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Assessing the life history of projectile points/knives from the Middle Holocene of Argentina's Southern Puna

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ABSTRACT

Lithic artifacts that belong to hunter-gatherer occupations from the Quebrada Seca 3 site during the Middle Holocene of the Southern Puna of Argentina, dating to *ca.* 4800–5900 cal BP are analyzed. These tools have been defined as stemmed projectile points whose blades were intensively maintained, resulting in asymmetric shapes. However, they have also been defined as knives because of their morphology when discarded. To establish a more complete version of the life history of these artifacts, from projectile points to knives, a research design was developed that includes several analytical microscopic and compositional techniques to identify the uses that were preserved over time. Information obtained through microwear analysis and the study of microscopic residues -microfossils and chemical residues – on the blades and stems indicates that these artifacts were used in several functions, with a first use as projectile points and a final use as knives in generalized plant and animal processing. The plant material processed includes roasted or dehydrated tuberous/roots. The tools were also used to cut animal skin, flesh and/or bone. Evidence for hafting to foreshafts or handles and for the use of adhesives was also found. The use-traces and life history results were mutually consistent. This contributed to the discussion of artifact life history and resource processing by the Middle Holocene hunter-gatherers of the South Central Andes.

1. Introduction

Flaked stone tools are analyzed which belong to hunter-gatherer occupations from the site of Quebrada Seca 3 (QS3) dating to the Middle Holocene, between *ca.* 4800 and 5900 cal BP, at Antofagasta de la Sierra in the Southern Puna of Argentina. These stone artifacts had previously been defined as stemmed projectile points or shafted knives (Aschero, 1988a; Aschero et al., 1991). This study sought to establish a more complete life history of these artifacts.

A research design was developed that includes several analytical microscopic and compositional techniques to identify the uses preserved over time of the tools. Previous compositional study of macro-microscopic residues on the blades and stems (Babot et al., 2009) and microwear use traces analysis (Cattáneo, 2008) indicated the processing of plant and animal material and the use of plant adhesives for hafting. This paper presents and cross-checks the results previously obtained through a detailed study of active edges and stems by means of several analyses: techno-typological, of microfossils through transmitted-light microscopy (TLM), of microwear use traces through reflected-light microscopy (RLM), and chemical through gas chromatography-mass spectrometry (GC-MS). This information is used to discuss the evidence for the artifacts' life histories and resource processing.

2. Regional setting

Antofagasta de la Sierra is part of the Argentine Puna, which is part of the Peruvian-Bolivian high plateau. In Argentine territory, the Puna is located between latitudes 22° and 27° S and corresponds to the geological province of Puna (*sensu* Turner, 1972). This province consists of two sub-provinces, the Northern and Southern Puna, with distinctive geological structural and morphological characteristics (Alonso et al., 1984). Antofagasta de la Sierra is part of the Southern Puna and is situated in the Northwestern corner of the Catamarca Province (Fig. 1). It's landscape is characterized by gently rolling plains that are interrupted by outcrops of igneous and metamorphic rocks, ranges of volcanic and sedimentary sequences

