basic outline is defined. The detached element (i.e. the microburin) is usually very small and, considered as a waste product, it is abandoned on site. Through the spatial analysis and an experimental session (see below), we tried to hypothesize the position of the operator during knapping (Figure 31).

Experimental data

For the reason explained in the previous section, the length of the trajectories of microburins after their pressure removal were measured through a series of experiments. The experimental sessions allowed the evaluation of a number of factors potentially influencing the length of trajectory: a) the type of raw material; b) the base of the anvil; c) the strength used for the removal; d) the height of the anvil from the ground.

The results of this study can be resumed as follows:

a. the raw materials used (Maiolica, Scaglia Variegata and Scaglia Rossa) show a similar mechanical behaviour during knapping and do not influence the length of the trajectory;
b. the base of the anvil appears to play a key role:
   - a rigid base, e.g. a stone or a piece of wood directly on the ground, results in a short centimetric trajectory;
   - a soft base, e.g. the knee or thigh of the knapper determines decimetric distances;
   - an elastic base, like when held freely in the hand, makes the element fly even 1-2 m away;
c. the strength needed for the removal mainly depends on the thickness of the blank, while, since the removal of the microburins is triggered by torsion, the width of the blank is less significant (Kompatscher 2011). The distance covered by the microburin is directly proportional to the thickness of the blanks and, as a consequence, to the strength exerted;
d. the greater the height of the anvil from the ground, the greater the dropping distance of the microburin.

Comparison with excavation data

In order to quantify the intensity of pressure used for blanks segmentation by applying the microburin technique, the different thickness of the microburins plotted during excavation were measured and divided into three groups: thin, up to 1.6 mm, medium, from 1.6 to 2.2 mm and thick, more than 2.2 mm. These were marked with three shades of red in the distribution map (Figures 31, 32). In the area of features SUs 20 and 21, a strong concentration of thick elements can be seen on the outer part of a semi-circular cluster, whilst medium and thin elements are concentrated towards its inner part. The spatial distribution of the various size classes of microburins may allow to infer that the knapper stood by hearth SU 20 in a sitting or squatting position facing W and laying the blank to be fractured with the microburin technique either on the knee or on the thigh.

A similar semi-circular scatter was found near palisade 2. Here the knapper is supposed to have been placed against the protection, facing S.

The semi-circular scatter of microburins on the map reveals a third area between squares 201/98c, 201/99i, also a possible working area for the production of microliths.

On the other hand, the distribution of microburins coming from sieving and plotted in 33x33 quadrants, gives a somewhat blurred picture which, in general terms, mirrors the spatial distribution of the plotted artefacts (Figure 32).

Retouched tools

Retouched tools, whose function is usually related to a variety of subsistence activities, are very few and are concentrated in three areas of the excavation: eight elements by SUs 20 and 21, four elements in the northern area and which can be related to palisade 2 and, finally, five elements to the W of the concentration of microburins recorded in squares 201/98c, 201/99i (Figure 33).

The fact that tools are also related to precise areas with a high density of microburins, may suggest that subsistence activities were taking place in the same places as those where microliths were manufactured.

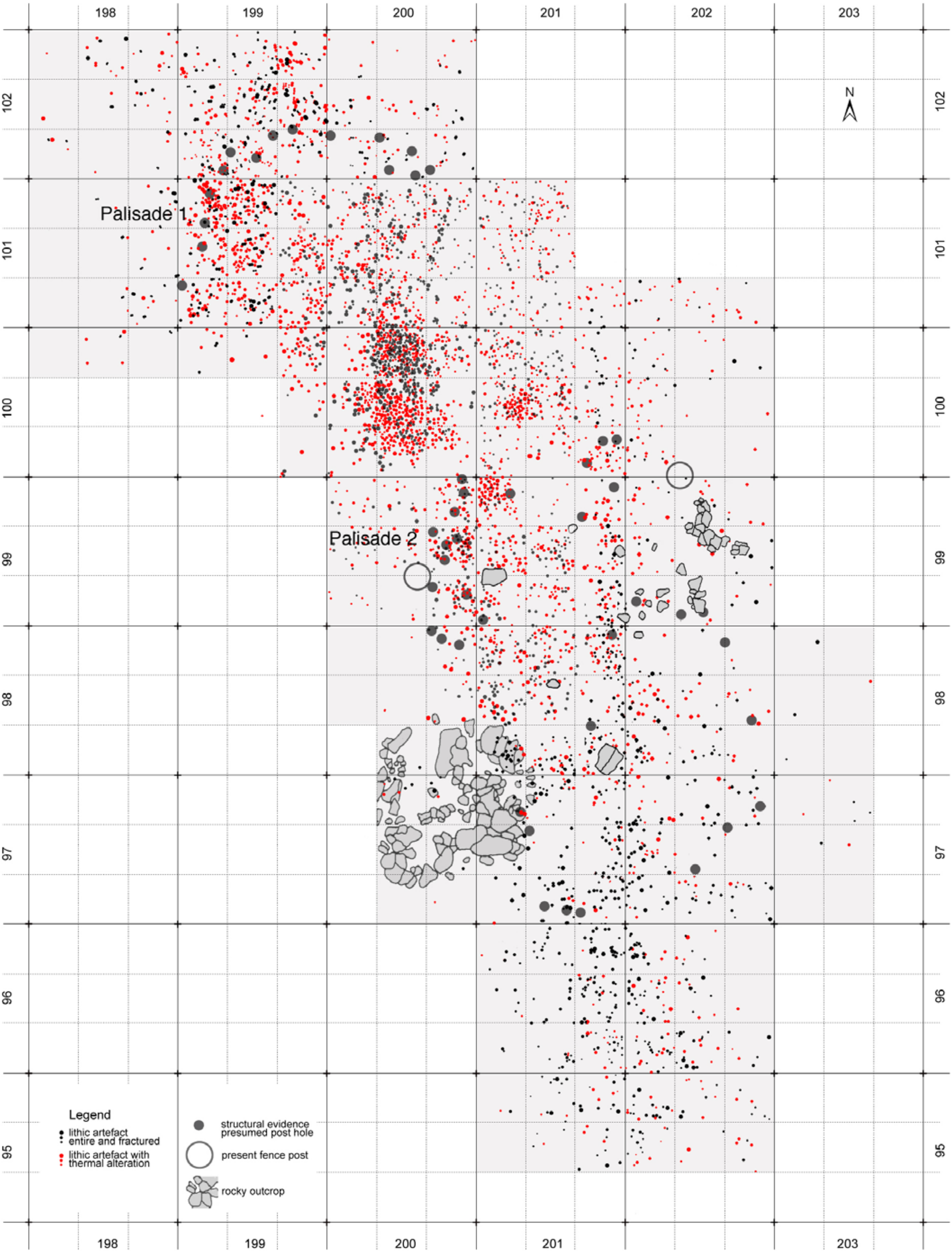


Fig. 29: Spatial distribution of the totality of spatial recorded lithic artefacts. / Distribuzione spaziale della totalità dei manufatti litici registrati.

