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The Tschonstoan Rock Shelter at Alpe di Siusi – Seiser Alm

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ABSTRACT – The Tchonstoan Rockshelter, at 1870 metres on Alpe di Siusi, was the subject of systematic excavations. Authors present the results of their research by discussing the geo-morphological characteristics of the site, the raw materials and the typological and technological features of lithic industry.

Key words: Epigravettian, Trentino, Italy
Parole chiave: Epigravettiano, Trentino, Italia

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1. INTRODUCTION

The study of Late Glacial and Early Postglacial sites on the southern slopes of the eastern Alps and the Venetian Pre-Alps has made it possible to reconstruct the main stages of the process of repopulation of Alpine valleys and mountain areas by the last hunter-gatherers after the retreat of the Würmian glaciers, and to present an archaeological sequence of reference that covers the chronological interval between early Dryas and Atlantic (BROGLIO 1980; BROGLIO & LANZINGER, 1996). The topographic distribution and the age of the sites on the valley floor suggest a progressive penetration of the Alpine area by human groups along several routes, such as the Adige and Isarco valleys and the Cismon Valley. During temperate (Allerød) and warm (Preboreal and Boreal) phases, a way of life was followed that took place partly in the valley floor and partly in mountain areas. Finds made in the lower Adige Valley (Soman Rock Shelter near Ceraino), the Cismon Valley (Villabruna Rock Shelter in the Val Rosna) and on the mountain plateaus (in particular on the Sette Comuni Plateau at the Dalmeri Rock Shelter and in Val Lastari) are indicative of the settlement systems established during the Allerød: groups of Epigravettian hunters would leave the valleys in late summer and autumn and establish camps in sites at altitudes between 1000 and 1500 metres, to hunt ibex (CASSOLI *et al.,* 1999). Finds made in the Adige Valley at Trento (Romagnano, Pradestel, Vatte and Gaban Rock Shelters) and in numerous sites located between the Alpine watershed and the northern margin of the Venetian Pre-Alps (the most interesting data refers to the Frea IV Rock Shelter in Upper Valgardena-Gröden and Mondeval in Val Fiorentina) are instead characteristic of Preboreal and Boreal settlement systems: Sauveterrian hunters seasonally migrated from the valleys to altitudes between 1900 and 2400 metres, especially in the Dolomites, occupying either open sites in humid areas and on mountain passes or rock shelters, where they hunted ibex and deer (ALCIATI *et al.*, 1994; ANGELUCCI *et al.*, 1999; ALESSIO *et al.*, 1996). The two phenomena seem to be distinct and developed during the climatic phases of the Allerød and the Preboreal-Boreal, chronologically separated by the cold dry phase of the late Dryas, which lasted several hundred years. However, recent finds, amongst which Bus de la Lum on the Cansiglio Plateau (PERESANI *et al.*, 2000) and La Cogola Rock Shelter at the head of Val d'Astico (DALMERI *et al.*, 2000) suggest the persistence, at least in some cases, of systems characteristic of the Allerød also during the Late Dryas and the beginning of the Preboreal.

The Late Glacial age sites have provided lithic assemblages that are typical, from a technical and typological point of view, of the Late Italic Epigravettian, and differ from the contemporaneous industries of the northern slope of the Alps which are attributable to the Epimagdalenian (BANDI, 1968; BROGLIO, 1994). Postglacial sites have provided assemblages that can be ascribed to the Sauveterrian-Castelnovian, widespread in the Po Valley, Karst, Italian Peninsula, and in the Mediterranean regions of France; they differ from the complexes of Beuron-Coincy and Montbani north of the Alpine watershed (BANDI, 1968; BROGLIO, 1971; BROGLIO & KOZLOWSKI S., 1994). During the Late Glacial and Early Postglacial the Alpine watershed thus acted as a barrier, which was only overcome at the beginning of the Atlantic when in the Upper Rhine Basin and Adige Basin there appeared several common elements that are characteristic of the Late Mesolithic in the area of the Alps, such as deer antler harpoons (BAGOLINI & BROGLIO, 1985). It can therefore be considered that, until the Atlantic, contacts between populations in the southern Alpine area and contemporaneous populations in other regions of Europe – as evidenced in the Late Glacial by the phenomenon of "azilianisation" of Late Epigravettian industries dated to the Bølling-Allerød interstages (LAPLACE, 1964; BROGLIO, 1995) and in the Early Postglacial by the affirmation of operational sequences and of types of tools and backed tools characteristic of the Sauveterrian (BROGLIO, 1980) - were carried out through the regions of the Western Mediterranean and Upper Adriatic rather than across the Alpine passes.

Amongst the finds in the Dolomites, exceptional was that made in a small rock shelter formed by the eastern wall of a boulder known as Tschonstoan, at 1870 metres on the Alpe di Siusi – Seiser Alm. Already on the basis of the few artefacts unearthed, it was clear that the lithic assemblage of this site could not be ascribed to the Late Italic Epigravettian, as in the case of the Veneto and Trentino sites belonging to the end of the Upper Palaeolithic, nor to the Sauveterrian-Castelnovian of the Adige Basin, amply documented throughout the region and also in many sites of the Alpe di Siusi (BAGOLINI *et al.*, 1980, 1983; BROGLIO *et al.*, 1982; LUNZ, 1986). In 1986 the site was the subject of systematic excavations, the results of which are illustrated below.

2. GEOGRAPHIC AND MORPHOLOGICAL SETTING

The Alpe di Suisi (Seiser Alm) is the largest and most characteristic of the plateaus in the Dolomites. The altitude of the basal portion is 1850 metres above sea level. To the west it is bordered by a steep but not impassable slope which separates it from the morphological terrace where the towns of Siusi and Castelrotto are located (1000 metres a.s.l.), to the south by the peaks of I Denti di Terra rossa (2655 m.), Cresta di Siusi (about 2300 m.), Sasso Piatto (2958 m.) and Sasso Lungo (3181 m.). Of note is the large deep valley of Val Saltria which borders the Alpe to the northeast and joins it with Val Gardena at Santa Cristina and therefore with all the northern border, watershed with Val Gardena, which is characterized by a series of modest reliefs.

Due to intense prospecting activities in Alpe di Siusi, to date 23 prehistoric sites in which finds have been made on the surface or due to excavations have been reported (LANZINGER 1985; LUNZ, 1986). All these finds have been modest both in terms of area (concentrations of objects in areas of a few square metres), and in terms of the number of objects found. The boulder called Tschonstoan is found at an altitude of 1870 metres and is 800 m from the western border of the plateau, in the locality of Compatsch. The local substrate consists of vulcanites (hyaloclastic rock and pillow lava) from the Ladinica age. On this not very resistant lithology, glacier action has had a very soft effect on the landscape while the streams that followed have cut into the slopes. The axial parts of the plateau once held modestly sized lakes that are now completely filled with sediment or have become bogs (Palù grande and Palù piccola).

The boulder falls within the olisto liths category, which is well known in the Dolomite area. In this case it is a decametres large portion of a dolomite reef of the same type found on the overhead "Denti di Terra Rossa". During the middle Triassic it separated from the main carbonate body and slid along an ocean escarpment. The large boulder was progressively buried by slope sediments and by volcanic systems of the middle Triassic. Tectonic-orogenetic events and the morphogenetic actions of glaciers then selectively lowered the topographical levels of volcanic compositions with respect to the surrounding carbonate heights, drawing the present landscape of the plateau and exhuming the Tschonstoan block, which today rises up as an isolated carbonate boulder in a local context that is exclusively volcanic. The boulder is to be found on the lower part of the slope, close to the connection with the basal plain in proximity to a modest stream that has blandly cut into the slope. Locally, in the area surrounding the boulder, there are several small agricultural terraces.