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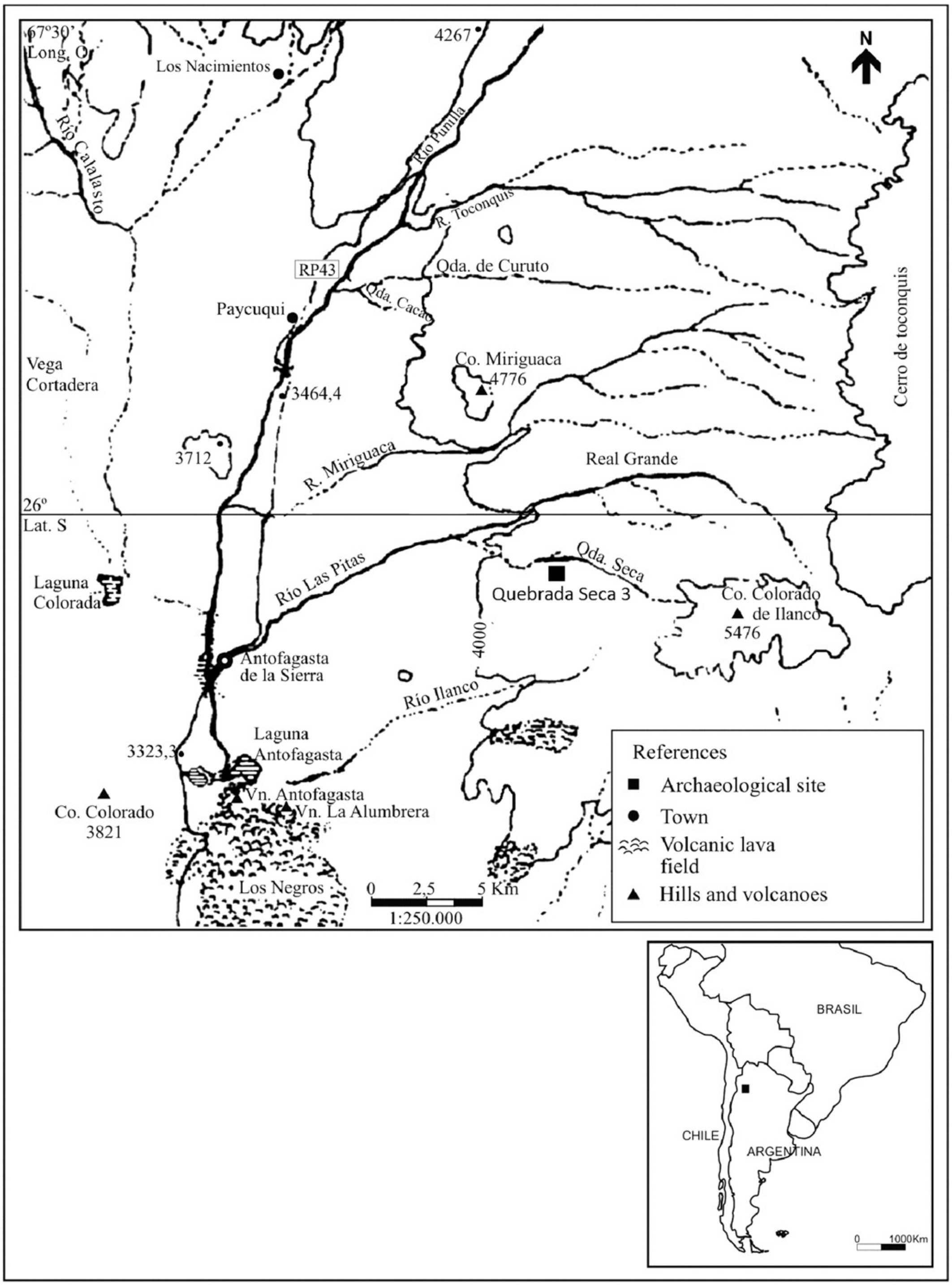

Fig. 1. Map of Antofagasta de la Sierra and location of Quebrada Seca 3.

(García Salemi, 1986; González, 1992). An intense volcanism during the Quaternary and Tertiary (mainly during the Miocene) plus major neo-tectonic phenomena gave the landscape its particular features (García et al., 2000).

There are several perennial streams that end in endorheic basins whose flow variation throughout the year is not significant (Tchiliguirian and Olivera, 2000). The region also contains a set of wetlands unusual for the Southern Puna (Olivera and Aguirre, 1995; Tchiliguirian and Barandica, 1995), which enabled human occupation throughout the Holocene, starting *ca.* 12,000 cal BP (Olivera et al., 2006).

From an environmental point of view, the Puna is a high desert biome located above 3500 m, and characterized by an arid and cold climate, intense solar radiation due to altitude, high thermal amplitude between day and night, strong seasonality, low summer rainfall, and low atmospheric pressure. The average rainfall ranges from 18 to 400 mm per year in the wettest portion of the region, and the amount decreases from northeast to southwest (Yacobaccio, 1998). From a phytogeographical point of view, the Antofagasta de la Sierra basin corresponds to the Puna province in the Andean Patagonian Dominion (Cabrera, 1953, 1957, 1976). Shrub steppe vegetation is dominant, but herbaceous, halophyte, and psammophyte vegetation are also present, as well as the wetlands (Cabrera, 1957; Cabrera and Willink, 1980). Below 3800 m the tolar is developed, where there are abundant shrubs and sub-shrubs of *Parastrephia* and *Acantholippia*, among other genres (families Asteraceae, Verbenaceae, Solanaceae and Fabaceae). At that altitude, a grassland occurs that abounds in species of *Festuca* and *Jarava* and in shrub species of the genus *Adesmia*, *Baccharis*, *Parastrephia* and *Fabiana* (families Poaceae, Asteraceae and Fabaceae; Cabrera, 1953, 1976; Rodríguez, 1998; Rodríguez and Rúgolo de Agrasar, 1999). The meadows, characterized by grasses and rushes, are present along the river beds (Pérez de Micou and Ancibor, 1994).