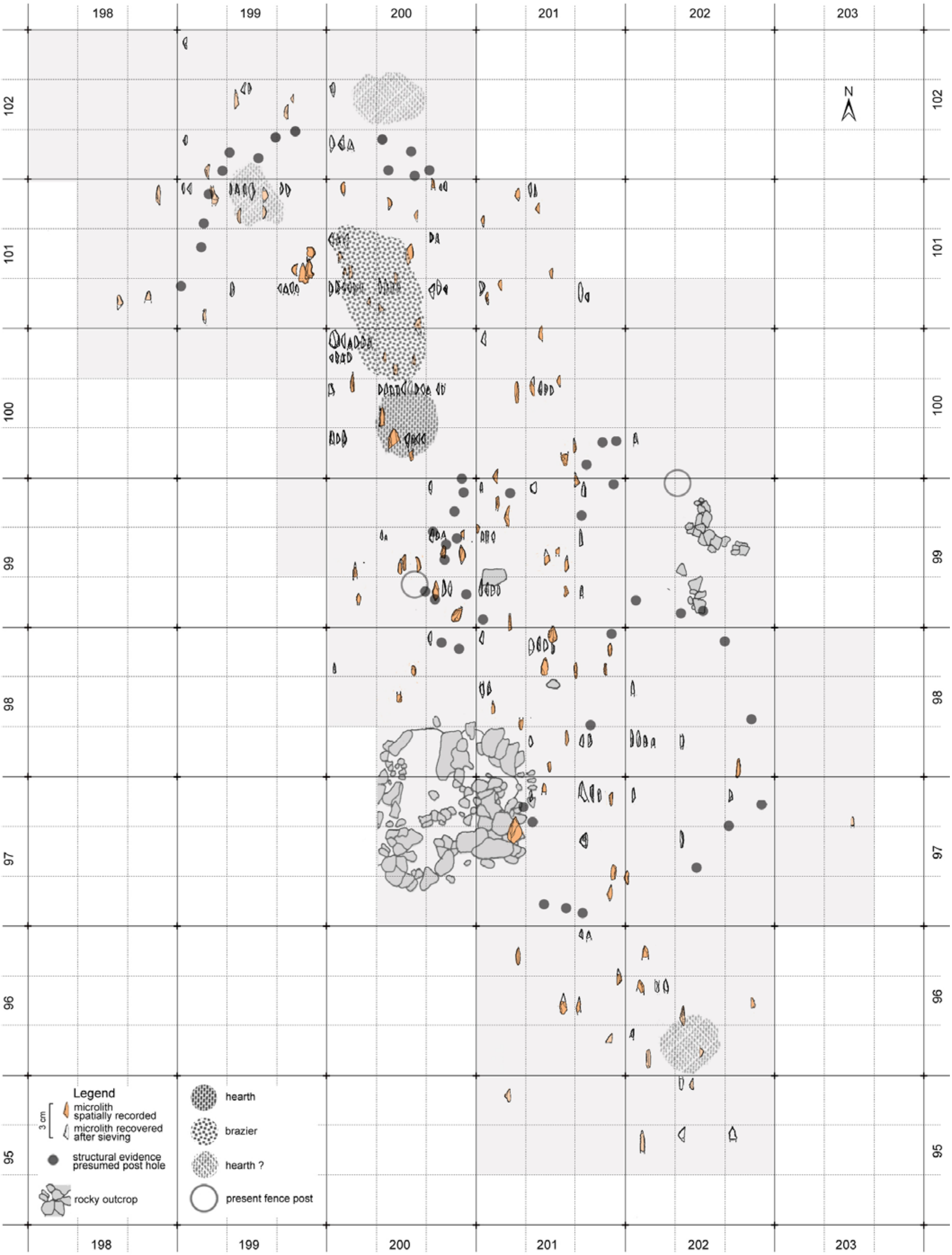


Fig. 30: Spatial distribution of plotted microliths (orange) and of those recorded by sieving (white). / Distribuzione spaziale delle armature (arancioni) registrate e di quelle identificate in fase di vaglio (bianche).