3. THE EXCAVATION AND THE DEPOSIT

Excavation of the archaeological deposit in 1986 took place in the area below the rock shelter formed by the east wall of the boulder; along the other walls sample excavations were made with poor results (Broglio & Lanzinger, 1986). The anthropic deposit provided finds from different ages: a Palaeolithic industry, the subject of this paper; a Copper Age arrowhead; several ceramic fragments; post-prehistoric artefacts.

On the basis of the information supplied by the discoverers, the excavation covered an area of about 15 m^2 (Cion1) at the foot of the most sheltered part of the boulder on the eastern side. Two other sample takings, which gave almost no result, were made on the west side: Cion 3 over 4 m^2 and Cion 3 over 4 m^2. Normal excavation techniques were adopted with topographic and stratigraphical references. Excavated earth was systematically sieved using a 2 mm wide mesh.

The excavations brought to light a series of holes that affected the whole pedogenized series, down to the colluvial substrate. In the interior part, close to the walls of the shelter over an area of 1 m^2, there were signs of previous excavations and the presence of numerous blocks which, in order to improve the quality of the grazing land opposite the shelter, were in all probability taken from the outside and placed there. In the more external part, it was noticed that the original soil had been covered by a homogeneous layer of earth to level out the terracing of the neighbouring hay field. The very thin thickness of the organic layer of the profile indicates that this levelling took place in post-prehistoric times.

The portion of undisturbed soil below the re-excavations is limited to about 10–20 cm of sediment above the non pedogenized colluvial volcanoclastic substrate. In all probability, these are the lower parts of the original late glacial profile, and anyway were not affected by the prehistoric settlement levels. For all these reasons the stratigraphical and pedological examinations of the site do not have any significance for the purpose of palaeoenvironmental interpretation and the study of the utilisation surface.

4. THE LITHIC ASSEMBLAGES: THE RAW MATERIALS.

The density of the lithic assemblages, excluding the Copper Age arrowhead, which does not seem to be connected to any of the other finds, is low. 104 artefacts (including those collected by the discoverers) were found, which included two pairs of fragments that are connected.

Examination of the lithic material was based on macro-mesoscopic characterisation of the lithotypes represented using chromatic distinction and micro-palaeontologic parameters, with the intention of establishing the probable area of origin of the archaeological samples to compare them with samples of flint collected from outcrops in the area surrounding the site. The assemblage included a wide variety of lithotypes that can be divided into three groups:

a) flint originating from the Jurassic-Cretaceous series of the Veneto-Trentino Pre-Alps, described as *Selce Atesina s. l.* (Flint or Chert from Adige basin);

b) flint originating from the Middle Triassic formation of Livinallongo, described as *Selce Dolomitica* (Dolomite Flint);

c) rock crystal (Quartz) originating in the valleys between Pusteria and the Alpine watershed.

4.1. *Selce Atesina s. l.*

This is the most abundant lithotype (85% of the total). This large group includes red, greenish-yellow and grey lithotypes.

Several brownish-red archaeological samples are characterised by a microfossil faunal association, dominated by various species of *Globotruncana* which identify it as originating from Southern Alps outcrops of the upper Cretaceous. The most typical stratigraphical unit of this period is the Scaglia Rossa (Red Flake), a rock formation whose colour varies from whitish-pink to brick red, consisting of micritic limestone rich in planktonic foraminifers. Always represented in this, sometimes in great quantities, are flint layers in beds and nodules with colours that vary from brownish-red to bluish-red. One batch of red flint from Tschonstoan, that is homogeneous interms of colour but especially in its micro-palaeontological aspects, is characterised by a high concentration of radiolarians that are well preserved and visible with a microscope. This peculiarity suggests that it originated from outcrops that are stratigraphically located at the top of the formation.

The grey flint can be compared with flint contained in the formations of the middle-lower Cretaceous. The flint stone formation most typical of this chronological period is Biancone, constituted by an association of micritic white or slightly greyish limestone. In Val d'Adige these limestones do not exceed 20 m in thickness, while to the south and east they are thicker, exceeding 300 m on Mt. Lessini and in the Vette Feltrine. The flint is present in abundance throughaut the formation, with very variable colours and a vast range of tones. In general at the base of the formation the flint is a typical yellowish colour, and has pinkish tones in the areas where the thickness of the formation increases and the passage from the underlying Rosso Ammonitico is very gradual. In the intermediate part a greyish tone predominates, from tones in yellow in the low parts, progressively darker towards the top, in correspondence with the passage from the Scaglia Variegata. Most of the artefacts found at the site can be attributed to this formation, even though they present extreme chromatic and structural variability. Several flints are characterised by the widespread presence of whitish marks and opaque "flames" in light grey or milky coloured paste. A small batch of grey glassy flint found well away from the rest of the assemblage also forms part of this group.

In several grey artefacts, cavities are visible: these are connected to the dissolution of dolomite rhombohedrons. This characteristic has up to now not been found in other archaeological assemblages from the Adige basin, while it has been noted in other areas and in several geological outcrops in the Southern Alps. Various mechanisms have been suggested to explain the phenomenon, and a greater concentration of outcrops with this characteristic can be found in the proximity of active tectonic margins. Dolomitization phenomena of the stratigraphic unit during the passage from to the Jurassic to Cretaceous (Rosso Ammonitico and Biancone) are also documented in areas where there exists Tertiary Volcanism, to which they may be connected. These areas are found in central-east Trentino (mostly east of the Adige Valley) in the areas of Lessini and the Asiago Plateau. The same areas, and particularly the most eastern sectors of the Trentino-Veneto area, also show evidence of intense Tectonic sin- and post- sedimentary deformation that also affected the same stratigraphical intervals.

A certain number of yellowish artefacts can be compared with the flint outcrops of the middle Adige Valley in the area between Trento and the lower Val di Non, in Mount Lessini, in Tesino and in the Asiago Plateau. This is a relatively characteristic flint as regards its limited vertical distribution within Cretaceous stratigraphical series, which is situated in the proximity of the transition between Scaglia Variegata and Scaglia Rossa. The Scaglia Variegata is represented by greyish marly limestone marked with bioturbation and organised in decametre wide layers which alternate with blackish-grey marl (a little thicker than 20-30 cm). The transition from the underlying formation is progressive and sometimes difficult to determine, and is characterised by a progressive increase of the organic fraction of the sediment. The flint is typically dark, grey with blackish streaks or more commonly tending toward black, often with differently coloured flecks, even if, they are not as frequent as Biancone.

A few pieces, decidedly in the minority, are somewhat similar to the flints of Rosso Ammonitico, which are abundant in the intermediate levels of the formation (Fonzaso Formation), consisting of a sequence of tightly stratified red and pinkish limestone, in which the violaceous red to greenish flint is present in the beds and nodules. This stratigraphical layer is well represented in the eastern sector of the Veneto-Trentino area, and its gradually gets thinner towards the Adige Valley, where in some cases it is not even present.

4.2. *Selce Dolomitica*

This flint is not glassy, often opaque, has a granular appearance, colour between black and blackish-brown, greenish or greenish-brown. This flint is found in the middle Triassic formations of Livinallongo. The finds at Tschonstoan originate from different stratigraphic levels, within the same sedimentary sequence: black lithotype characteristic of the 10-20 m basal (Plattenkalk) and blackish-brown lithotype from the middle-upper part of the unit (Knollenkalk). The Livinallongo formation is widespread throughout the Dolomites but especially in the area between Canazei and Ortisei, south-west of Alleghe and in a narrow band that extends between Ortisei – San Vigilio di Marebbe and the southern slopes of Monte Popera at Sesto.