The QS3 site (Fig. 2) is a rockshelter located at the foot of an ignimbrite cliff that forms the southern margin of the valley of Quebrada Seca. It lies at an altitude of 4100 m.a.s.l (Aschero, 1988b). The shelter faces northeast and has an area behind the dripline of 9 m width × 5 m depth, with an average area of 24 m^2. This area was divided into outer (alero) and inner (cueva) based on a dip in the shelter's roof that restricts the useful area (Aschero et al., 1991) (Fig. 3).

Four stratigraphic units were delineated (Aschero, 1988b; Aschero et al., 1991):

Layer 0: superficial, loose sandy-silty, with camelid feces. The sediment is interspersed with plant remains, fauna and carbonaceous sediments, the latter is apparently anthropogenic; Lens 1× is an episode of restricted deposit.
Layer 1: compact sediment, silty-sandy, archaeologically sterile.

Fig. 2. Above: view of the vega of Quebrada Seca; Below: photograph of Quebrada Seca 3 site.

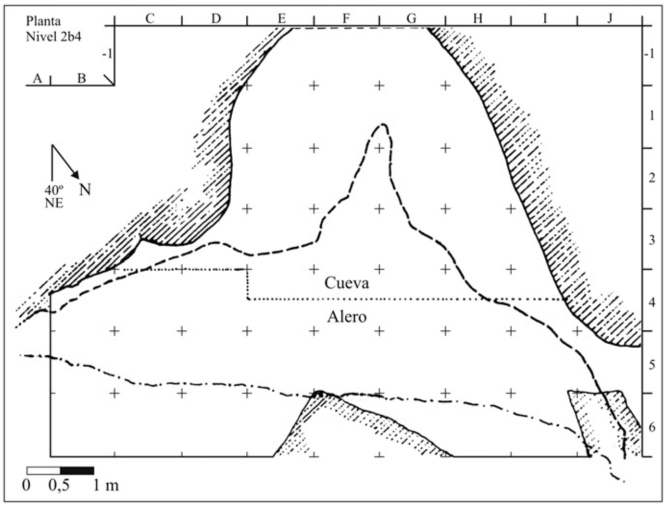

Fig. 3. The rockshelter of Quebrada Seca 3 (modified from Aschero et al., 1993–94).

Layer 2a: sandy sediment, non-compacted; it's top has a gray/light brown coloration and contains few archaeological remains.
Layer 2b: sandy or silty-sandy sediment, light brown with numerous archaeological remains. Despite being composed of a homogeneous matrix, within this layer it was possible to differentiate 25 levels. This was possible because the excavation of this unit was performed according to the spatial distribution and to the characteristics of preservation, of clustering and of scattering of artifacts, structures and ecofacts. Of particular importance was the correlation between areas of dispersed charcoal that are associated with hearths and accumulations of plant debris.

The stone tools analyzed here come from layer 2b, levels 2b2 to 2b4, whose radiocarbon dates ranges between 4800 and 5900 cal BP (Aschero and Hocsman, in press).

The dip in the roof was less of a constraint on the use of space in the shelter earlier as opposed to later in the sequence. The interior of the cave was a useful place for sitting during occupation of levels 2b2 to 2b13; when the surface of the site was lower, levels 2b14 and below, the cave could have been used by individuals in an upright position (Aschero et al., 1993–94).

In fact, the analysis of the distribution of the thermal features, dispersal charcoal areas and accumulations of plant remains, fauna and stone artifacts, shows a marked structure and a differentiation of the space in the time range of interest (Aschero, 1988b; Aschero et al., 1991, 1993–94; Manzi, 1994, 2006).

According to Aschero et al. (1993–94), the spatial organization of activities and disposal/abandonment of lithic artifacts at Quebrada Seca 3 site, indicates a seasonal, but frequently visited site, occupied by small social groups.