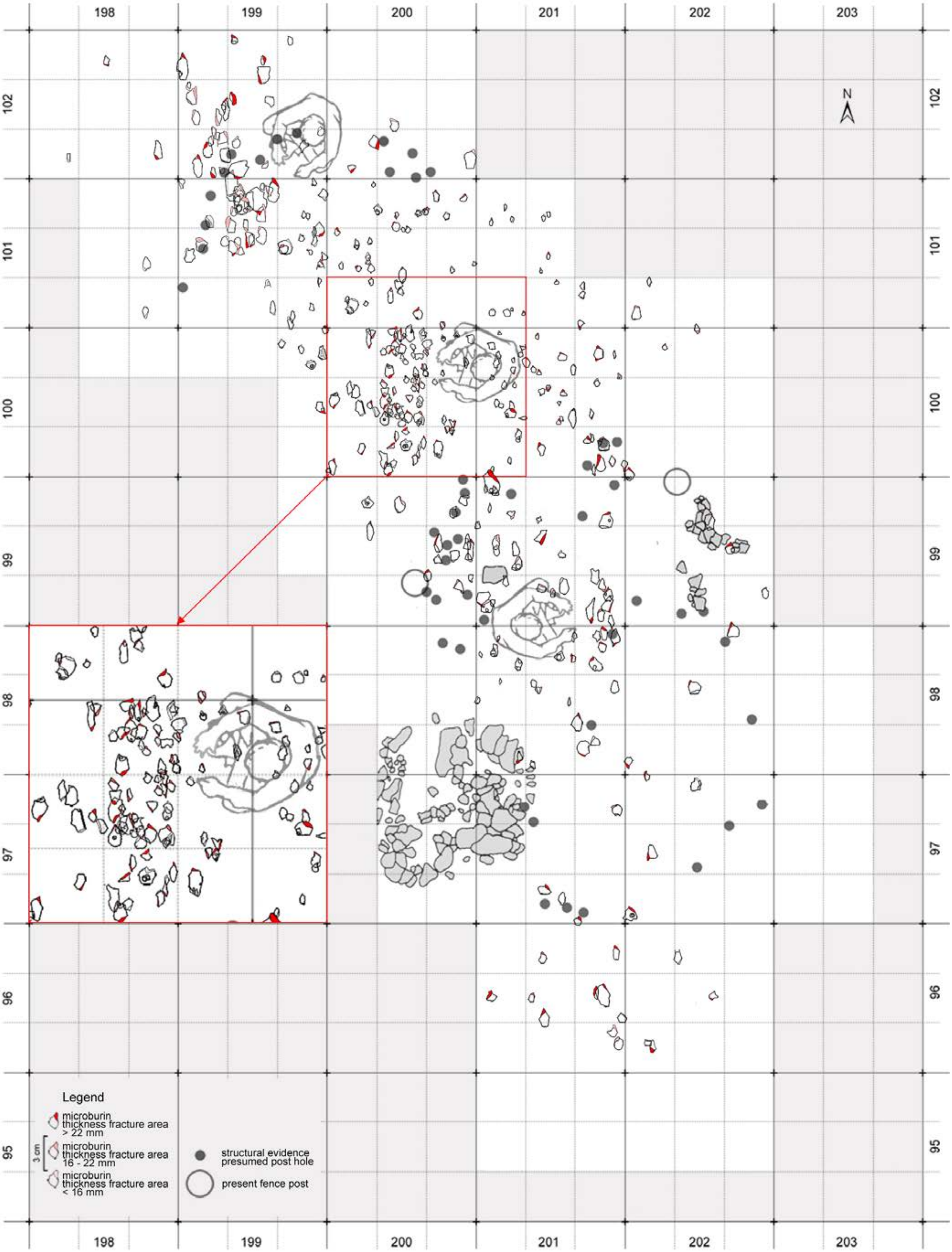


Fig. 31: *Spatial distribution of microburins revealing presumed activity zones in the paleosurface. / Distribuzione spaziale dei microbulini che permette di ipotizzare presunte aree di attività sulla paleosuperficie.*

Fig. 32: Spatial distribution of the totally of microburins recovered by sieving. / Distribuzione spaziale di tutti i microbulini identificati in fase di vaglio.

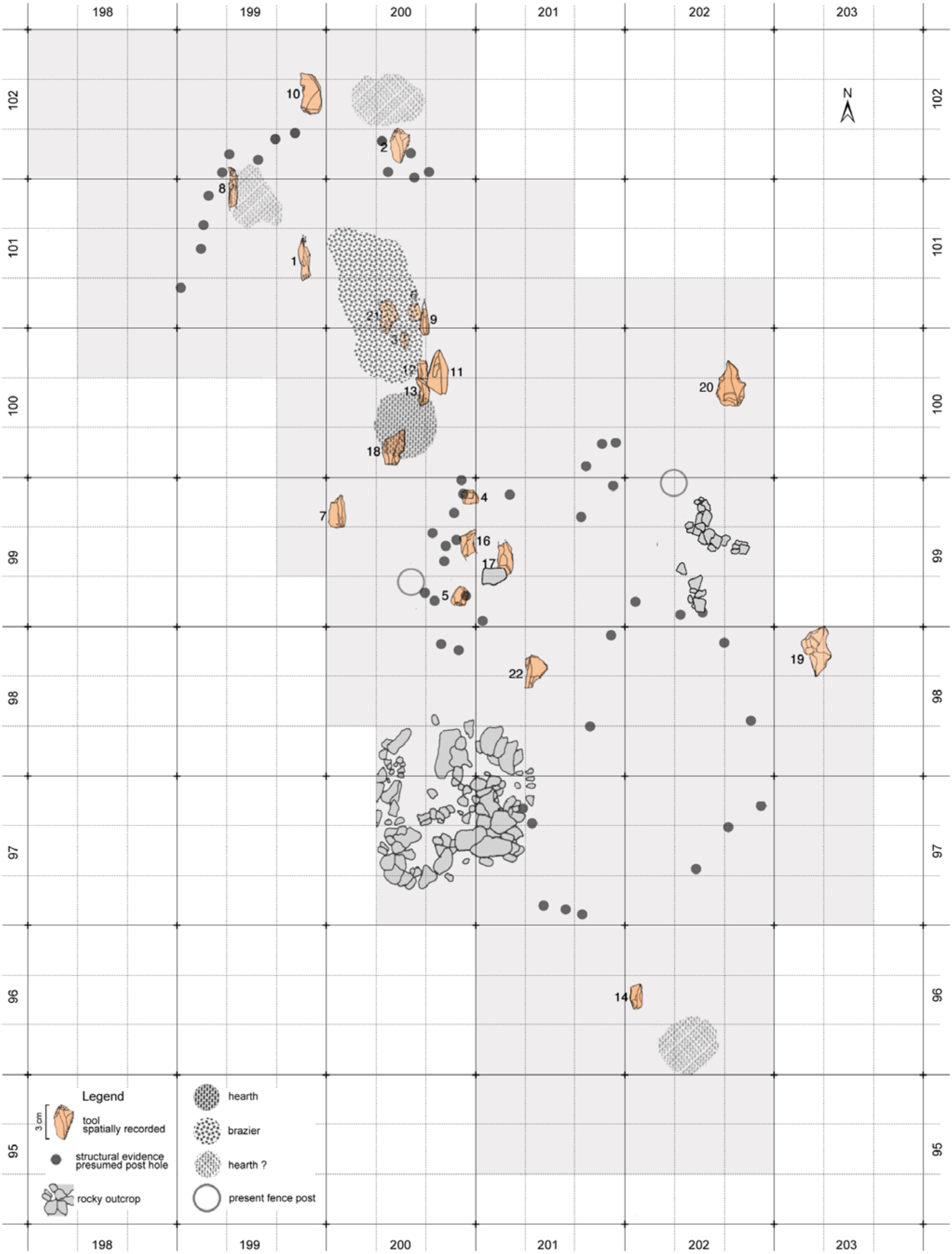


***Fig. 33**: Spatial distribution of plotted tools (the numbers refer to the artefacts drawings fig. 27). / Distribuzione spaziale degli strumenti registrati (il numero si riferisce ai disegni dei manufatti fig. 27).*