In many Mesolithic sites in the Dolomites, this type of flint, at times associated to the flint originating from the Cretaceous formation of Marne del Puez, was used together with Atesina flint s.l., always with a relatively low incidence.

At Tschonstoan, as in other Mesolithic sites in the Dolomites, little use was made of local lithic resources: "Dolomite" flint supplied 15% of the materials used to make the artefacts, and rock crystal 2%. Exploitation of resources was limited to the Livinallongo Formation and ignored other flint formations, of better quality, such as the Marne di Puez, also used in historic times for the production of steel. Due to the fact that the better quality flint of Marne di Puez is found in Upper Val Badia and in Gardenaccia, it is possible to hypothesise that these areas were not reached by the routes taken by the hunters of Tschonstoan. However they had to reach the valleys to the north of Pusteria to procure rock crystal.

The other artefacts (85%) were made of materials originating from upper Jurassic and Cretaceous outcrops in the Trentino-Veneto areas, and are referable to the large group normally defined as "Atesina Flint". In reality these terms are not really correct, as the lithic material to which they refer is present over a wide area, which comprises the middle basin of the Adige, the areas of the plateaus of Asiago, Folgaria, Lavarone and the area of Tesino. Amongst the materials found at Tschonstoan, litho types from the Rosso Ammonitico (Fonzaso Formation p.p.), Biancone, Scaglia Variegata and Scaglia Rossa are present. These are distributed over a large area more or less corresponding to the large palaeogeographical Jurassic domain known as the Trento Platform. As already mentioned, the Fonzaso Formation, well represented in the eastern part of the Veneto-Trentino sector, comes almost completely to an end at the western margins of Altopiano di Folgaria; therefore it would seem that we can exclude the origins of materials from this formation from the central-west sectors of Trentino.

Analysis of the relative percentage within this group evidenced that the elements made of materials from the lower Cretaceous (Biancone) formations are much more abundant. This may limit the origin of the material to the areas where Biancone is well represented and contains flint suitable for flaking. This area corresponds to the eastern sector of the Veneto-Trentino plateau which circles around the Altopiano di Asiago and the northern part of the Tesino basin. In this area Biancone flint is present in nodules characterised by a widespread presence of white opaque veins and marks, similar to those of Tschonstoan, which are rarer in the western area. In the same area the presence of grey glassy flint is widespread; one must also take into account that flint with dolomite crystals is documented in the eastern sector (for example in Valle del Piave), but has not been found in geological samples or archaeological assemblages from western Adige Valley.

These considerations suggest that most of Tschonstoan's lithic material comes from the central-west sector of the Trentino-Veneto area, bordered to the west by the Valle dell'Adige and to the east by Valle del Piave. The outcrops of Monte Baldo and Upper Lessini are therefore excluded.

These are associated with a small quantity of low quality flint, originating from Dolomite outcrops, probably used only occasionally.

5. DEBITAGE

In classifying the lithic finds, the proposals of Inizan *et al.* (1995) were followed as regards the technological characteristics, and those of Gallet (1997) for morphometry. In identifying the stages of debitage, reference was made to a uni- and bi-directional blade and bladelet production method starting with precores made from large flakes, by direct percussion using a soft-stone hammer.

The collection consists of 103 artefacts with a total weight of 113.6 gr, which are attributed to 32 technological categories (Tab. 1) and to 5 stages of knapping (Tab. 2). From a morphological viewpoint there are 16 flakes, 12 blades, 51 bladelets, 2 burin remnants, 1 core and 20 unidentified fragments. 80% of the artefacts are represented by fragments.

For the attribution of the artefacts to the 5 knapping stages, the criteria below were followed.

1 – Shaping out: flakes with more than 25% of the dorsal face occupied by cortex and without previous flaking scars.

2 – Core reduction: preparation and re-preparation flakes of the flaking surface and flakes resulting from rejuvenating of striking platform(s).

3 – Production: retouched flakes; blades and bladelets even if they were later retouched.

4 – Production accidents: flakes, hinged or plunging blades and bladelets.

5 – Abandonment: cores.

The number of artefacts attributed to the initial shaping-out stage of the block of raw material represents 4% of the total and 18% of the overall weight. The reduction stage, which comprises elements derived from the actions necessary for re-preparation of the striking platform(s) and from rejuvenation of the flaking surface(s), accounts for 15% of the artefacts and 31% of their weight; production accounts for 80% of the artefacts and 43% of their weight. Micro-burins and burin remnants were not taken into consideration as they are the result of work carried out after debitage. Several flaking products were used without further retouch (infra, p. 79), while others underwent subsequent reworking, as evidenced by the presence of knapping residues such as micro-burins, burin remnants and those from the retouching of blades and flakes. The only core found belongs to the abandonment stage (Fig. 2), and weighs 4.2 gr. The lithological categories have been grouped according to the corresponding knapping stages (Tab. 3).

The lithic assemblage at Tschonstoan suggests a sequence of operations aimed at the production of blades and bladelets. The creation of blade and bladelet blanks requires a series of preparatory actions on the raw block of material, so that a pre-core with optimal shape and dimensions can be obtained. In order that blank knapping can begin, a pre-core must meet minimum requirements such as the presence of a striking platform and flaking surface that form an angle less than 90°. The flaking surface must have a ridge or a pronounced convex shape that runs longitudinally starting from the proximal part of the pre-core (i.e. close to the angle formed with the striking platform) down to the distal end of the area to be used for production. This morphology can be obtained in various ways, depending on the initial shape of the raw block. It is possible to exploit the natural convexity of nodules of lenticular shape, block edges, and the lateral profiles of large flakes, or create ridges or dihedral angles by removing flakes including entire block surfaces, or else use the "Corbiac technique" (BORDES, 1968). In the Tschonstoan assemblage, 4 artefacts (3 bladelets and a blade with proximal fracture) suggest the method adopted: in fact, they have *sous-crêtes* on their dorsal surface (PELEGRIN, 1995). The other artefacts, with the exception of the two partially corticated flakes, belong to subsequent knapping stages.

During production a knapper may encounter problems caused by progressive flattening of the flake surface, which needs to be restored by detachment of lateral flakes, blades or bladelets, to accentuate the bending of the core. As production progresses it is necessary to regulate the angle between the striking platform and flaking surface by detaching flakes from the platform (*tablettes*). This stage of reduction is represented by 6 flakes resulting from the rejuvenation of the flaking surface, a lateral bladelet, three lateral flakes and a *tablette.*

At Tschonstoan the products include 9 blades (1 whole blade, 1 with proximal fracture, 1 proximal fragment, 2 medial fragments, 4 distal fragments), 37 bladelets (3 whole, 1 with proximal fracture, 5 with distal fracture, 8 proximal fragments, 24 medial fragments and 6 distal fragments), and 2 flakes (one unidentifiable due to retouching and 1 unidentifiable due to retouching and fracture). The dorsal surface of the blade products presents unidirectional scars, the bladelet products unidirectional and bi-directional scars. All the bladelets obtained using the bi-directional method are made from allochthonous flint (Tab. 5).

The core, obtained from a flake, presents negative scars of two main flakes, whereby the knapper obtained the striking platform and then a bladelet. The angle formed by the striking platform and flaking surface is about 75°. Besides these flakes others are present, from the preparation of the striking platform and the flaking surface, obtained starting from the striking platform: two of these precede the detachment of the bladelet, and are positioned near the impact point.

The artefacts have been attributed to five categories on the basis of the morphology of the ventral surface (Tab. 4). Of the 27 products with concave ventral surfaces, 75% were obtained using the unidirectional method and 25% using the bi-directional method. Of the 26 products with a linear ventral surface, 85% were obtained by the unidirectional method and 15% the bi-directional method.

From analysis of the morphology of butts (LAPLACE, 1964) and the methods of preparing the impact point (GALLET, 1998), information was obtained regarding the knapping techniques employed.

Five types of butts (plain, dihedral, faceted, punctiform, linear) were identified. The presence of corticated butts was not found in any of the artefacts (Tab. 6).

Six types of preparation of the impact point were identified (i.e. the process of reduction of the flaking surface area immediately in front of and/or at the sides of the butt) (Tab. 7).

The artefacts with a proximal part were attributed to two categories based on the dimensions of the bulb (GALLET, 1997). 71% had an elevation = 1.5 mm and an extension = 5 mm; 29% were characterised by a bulb elevation > 1.5 mm and an extension > 5 mm (Tab. 8).

The dimensional characteristics of the bulb can be associated to the intensity of force used by the knapper at the impact point, the direction of the strike (receding or tangential), any discontinuities present in the flint, the type of material used as a hammer (hard stone, soft stone, horn, wood), and the percussion technique (direct or indirect).

The processing of the products on site is represented by knapping debris (ordinary microburins and burin remnants), flaking accidents (dorsal micro-burins) and backed tools in the course of being manufactured. The only core is at an initial stage of processing, so it is not possible to identify the method of production and technique employed.

Direct percussion is evidenced by the presence of products with a flat ventral surface obtained using the bidirectional method, by the morphology of the butts and the extent of the bulbs. The use of a stone hammer (PELEGRIN, 1997) seems to be demonstrated by the characteristics of the butts (mostly plain and faceted, but never dihedral), by the type of preparation of the impact point (removal of flakes from the flaking surface and abrasion of the overhang) and the extent of the bulb in the products.

6. TYPOLOGY

Fifty-two artefacts were retouched: two tools (a frontal scraper fragment; a small backed knife: (Fig.2), 6 flakes or blades with partial marginal retouching (Fig. 2) and 43 bladelet backed tools (Fig. 3). There was also one splintered piece (Fig. 2), 2 sharpening spalls (Fig.2), 6 microburins, of which one ordinary and 1 backed (Fig.3) and 4 backed tools in the course of manufacture (Fig.3).

Examination of the materials used shows a preference for allochthonous flint, since 54% of the allochthonous flint blanks were used to produce tools or backed tools, against 37% of the blanks in Dolomite flint. Allochthonous flint was used for 92% of retouched artefacts, and Dolomite flint for 6%. The preference for allochthonous flint is even more marked if one excludes flakes and blades with marginal retouches. Given the high incidence of backed tools with respect to other tools, the preferential use of bladelet and micro-bladelet blanks is evident.

The 43 backed tools, the 4 unfinished backed tools and the 6 micro-burins constitute, from a typological viewpoint, the most interesting assemblage of the collection (Tab. 10). An initial observation can be made regarding the typometry of the backed tools, by dividing them into three typometric categories of length exceeding 25 mm (I), between 25 and 12 mm (II), and less than 12 mm (III). In order to make a correct comparison with other assemblages, only those coming from excavations carried out using the same methodology were considered (that is, sieving the sediments of the anthropic unit with a 2 mm mesh and then washing the residue). As can be noted in Tab. 12, 63.4% of the backed tools of Tschonstoan fall within category I, while category III represents no more than 2.4% of the total. Category III increases markedly in the late Epigravettian assemblage at Piancavallo with segments and triangles and even more so in the Sauveterrian sequence at Romagnano III (40 – 60%). It is therefore evident that, from the viewpoint of their typometry, the backed tools of Tschonstoan differ from the segment and triangles industries that characterised the very end of the Epigravettian and the Sauveterrian sequence.

A second consideration can be made concerning the typology of the backed tools. From this point of view a distinction must be made between backed points, backed bladelets, triangles, and segments.

The backed points are represented by 5 fragments of which 1 could be attributed to a double backed point (Fig. 3). Due to the fragmentation of these backed tools it would not seem reasonable to go beyond a generic attribution to the late Epigravettian.

Backed bladelets are represented by 20 pieces that prevalently show an "intermediate" retouch between the marginal and backed type, and which can be typologically classified close to the *Lamelles à dos* of the late Magdalenian and the Epimagdalenian. The blanks comprise both bladelets and micro-bladelets, while the retouch - although limited to the marginal area of the blank - presents a greater intensity of marginal retouching and a rectilinear or sub-rectilinear trend. Backed tools of this type, though present, are rare in the late Epigravettian (Fig. 4-5). Only one backed tool may be classified as a deep backed bladelet, and one fragment as a backed bladelet with truncation.

There are also two fragments of probable segments (on a bladelet blank) and two triangles (Fig. 3). Microburin technique is documented by 4 ordinary microburins and one "Krukowski" backed microburin (Fig. 3).

7. FUNCTIONAL ANALYSIS

The functional analysis of the Tschonstoan lithic assemblage included the identification, quantification, and observation of the degree of evolution of the alterations suffered by the artefacts. The lithic assemblage observed through a stereomicroscope at low magnification (10X – 63X) shows macro traces and wear caused by use. Observation through a reflection light metallographic microscope of silicone casting of the micro-surface of several artefacts showed the presence of as light alteration of the surface of the artefact, and demonstrated the absence of micro-traces that can be attributed to an extremely short and occasional period of use that has not left any evidence.

Analysis of the surface alterations and the selection of the material was carried out taking into consideration 93 artefacts, of which 92 where flint and 1 rock crystal. Preliminary observation identified the quantity of artefacts that had been subjected to strong thermal stress by fire (presence of concave fractures and fissures, pinkish surface colour). This type of alteration produces radical changes in the structure of flint, and as a consequence, completely cancels any evidence of utilisation. For this reason 11 artefacts were not analysed, and only one, with this alteration at the initial stages, was subjected to analysis.

Tab. 13 shows the data relative to surface alterations (Levi-Sala, 1993; Plisson & Mauger, 1988; Röttlander, 1975; Stapert, 1976; Texier, 1981).

Also present were 19 artefacts with mechanical type alterations, i.e. micro-flaking attributable to flint on flint rubbing which occurred during deposition, during the removal of the artefact and/or caused by the compression of the sediment or by trampling. However this alteration did not, in most cases, prevent the recognition of wear macro-traces as it was of a light degree.

White patina was identified on 27 artefacts, which mainly attacked grey or whitish coloured flints. Caused by chemical-physical phenomena, white patina causes an alteration of the flint structure that stands out due to the different refraction of light caused by a whitish halo – almost a veil – that tends to cover the whole artefact. In the most advanced stages, this alteration changes the flint into an amorphous structure, with a chalky consistency. The industry at Tschonstoan presents white patina at its initial / medium stage of development. A glossy appearance (soil sheen and glossy patina) was observed, which can be recognised by the homogen ous luminosity that it creates on the surface of the artefacts. This alteration is caused by the mechanical phenomenon of abrasion which produces a gloss technically defined as soil sheen, or by chemical phenomena which cause a gloss technically defined as glossy patina. This patina is present on 54 artefacts, generally at a quite advanced stage, which most by prevents any evaluation of the presence of use micro-traces.