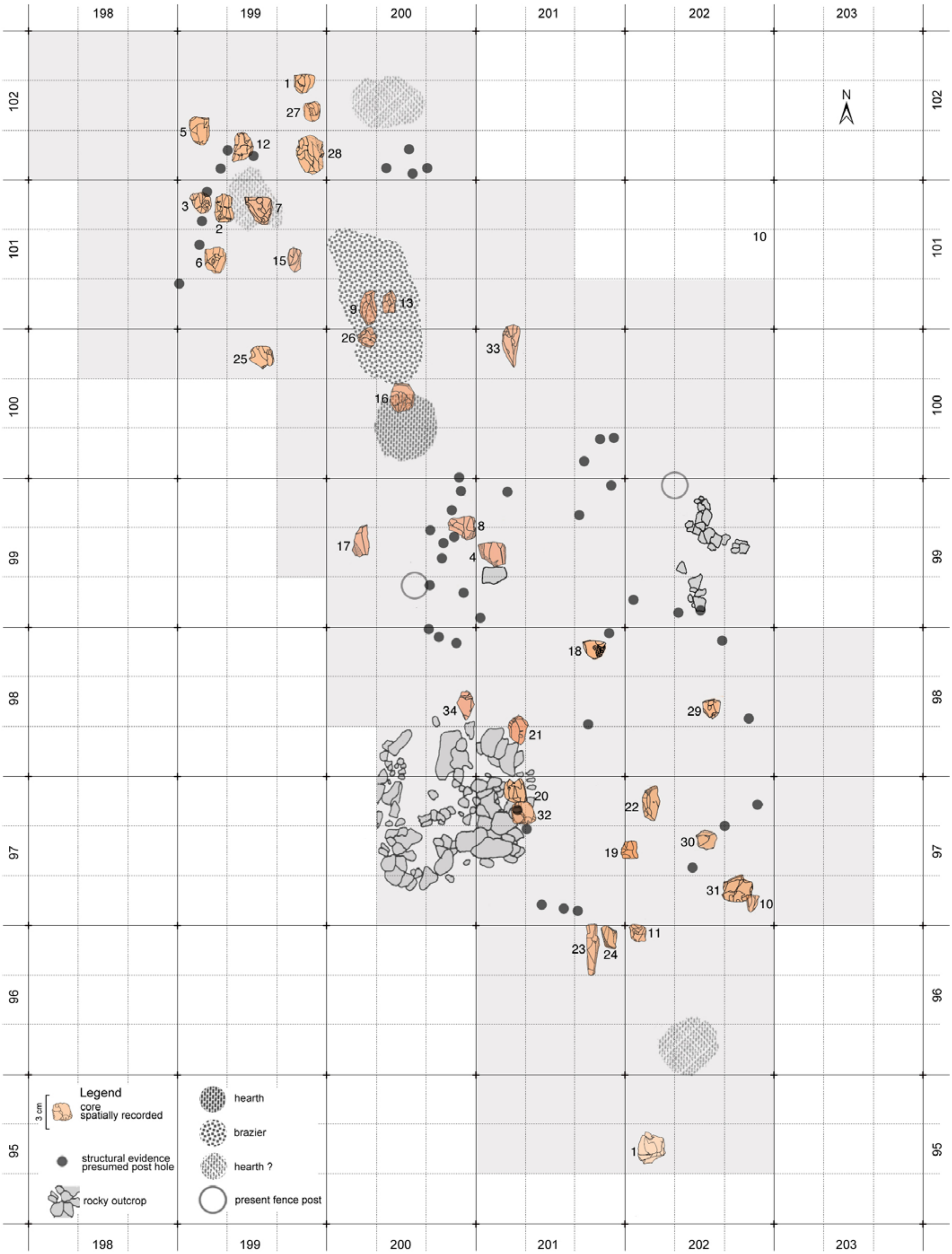


Fig. 34: Spatial distribution of plotted cores (the numbers refer to the artefacts drawings figs. 23, 24, 25). / Distribuzione spaziale dei nuclei registrati (il numero si riferisce ai disegni dei manufatti figg. 24, 25, 26).

Cores

34 cores are present of which 10 are located near palisade 2. Six pieces are in or around SUs 20 and 21, while a further cluster was found in the southern part of the excavation, in an area almost devoid of artefacts (Figure 34).

Artefacts from sieving

During sieving 15,708 artefacts were recovered from the 33x33 cm quadrants over an area of 20 m^2. The artefacts were divided into four dimensional categories: maximum size up to 0.5 cm (No. 8,467), 0.5 to 1.0 cm (No. 5,978), 1.0 to 2.0 cm (No. 835) and greater than 2.0 cm (No. 22). In general, their spatial distribution mirrors that of the plotted artefacts. Due to the extremely low number of artefacts found during the excavation of squares 200/97, 203/97, 203/98 and parts of square 200/98, the sediment from these areas was not sieved.

Vertical Distribution

The vertical distribution of lithic artefacts was systematically analysed through the elaboration of vertical profiles. On each profile, the position of the lithic assemblage found on a 33 cm large sector was projected. Particularly significant are the N-S, (crossing 200.50E and 201E) and E-W (crossing 99N, 96.66N and 96.33N) profiles (Figures 9, 19). In general, it can be observed that the dispersion of lithic artefacts gradually decreases from bottom to top, becoming null in the topsoil. In the N-S section (crossing 200.50E) which runs across the combustion features SUs 20 and 21, the predominance of thermo-altered knapping products (90%) is evident across the entire thickness of the filling of hearth SU 20 (SU 39). It is also possible to note the virtual absence of material in the basal fill of the SU 21 brazier (SU 10 very high concentration) (Figure 19). The presence of thermo-altered lithic artefacts increases considerably in the upper unit of the brazier's filling (SU 10 high concentration); the maximum density is noted by SU 20 hearth, while a progressive decrease is observed moving away from it to the N. In SU 10 high concentration, the thermo-altered products amount to 40%. Comparison to the horizontal distribution of the artefacts confirms the clear predominance of thermo-altered products in the SU 20 hearth area, which contrasts with a predominance of not thermo-altered products in the SU 21 brazier area (Figure 19).