In conclusion, the conservation of this lithic assemblage did not permit metallographic and interferometric analysis with optical systems for the identification of any polishing, micro-abrasion, micro-rounding and residues. The function study was performed by analysis of the use macro-traces (micro-flaking, wear) (SHEA, 1991; LONGO, 1994; LEMORINI, 1997; BROGLIO *et al.*, 1998). 82 (88%) of the artefacts were discarded and on 11 (12%) pieces macro-traces for diagnostic use were found. The categories of the discarded, materials are represented by those artefacts that did not have utilisation macro-traces along their edges. Obviously, artefacts that have undergone medium/advanced stages of thermal alteration could not be analysed.

11 (12%) of the artefacts had utilisation macrotraces for a total of 16 used areas (PFA). These areas coincide with the parts of the edges on which the macro-traces developed. Tab. 14 summarises the data relative to the actions carried out and the worked materials. As regards the, a detailed evaluation was made; as regards the letter, the macro-traces analysis only supplies generic indications on the consistency of the material worked. Three categories of materials were identified: less resistant (animal tissues, vegetable fibre); resistant material (soft wood, wet or dry hides, soft stone); very resistant material (bone, horn, hard stone, hard wood, teeth, shell). Intermediate categories were inserted for those cases where the interpretation of the worked material was uncertain.

Seven artefacts had impact macro-traces. These were blanks that were processed and used as projectile points: exclusively points, backed bladelets and retouched bladelets. Of particular note was the double use of one backed bladelet, which was used both for a cutting action and as a projectile point. A second interesting example is a retouched bladelet, which on both ends has impact fractures that are difficult to interpret: in this case they could be related to reuse of the artefact.

The un-retouched blades were used for several actions, specifically for scraping, cutting and carving. Cutting is differently associated to three categories of material; the incision was made in a resistant/very resistant material. It is emphasised that the consistency of the object struck is also conditioned by the velocity of the impact.

Significant were the traces that evidence the presence of a handle, identified on two un-retouched blades. On both blades, the macro-traces were localised at the left margin, while in one case two distinct areas on the same margin were identified but referable to the same evidence. These macro-traces are the product of the slight rubbing of the handle on the artefact that was partially inserted but not perfectly immobilised in it.

8. DISCUSSION

The first problem posed by the Tschonstoan lithic assemblage regards its homogeneity and its chronological and cultural attribution. Considering the modest number of artefacts and the impossibility of correlating a specific type of lithic material with a method of exploitation and product processing, as well as the compatibility of the association from a technological and typological viewpoint (apart from the Copper Age arrowhead), incline us towards the homogeneity of the assemblage. The production of blanks belongs to the processes already known in the Late Epigravettian period of the region; the use of direct percussion with a soft stone hammer (MONTOYA, 2000. pers. comm.) suggests a period between the Allerød and the beginning of the Preboreal. The considerations made regarding the dimensions of the backed tools would seem to exclude both an Epigravettian hypermicrolithic facies and the Sauveterrian. It is nonetheless evident that the Tschonstoan assemblage differs in the typological structure from the coeval industries of the Late Epigravettian, as several categories (backed points, backed and truncated bladelets) are underrepresented, while a very rare category (*lamelles à dos* of the type noted in the Epimagdalenian) is well documented. We exclude that this is due to a north Alpine influence, as most of the materials used to produce the bladelet blanks originate from the area of the Asiago plateau or the Tesino, where late Epigravettian industries are widespread and are the only ones present between the Allerød zone and Preboreal. We are therefore led to consider that the anomalous typological structure of the assemblage is to be correlated with the activities carried out at the site.

To describe the environmental surroundings of the site at the time of prehistoric human presence, the area offers several palynological studies, one of which in fact dealt with a humid biotype in Alpe di Siusi. Unfortunately, like other upper-level peat bogs in the area, organic sedimentation is documented only from the end of the Boreal, in the Holocene. Palaeoenvironmental interpretation of the preceding periods is consequently based on the palynological literature regarding the mountain area of the region, in particular on the pollinic series of Viotte di Monte Bondone on the mountain of Trento (KOFLER, 1994) for the Late Glacial period, and of Hirschbichl near the Staller Sattel - Osttirol (OEGGL & WAHLMULLER, 1994) for the Holocene. In whatever way the interval of anthropic occupation of the shelter is identified - whether attributed to the Late Glacial or Preboreal - the situation around the site must have been that of Alpine meadow or the upper limits of the forest, with pine and larch associations among the dominating arboreal species in an open forest. Human occupation of the site, in this environment, is suggested by the typological structure of the lithic assemblage and by functional analysis of the backed tools: it was evidently a temporary camp, used during hunting expeditions. Other more recent sites (Boreal) of the Alpe di Siusi, situated at greater altitudes (about 400 m higher) have furthermore led to the same conclusions (LANZINGER, 1985).

Examination of the lithic assemblage permits the affirmation that the Epigravettian hunters arrived at the Alpe di Siusi with equipment mainly consisting of bladelet blanks destined for the production of backed tools, which were finished at the site. In the Dolomite area they procured local flint and, north of Val Pusteria – Pulterstal, rock crystal. They consequently knew the Dolomite area and its resources well. In this occupation, Tschonstoan, an isolated boulder, must be considered a reference point, almost a landmark.

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Tschonstoan was reported as an archaeological site by J.M. Moroder and F. Prinoth, collaborators of the Museum de Gherdeïna in Val Gardena – Gröden, who made a survey at the foot of the boulder and found several artefacts that are now conserved in the Museum. In July 1986 A. Broglio and M. Lanzinger organised an excavation of the site, with the participation of Prof. L. Cattani, the Drs S. Bonardi, E. Gerhardinger, L. Longo, M. Luise, M. Peresani, Mr A. Alleganzi and V. Rotelli. The work was carried out with a financial contribution from the "Soprintendenza ai Beni Culturali della Provincia Autonoma di Bolzano", thanks to the kind assistance of Dr L. Dal Ri, Archaeologist of the Province. The finds from the excavations are conserved at the Museo Archeologico Provinciale of Bolzano.

SUMMARY - The Tschonstoan shelter (Alpe di Siusi, Eastern Dolomites) is situated at an altitude of 1870 m a.s.l., and is formed by a jutting rock face of a carbonate boulder that rises in isolation in a local vulcanic context. The excavations of the archaeological deposit, carried out in 1986, covered an area of 15 sq. m. below the eastern wall of the boulder, and brought to light artefacts from different periods, including historic ceramic fragments, a Copper Age arrowhead, and an Upper Palaeolithic assemblage which is the subject of the present study. This work presents an analysis of the lithic finds that had the aim of identifying the lithotypes (Atesina flint, Dolomite flint, rock crystal) and the originating areas, a reconstruction of the operational sequences adopted for production of the blanks and the typological definition and typometry of the tools and backed tools, as well as their utilisation. The results permit the lithic assemblage to be attributed to the late Epigravettian, and to hypothesise sporadic occupation of the site connected to hunting activities in the final phase of the Upper Palaeolithic by human groups originating from the south Alpine area (Asiago Plateau – Tesino).