On a whole, these differences in vertical distribution between structures SUs 20 and 21 can be interpreted as a temporal sequence of anthropic actions that point to their simultaneous use: (a) in a first phase, the charcoal produced in SU 21 hearth is picked up and deposited in the brazier; (b) subsequently, the knapping activity contemporary with the use of the two structures determines the thermal alteration of the knapping products that drop into the hearth while those that end up in the brazier area remain unaffected; c) the constant gathering of charcoal from the hearth to feed the brazier also involves thermo-altered lithic waste; thermo-altered and not thermo-altered knapping products will therefore be found mixed in the brazier.

Radiocarbon datings

Thirteen 14C-AMS datings on charcoal samples from burned wood have been analysed. According to the results of the radiocarbon dating analysis, the sequence ranges from 9240 ± 45 BP (LTL 19704A) to 8256 ± 65 BP (LTL 19703A) uncalibrated, corresponding to a maximum range from 8610 to 7077 cal BC (2 sigma) (tab. 6).

The analysis of the results in their chronological sequence clearly shows that all dates fall in the early Holocene (Walker at al. 2012) in the Preboreal and Boreal chronozone (Stuiver et al. 1998; Ravazzi 2003). Considering the 14C-ages according to their stratigraphic sequence, on the other hand, it can be noted that both series are not perfectly in line with each other. The dated charcoal yielded an apparent age of the archaeological context. The time-width derives from the 'old wood effect' and from the use of dead wood as fuel. Unfortunately, short-lived samples such as small braches or carpological remains have not been dated. The effects of these processes cannot be quantified but, in general, carbon 14 dating results must be considered older than the archaeological context being dated.

The set of data belong to horizons of evident anthropogenic origin, dating the human frequentation to a chronological period ranging from the beginning of the 7th to the middle of the 9th millennium cal. BC. This is in agreement with the archaeological data through which the human frequentation is attributed to the Early Mesolithic (Sauveterrian) period (Figure 35).

Discussion

In the high-altitude open-air sites of the Dolomite area and Lagorai chain, such as the Colbricon (Bagolini & Dalmeri 1987) and of the pre-Alpine area of the Sette Comuni plateau (Angelucci & Peresani 1995; 2000), pedogenetic processes led to a drastic reduction of the archaeological evidence resulting in the preservation of the sole lithic industry. In podzolic soils, artefacts are concentrated at the boundary between the E and Bs horizons, indicating that this was the most likely stratigraphic position of the Mesolithic frequentation (Kompatscher et al. 2016). As also noted for site SA4, post-depositional processes of pedoturbation after human occupation (mainly cryoturbation and bioturbation) have produced the scattering of artefacts across the whole profile (Angelucci & Peresani 1995, 2000; Angelucci 2000). None of the sites investigated in the past have yielded faunal remains, while anthracological remains are very scarce and in a poor state of preservation. Recently, the integration of microstratigraphic data with those obtained from the three-dimensional plotting of all lithic artefacts has made it possible to deepen our knowledge of the living space of Mesolithic hunting camps (Fontana et al. 2012, 2017, 2018; Kompatscher et al. 2016; Sangiorgi 2018). Within Site SA 42 an anthropic soil has been identified formed by the juxtaposition and combination of different 'evident' and 'latent' structures (Leroi-Gourhan 1984; Yar & Dubois 1996).

The investigated living floor covers an area of 22 m2, along a belt which is oriented NW-SE and constrained by the morphology of the rocky outcrop that borders the settlement to the west. Its identification was possible mainly thanks to the presence of evident structures, such as combustion features and post holes, and thanks to the analysis of the spatial distribution of the various categories of lithic artefacts.

Although the presence of a living floor is rather obvious, it is not possible to separate stratigraphically the number of occupational events. In this sense, the archaeological layer identified at SA 42 comprises a palimpsest of occupation episodes that are spatially separated but temporally indistinguishable (spatial palimpsest, sensu Bailey 2007). The limited horizontal movement of lithic artefacts in relation to their primary position can be recognized by the analyses of the spatial distribution of the lithic assemblage and by its correlation with the 'evident' structures. In this regard, the correlation between the spatial distribution of the thermally altered artefacts and the limits of the hearth SU 20 (Figure 29) is very clear. Also clearly visible are the small clusters of thermo-altered elements which suggest single sweeping and dumping events related to this hearth (Figure 37). Well defined clusters of microburins allow single manufacturing areas to be delimited (Figures 31, 32). Furthermore, the higher frequency of larger artefacts in correspondence with the structural alignments (palisade1 and palisade 2) can be explained with the 'barrier effect' (Figure 29).

Starting from the S (Figure 36), the possible dwelling structure was set against the rock outcrop to the W with a probable sheltering function. A further sheltering element is represented by palisade 1 located to the NW. In the space between the dwelling structure and palisade 1, various activities involving microlith production and the use of tools were carried out. The inside of the dwelling structure is characterised by the scarcity of lithic industry except for two clusters of cores found along its perimeter.

Lab. code	SU	Coordinates	Material	14C age (BP)	δ13C (‰)	Cal BC (95,4%)
LTL 19703A	71D (post hole)	202/98	charcoal	8256±65	-26,3±0,6	7478-7077
LTL 18591A	70G (post hole)	201/97	charcoal	8434±55	-25,2±0,3	7589-7536
LTL 17586A	39 (hearth)	200/100	charcoal	8452±45	-23,1±0,5	7589-7377
LTL 14024A	10 surface (brazier)	200/101	charcoal	8605±60	-25,8±0,5	7760-7530
LTL 18502A	71K	201/97	charcoal	8631±55	-17,7±0,6	7802-7543
LTL 18590A	74	202/97	charcoal	8676±55	-26,1±3,3	7940-7587
LTL 20291A	10 (brazier)	199/102	charcoal	8738±45	-26,7±0,4	7944-7603
LTL 19701A	89	199/101	charcoal	8747±65	-26,3±0,2	8169-7595
LTL 19702A	83A	202/96	charcoal	8780±45	-26,6±2,5	8169-7607
LTL 20292A	94	199/102	charcoal	8783±45	-30,7±6	8170-7607
LTL 17587A	50 (post hole)	200/99	charcoal	8819±45	-21,3±5	8203-7736
LTL 18589A	83	202/96	charcoal	8877±55	-30,4±5	8240-7803
LTL 15955A	10 base (brazier)	200/101	charcoal	8868±65	-23,2±6	8237-7763
LTL 19704A	70E (post hole)	201/100	charcoal	9240±45	-24,7±4	8610-8304

***Tab. 6**: Radiocarbon ages and calibrated dates from the samples of SA 42. Samples were analysed by the Centre for Dating and Diagnostics - CEDAD, Department of Mathematics and Physics "Ennio de Giorgi", University of Salento, Lecce (Italy). These data were then calibrated for calendar age applying OxCal v.4.4.4 (Bronk Ramsey, C. OxCal v.4.4.4 https://c14.arch.ox.ac.uk/oxcal/OxCal.html, 2021) using the IntCal20 atmospheric curve for the northern hemisphere (Reimer et al. 2020), with a probability 2 sigma (95,4%). / Età rradiocarboniche e date calibrate dei campioni di SA 42. I campioni sono stati analizzati dal Centro di Datazione e Diagnostica - CEDAD, Dipartimento di Matematica e Fisica "Ennio de Giorgi", Università del Salento, Lecce (Italia). Questi dati sono stati quindi calibrati in età calendario applicando OxCal v.4.4.4 (Bronk Ramsey, C. OxCal v.4.4.4 https://c14.arch.ox.ac.uk/oxcal/OxCal.html, 2021) utilizzando la curva atmosferica IntCal20 per l'emisfero settentrionale (Reimer et al. 2020), con una probabilità 2 sigma (95,4%).*

To the north of palisade 1 is an area related to the use of fire. In particular, brazier SU 20 and hearth SU 21 were recognized (Figure 37). Analysis of the spatial distribution of the artefacts allowed to establish that these two structures were in use at the same time. It can be assumed that the maintenance of fire in SU 20, and thus the production of charcoal, is complementary to the function of SU 21 brazier. Combustion under reducing conditions in the brazier could have been employed for many purposes such as, for example, cooking or smoking food, or the processing of mastic for assembling microliths on shafts.

Knapping activity related to the production of microliths was identified by these structures. This comprises a squat zone, where the knapper sat and a drop zone with a high concentration of microburins (hearth side drop zone) associated with the presence of microliths and tools. To the E and SE of the hearth, two small clusters of thermally altered chert artefacts, about 25 cm in diameter, were interpreted as refuse dumps coming from the renovation/cleaning of the nearby SU 20 hearth. Three post holes with a stone packing can be interpreted as the base for a structure functional to SU 20 and 21 structures (Figures 19D, 37).

The Northern limit of the settled area, defined on the basis of the dispersion of the lithic emsemble, is bordered by palisade 2. This latter is defined by 7 aligned, sub-vertical post holes about 20 cm deep and reinforced by an intentional addition of soil on the E side (SU 90). From these features it is possible to infer the presence of a solid and complex planning. This is considerably different from palisade 1 testified by shallow and not regularly aligned post holes. On the E side of palisade 2 a charcoal cluster (SU 100) can be interpreted as a peripheral area linked to the use of fire. Charcoal clusters found N and S can be interpreted as evidence of sweeping and dumping related to hearth maintenance (SUs 101, 83A).

A "barrier effect" is visible by palisades 1 and 2, which have hindered the dispersion of the lithic industry towards the West (Figures 37, 38).

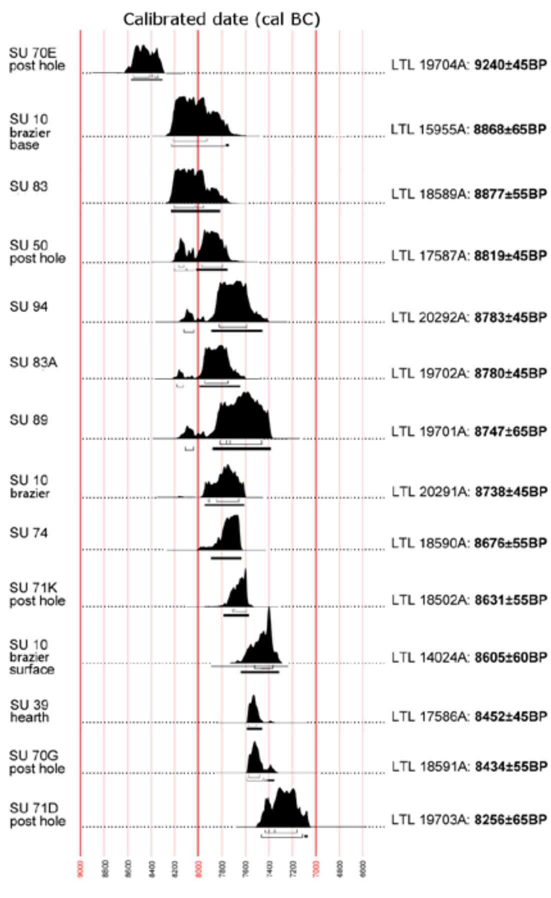


***Fig. 35**: ^{14}C AMS datings in chronological sequence. / Sequenza cronologica delle datazioni al Carbonio 14 AMS.*

Final remarks

Site SA42 can be interpreted as a high-altitude camp, located at the top of a morphological height with wide territorial visibility and along a mobility line leading from the Adige Valley to the core of the Dolomites region (Kompatscher et al. 2020).

From the functional point of view, the site shows typical characteristics of highly specialized camps for hunting activity and in particular for microliths production.

Chronologically, the settlement has been dated on a typological basis within the Middle Sauveterrian and on a radiometric basis between 8610 and 7077 cal BC (2 sigma).