RIASSUNTO - Il riparo del Tschonstoan, (Alpe di Siusi, Dolomiti Orientali) si trova a 1870 m s.l.m., ed è formato dalla parete aggettante di un masso carbonatico che si erge isolato in un contesto locale di tipo vulcanico. Lo scavo del deposito archeologico, realizzato nel 1986, interessò un'area di 15 mq sottostante la parete orientale del masso, e restituì manufatti di età diverse, tra cui frammenti di ceramica di età storica, una punta di freccia dell'Età del rame ed un insieme litico del Paleolitico superiore, oggetto di questo studio. Viene presentata un'analisi dei reperti litici volta all'identificazione dei litotipi (selce atesina; selce dolomitica; cristallo di rocca) e delle aree di provenienza, alla ricostruzione delle catene operative adottate per la produzione dei supporti, alla definizione tipologica e tipometrica di strumenti ed armature ed alle modalità con cui è avvenuto il loro utilizzo. I risultati pervenuti consentono di attribuire l'insieme litico all'Epigravettiano recente e di ipotizzare una frequentazione sporadica del sito legata all'attività di caccia nella fase finale del Paleolitico superiore, da parte di popolazioni provenienti dall'area sud-alpina (Altipiano di Asiago-Tesino).

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Technological category	**Number**	**Technological category**	**Number**
Partially corticated flakes	2	Side bladelets	1
Partially corticated flakes with proximal fracture	1	Bladelets with proximal fracture	1
Flakes	3	Bladelets with distal fracture	5
Flaking surface re-preparation flakes	6	Bladelets with proximal and distal fracture	1
Tablettes	1	Proximal bladelet fragments	8
Proximal flake fragments	2	Medial bladelet fragments	23
Medial flake fragments	1	Distal bladelet fragments	6
Blades	1	Hinged bladelets	1
Blades with proximal fractures	1	Hinged bladelets with proximal fracture	1
Plunging blades with proximal fracture	1	Distal hinged bladelet fragments	1
Proximal blade fragments	1	Burin remnants	1
Medial blade fragments	2	Burin remnants with distal fracture	1
Distal blade fragments	4	Bladelet cores	1
Distal plunging blade fragments	1	Undetermined due to retouching	1
Distal hinged blade fragments	3	Undetermined due to fracture	9
Bladelets	1	Undetermined due to retouching and fracture	10

Tab.1 - Frequency of the technological categories.

Work stage	Number	Weight (g)
Shaping out	2	18.0
Core reduction	11	31.2
Production	64	43.5
Production accidents	1	2.6
Abandonment	1	4.2
Total pieces	79	99.5

Tab.2 – Shows the number of artefacts belonging to the different knapping stages and their total weight. It was not possible to establish the knapping stage for 19 elements that had a total weight of 13 gr. 6 artefacts deriving from the reduction of products were not taken into consideration.

	Shaping out	Reduction	Production	Abandonment
Allochthonous flint	1	8	62	1
Dolomite flint	1	2	2	
Rock crystal		1		
Total	2	11	64	1

Tab.3 - Number of artefacts attributed to the different knapping stages. Artefacts that were the results of blank reduction (2 burin remnants and 5 micro-burins) and those that could not be identified were not taken into account: these consisted of 13 fragments of allochthonous flint, 3 in local flint, 1 rock crystal and two thermally altered fragments.

	Allochthonous flint					Dolomite flint					Rock crystal				
	V1	V2	V3	V4	V5	V1	V2	V3	V4	V5	V1	V2	V3	V4	V5
Shaping out	1					1									
Reduction	3		3		2			2			1				
Production	27	3	24	3	3			2							
Production accidents				2											
Abandonment		1													
Total	31	4	27	5	5	1		4			1				

Tab. 4 – Frequency of the type of ventral surface of the artefacts attributed to the various knapping stages: V1 concave, V2 convex, V3 flat, V4 *torse*, V5 undulated.

	Allochthonous flint		Dolomite flint		Rock crystal	
	S1	S2	S1	S2	S1	S2
Shaping out	3					
Reduction	8	1	2		2	
Production	49	7	1			
Abandonment	1					
Total	61	8	3		2	

Tab. 5 – Frequency of the type of dorsal surface of the artefacts attributed to the various knapping stages: S1 surface with unidirectional negative scars; S2 bi-directional scars.

	Allochthonous flint					Dolomite flint					Rock crystal				
	T1	**T2**	**T3**	**T4**	**T5**	**T1**	**T2**	**T3**	**T4**	**T5**	**T1**	**T2**	**T3**	**T4**	**T5**
Shaping out															
Reduction	1	1	3			2					1				
Production	5		5	3	3										
Production accidents															
Abandonment															
Total	6	1	8	3	3	2					1				

Tab. 6 – Frequency regarding the butt type of artefacts attributed to the various knapping stages: T1 plain, T2 dihedral, T3 faceted, T4 punctiform, T5 linear.

	Allochthonous flint							Dolomite flint							Rock crystal						
	P1	**P2**	**P3**	**P4**	**P5**	**P6**	**P7**	**P1**	**P2**	**P3**	**P4**	**P5**	**P6**	**P7**	**P1**	**P2**	**P3**	**P4**	**P5**	**P6**	**P7**
Shaping out																					
Reduction	2		1		1	2		2							1						
Production	12	1		1	1	1	4														
Accidents																					
Abandonment																					
Total	14	1	1	1	2	3	4	2							1						

Tab. 7 – Frequency of impact point preparation methods for the various knapping stages: P1 behind (by removal of flakes from the proximal part of the flaking surface), P2 raised (by removal of flakes from the striking platform), P3 behind and raised (a combination of 1 and 2), P4 *behind* (due to the presence of a negative bulb left by a preceding flake removal), P5 behind and raised (a combination of 4 and 2), P6 unprepared, P7 abraded.

	Allochthonous flint		Dolomite flint		Rock crystal	
	B1	**B2**	**B1**	**B2**	**B1**	**B2**
Shaping out						
Reduction	1	4	2			1
Production	18	3				
Production accidents						
Total	19	7	2			1

Tab. 8 – Frequency of bulb type for the various work stages: B1 elevation of bulb = 1.5 mm, extension = 5 mm; B2 bulb elevation > 1.5 mm, extension > 5 mm.

	% of retouched blanks of the total number	**% of retouched blanks of the total number of retouched pieces**
Flakes	13%	5%
Blades	41%	10%
Bladelets	70%	85%

Tab. 9 – Frequency of retouched blanks.

Backed points	4	Fragments of backed bladelets	12
Double backed points ?	1	Triangles	2
Marginal backed bladelets (including fragments)	20	Segments	2
Backed bladelets	1	Various proximal truncation on small flake	1
Backed bladelets and truncation	-	Total	43

Tab. 10 – Frequency of backed tools.

Fragments with deep backed retouch	I	II	III	?
Medial fragments	7	1	-	1
Distal fragments	1	2	-	-
Retouched marginal fragments				
Proximal fragments	6	1	-	-
Medial fragments	1	2	-	1
Distal fragments	4	-	-	1

Tab. 11- Typometry of backed tool fragments.

	Ov.bl.i.	**Blades i.**	**I**	**II**	**III**
Tschonstoan	89.1	4.9	63.4	29.3	2.4
Rom III AC7	64.3	1.0	11.7	37.7	49.6
Rom III AC8-9	62.3	-	15.7	44.2	40.0
Rom III AE-AF	74.5	1.4	13.3	26.4	59.0
Piancavallo	64.0	6.9	15.0	55.2	23.0

Tab. 12 – Indexes of frequency of retouched blade blanks s.l. (overall blade index, selective blade index, category I typometric index, category II typometric index, category III typometric index). Lithic assemblages considered: Tschonstoan; Romagnano III AC7 and AC 8-9 (middle phase of the Sauveterrian); Romagnano III AE-AF (early Sauveterrian); Piancavallo (end phase of the Epigravettian).

Alteration type	**Frequency**	**% Frequency**	**With traces of use**	**Without traces of use**
Thermal	12	13%	1	11
Mechanical	19	20%	4	15
White Patina	27	29%	4	23
Glossy appearance	54	58%	6	48

Tab. 13 - Alteration of the artefact surface. It must be emphasised that these categories may be associated together; for example on the same piece a double alteration was found. For this reason the quantative values shown are intended as the absolute values for that category with regard to the total of material analysed.

Action	**Frequency**	**Worked material**	**Frequency**
Cut	3	Less resistant	1
		Less resistant/resistant	1
		Resistant	1
Carve	1	Less resistant	1
Scrape	1	Resistant/very resistant	1
Impact	7	Unidentified	
Unidentified	1	Unidentified	

Tab. 14 – Action carried out and worked material.

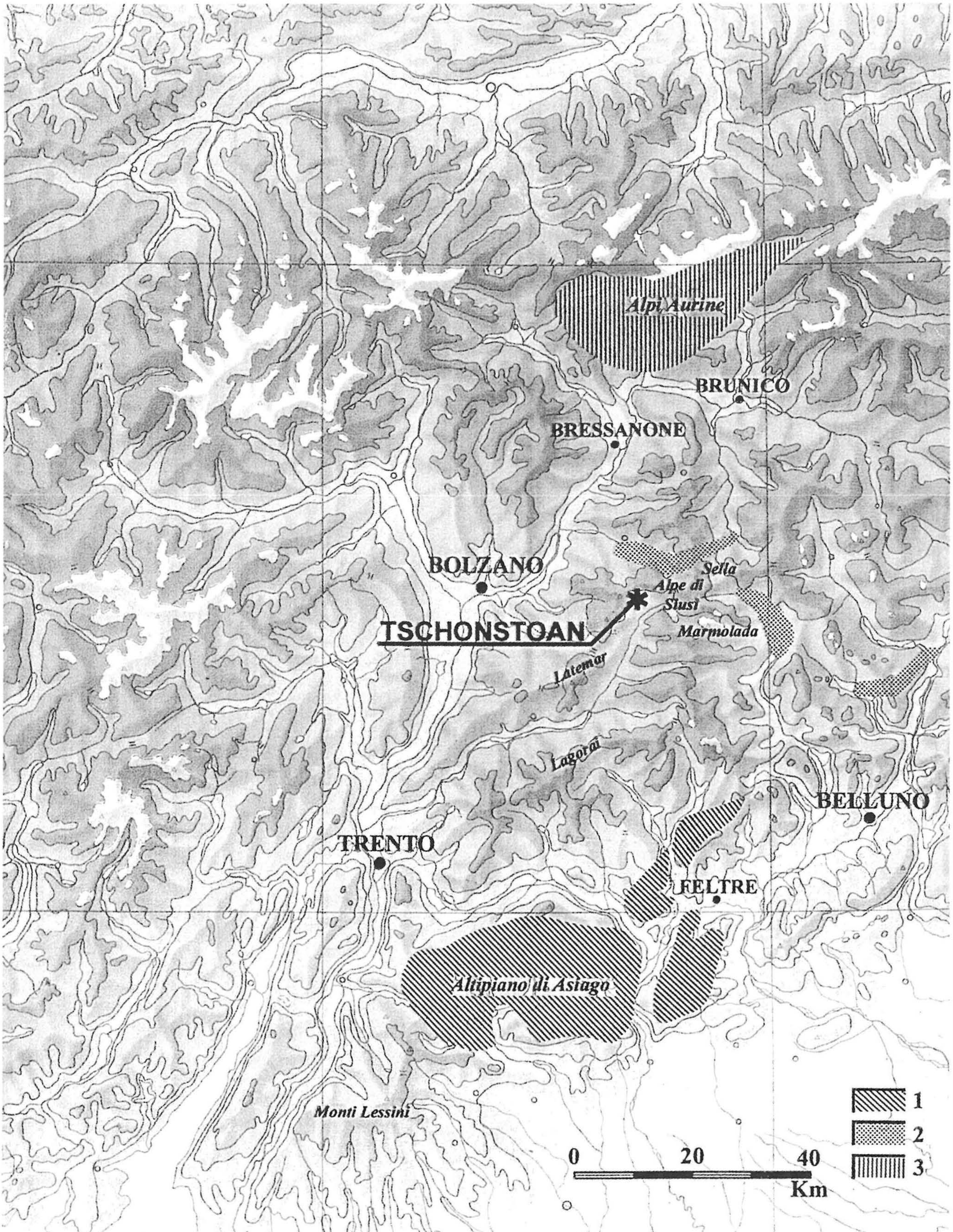

Fig. 1. Originating areas of the lithic materials found at Tschonstoan: 1 – Jurassic – Cretaceous series of the Veneto-Trentino Pre-Alps (Atesina Flint s. l.); 2 – Middle Triassic formation of the Dolomites (Dolomite Flint s. l.); 3 – Valleys between Pusteria and Alpine watersheds (Rock Crystal). (AVANZINI, 2001).