Since postdepositional phenomena (pedoturbation, freeze-thaw, erosional events) acted on the vertical displacement of the lithic artefacts but with very little influence on their horizontal displacement, the preservation of the archaeological record is good. This has allowed to study and to reconstruct in detail the intra-site organization of a Mesolithic hunter-gatherer camp. Mesolithic hunters organized a complex living space, which was investigated over an area of 22 m2, by exploiting the natural morphology of the area and setting up a number of features (dwelling structure, knapping areas, fire use areas, etc.) with different functions but, at the same time, clearly related one another.

To this regard, the simultaneous use of hearth SU 21 and brazier SU 20 was discussed. Furthermore, the presence of a high number of microburins points to multiple seasonal occupations that, however, respected the same functional and structural areas. The high occurrence of thermo-altered lithic elements (56,65%), comparable with that of the nearby SAXV and SAXVI sites (49%, Lanzinger 1985) is considerably higher than that found at the other sites on the Ridge (<22.9% SA 56, Kompatscher et. al. 2020). The larger presence of thermo-altered elements can be interpreted as the result of a fire. The presence of charred wooden elements found within post holes, excluding those of palisade 2, suggests that this event may have occurred at the time of the Mesolithic frequentation. In the future, we aim to further investigate the activities that took place in this site by applying other analyses such as the technological and traceological study of the lithic industry and the taphonomy of charcoal remains (Figure 39).

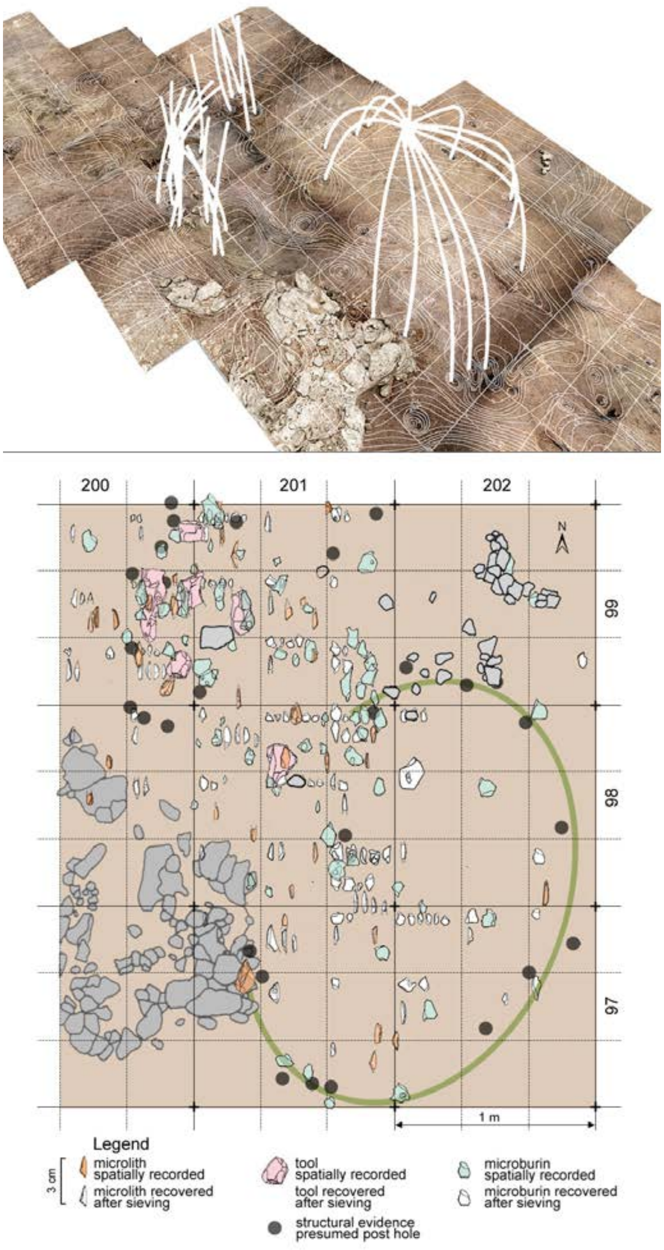


***Fig. 36**: Plotted artefacts (coloured) and artefacts recovered from sieving (white) distributed in the zone of the possible dwelling structure (shown as a suggestion in the picture above). / Distribuzione spaziale dei manufatti registrati in fase di scavo (colorati) e dei manufatti identificati in fase di vaglio (bianchi), relativa alla presunta struttura abitativa ipotizzata nell'immagine soprastante.*

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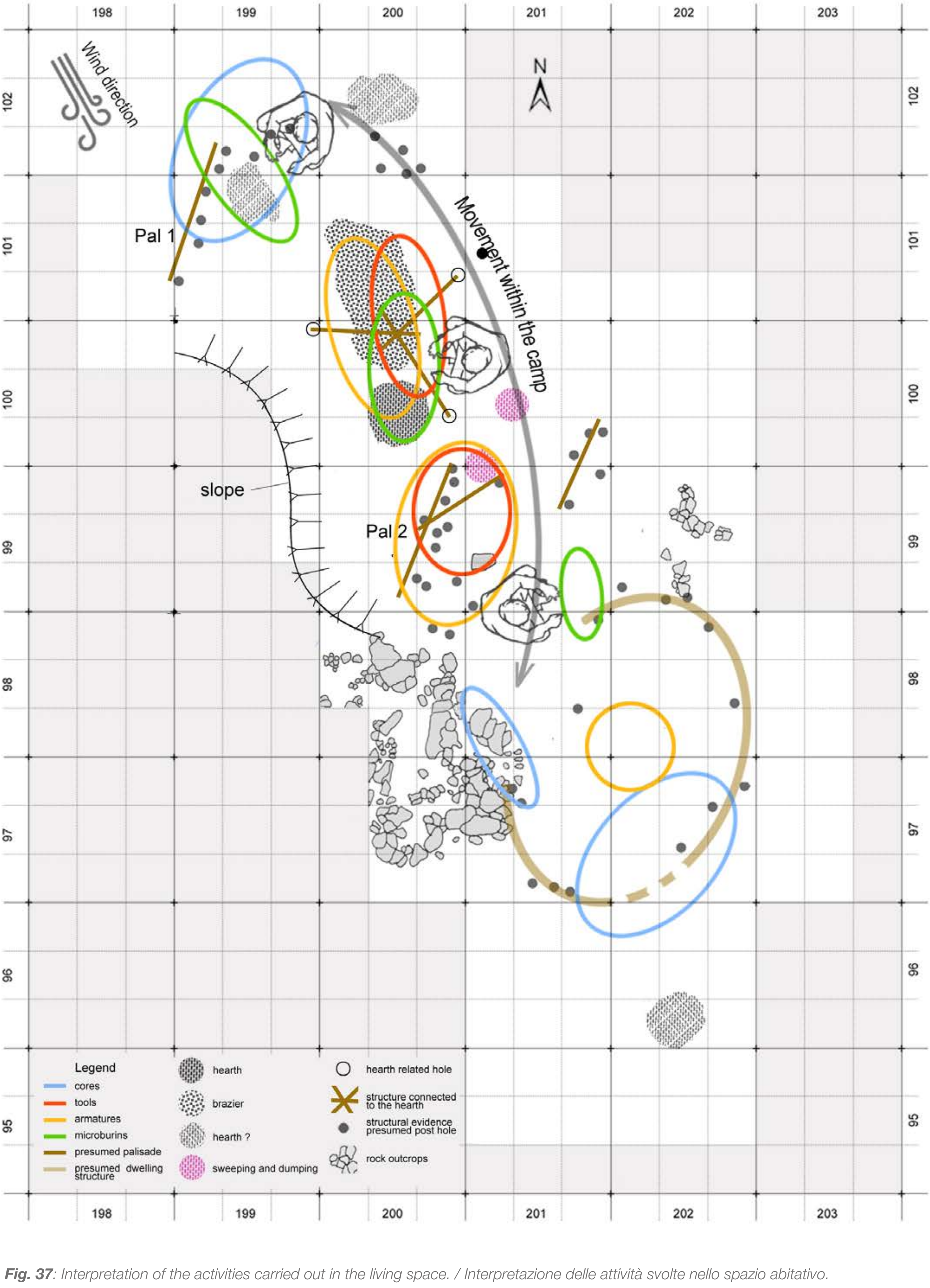

***Fig. 37**: Interpretation of the activities carried out in the living space. / Interpretazione delle attività svolte nello spazio abitativo.*

***Fig. 38**: Impressions from everyday life and conditions on SA 42 excavation. / Immagini relative all'attività di scavo archeologico nel sito SA 42.*

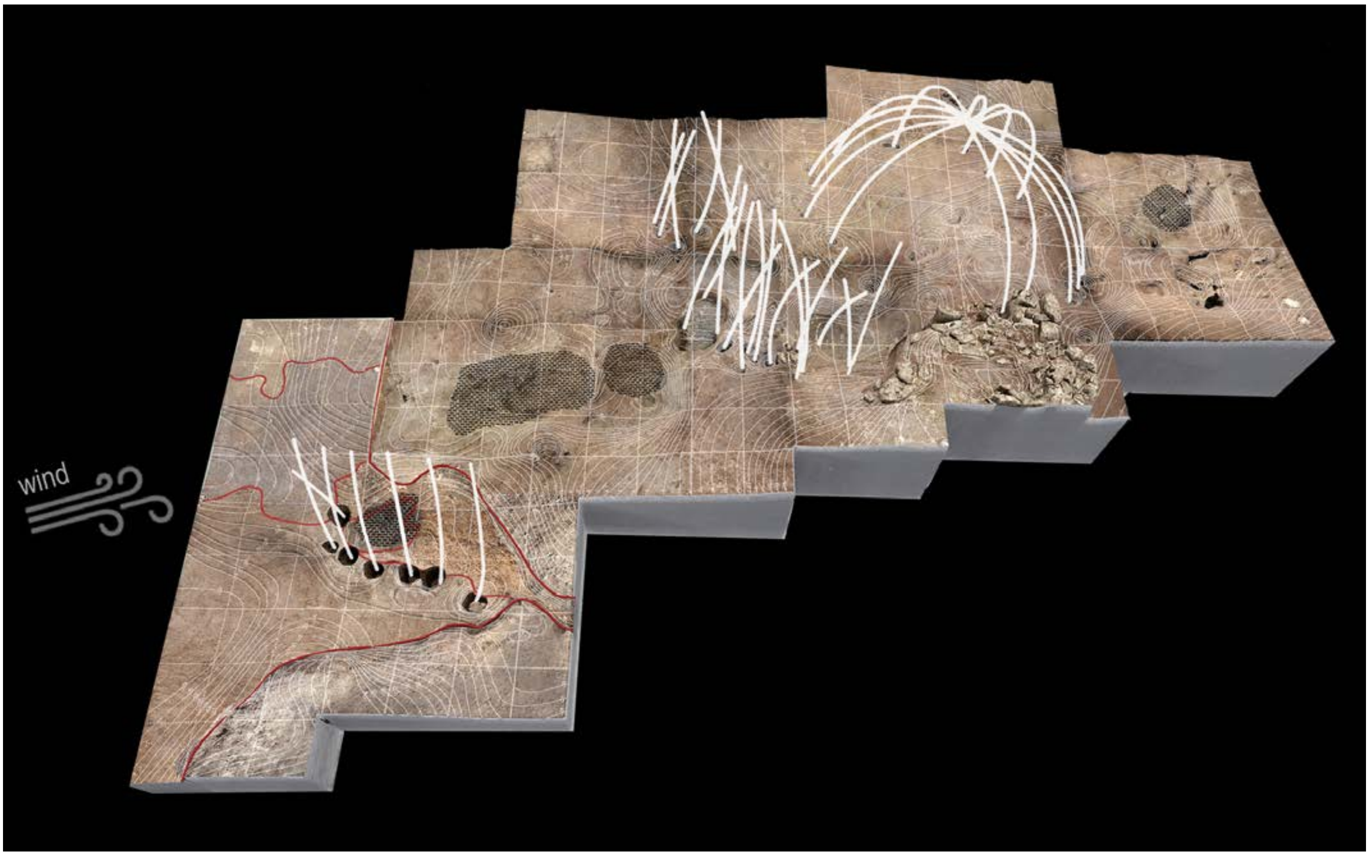

***Fig. 39**: Interpretation of the dwelling ensemble (Realization of the 3d images of the excavation area: visual4d Rendering&Multimedia, Rovereto). / Interpretazione del complesso abitativo (Realizzazione delle immagini 3d images dell'area di scavo: visual4d Rendering&Multimedia, Rovereto).*

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