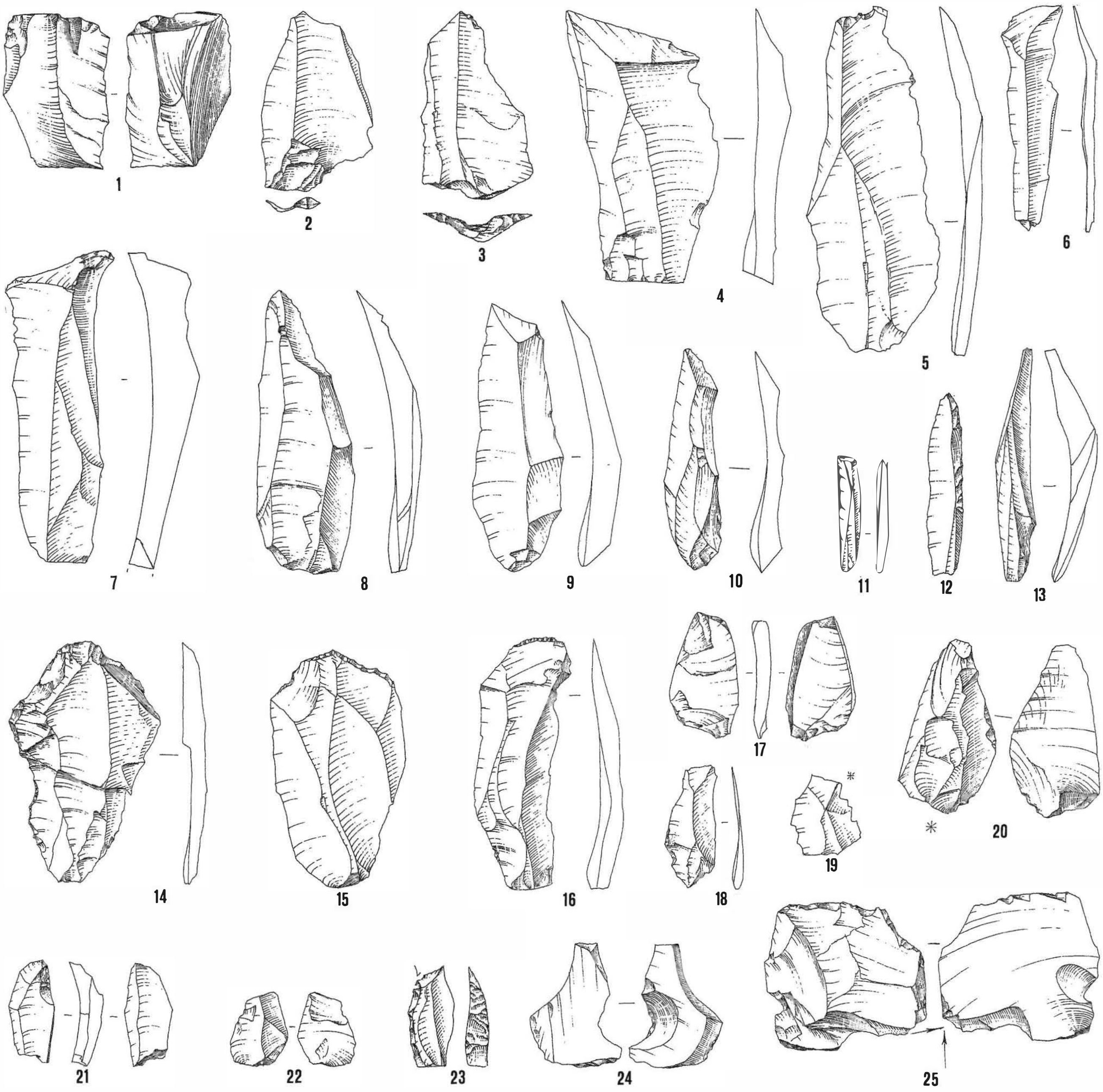

Fig. 2. Tschonstoan: bladelet core (n.o 1); blade flakes (n.os 2-4); blades (n.os 5-7); blade with *sous-crête* (n.os 8-10, 12); burin remnants (n.os 11, 13); retouched flakes (n.os 14-16, 18-20); *pièce écaillée* (n.o 17); bladelets fr. (n.os 21,22); backed knife fr. (n.o. 23); notch (n.o. 24); burin (n.o. 25). (Drawing G. Almerigogna; nat. size)

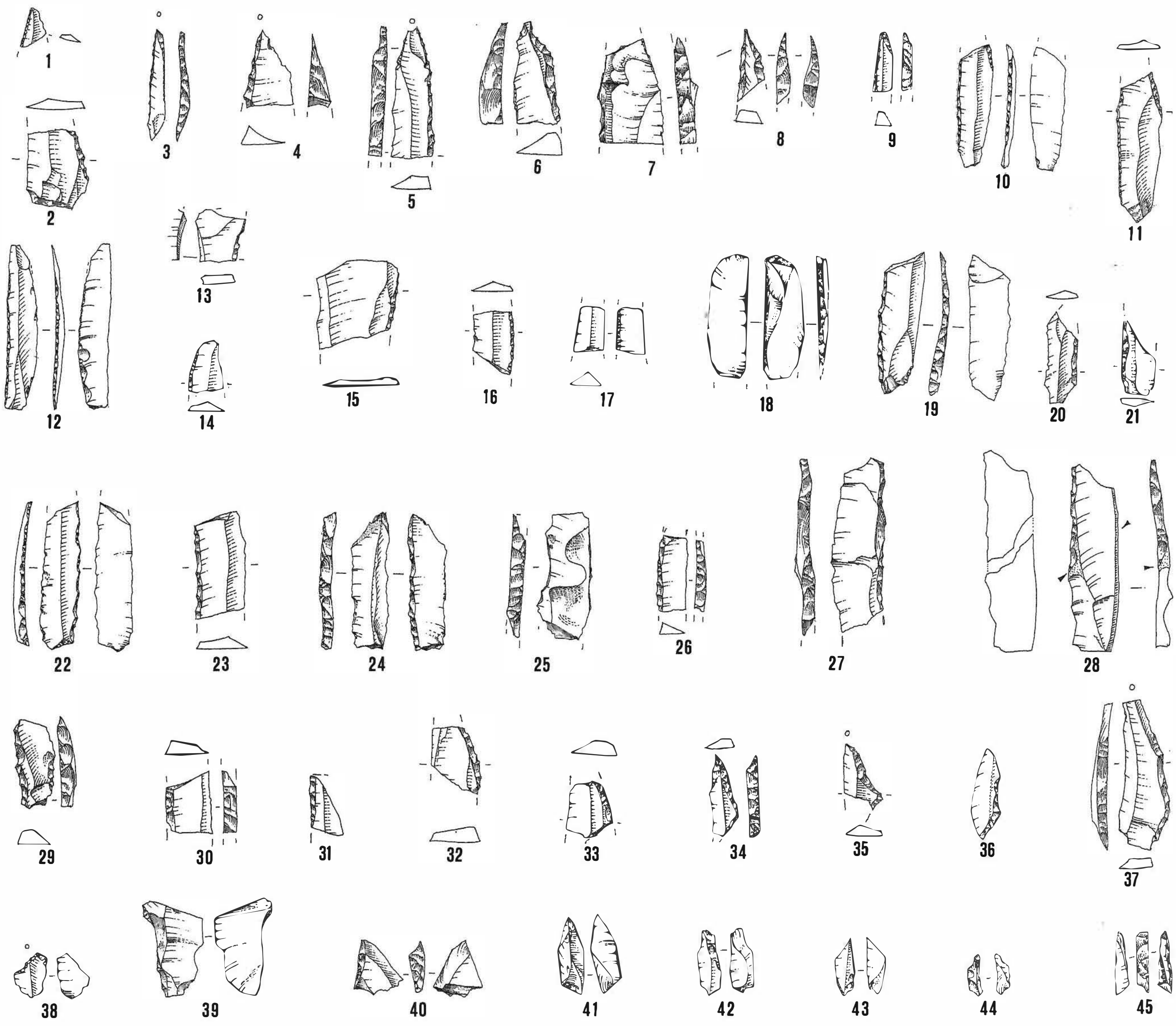

Fig. 3. Tschonstoan: backed points, including fragments (n.os 1-11); marginal backed bladelets (n.os 12-23); backed bladelets (n.os 24-31); geometrics (n.os 32-36); various (n.os 37, 38); microburins (n.os 39-45); (Drawing G. Almerigogna; nat. size).

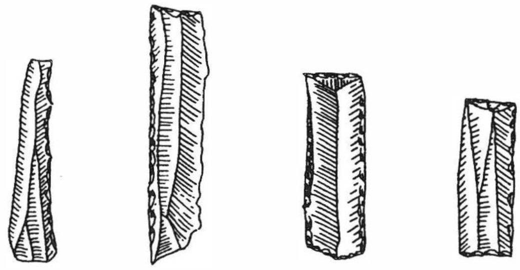

Fig. 4. Moosbühl: *lamelles à dos.* (from BANDI., 1968). (nat. size)

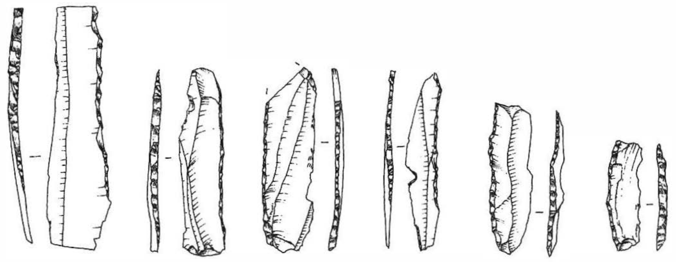

Fig. 5. Val Lastari : *lamelles à dos.* (By courtesy of M. Peresani ; drawing by G. Almerigogna - nat. size).