The Middle Holocene occupations studied here are characterized by evidence of camelid hunting (*Lama vicugna* and *Lama guanicoe*: Elkin, 1996). Reigadas (2000–2002, 2008) noted from the evidence of camelid fiber, an instance of experimentation at the local level, involving a context of intentional management of wildlife between 4500 and 6500 cal BP.

Also, previous residue studies on grinding stone tools from the site showed that around 5500 cal BP (levels 2b3 and 2b2, Aschero et al., 1991), hunter-gatherers who occupied this residential base used a variety of wild and domesticated food plants, including undifferentiated tubers and roots, seeds of aff. *Chenopodium quinoa* and *Ch. pallidicaule* (Amaranthaceae), and fruits of *Opuntia* sp.

(Cactaceae; Babot, in press). From *ca.* 4800 years BP (level 2b2, Aschero et al., 1991), new data indicate that Cyperaceae tubers and grains of *Zea mays* were also processed for consumption, and that the stems, leaves and petioles of species of Poaceae and Arecaceae were processed for the manufacture of artifacts (Babot, in press). This latter is consistent with the recovery of reed shafts (*Rhipidocladum neumannii*, *Chusquea lorentziana*) and basketry and cordage (*Cortaderia* spp., *Deyeuxia* spp. and *Acrocomia* sp.) from the site (Rodríguez and Martínez, 2001; Rodríguez, 2004). Woody plants were also used as fuel (e.g., *Adesmia horrida*, *Hoffmanseggia eremophila*), Poaceae species were used to soften the floors of the shelter, Cactaceae species, for the manufacture of thorns and needles, and *Hoffmanseggia eremophila* fruits for possible human consumption (Rodríguez, 2004).

3. Materials and methods

3.1. The archaeological artifacts and the general protocol

The projectile points studied in this work are labeled Morphological Type "Quebrada Seca F" (MT QSF) by Hocsman (2006). This type appears in the Argentine Northwest between *ca.* 6500 to 4000 cal BP. The present sample consists of ten projectile points from levels 2b2, 2b3 and 2b4 of QS3, with dates between *ca.* 4800 and 5900 cal BP (Table 1).

This research started with the hypothesis that these artifacts began their life histories as projectile points and completed it as knives. With this mind, a sequence of analytical procedures was devised to preserve the integrity of use residues and microwear use traces: 1) Techno-typological analysis that provides the specific life-history hypotheses for each artifact. This allowed identification of specific areas in the stems that needed closer observation by means of microscopic and compositional techniques. 2) Observation of the tools by reflected light microscopy to locate areas with adhering residues and substances. 3) Removal of samples of microfossils on blades and stems, by dry scraping, and registration of loci for identification. 4) Solid–liquid extraction of chemical residues on blades with organic solvents, and recovery of solids filtered for analysis of microfossils. 5) Cleaning of blades and stems and subsequent microwear use trace study by means of reflected light microscopy.

3.2. Techno-typological analysis of artifacts

The techno-typological analysis of artifacts was conducted using a macroscopic and morphological approach proposed by Aschero (1975, 1983) and Hocsman (2006, 2009). The principle of descriptive morphology is an analytical strategy based on distinguishing the distinct components of the morphology of an object so as to establish its particularities (Brézillon, 1983). It is based on the description of the 'forms' of each piece, prior to the segmentation of its parts and/or different sectors consistent with standardized attributes.

Table 1
Characterization of artifacts analyzed and analytical techniques applied in each case. Abbreviations: RLM, Reflected Light Microscopy; TLM, Transmitted Light Microscopy; GC-MS, Gas Chromatography-Mass Spectrometry.

Artifact number	Level	Condition/part of the artifact	RLM	TLM	GC-ME
283	2b2	Stem-fractured/Stem-blade fragment	X	X	X
292	2b3	Complete	X	X	X
506	2b3	Blade-fractured/Stem-blade fragment	X	X	
508	2b3	Stem-fractured/Stem-blade fragment	X	X	X
510	2b3	Blade-fractured/Stem-blade fragment	X	X	X
34	2b3	Stem-fractured/Stem fragment	X	X	
109	2b4	Stem-fractured/Stem fragment	X	X	
58	2b4	Complete	X	X	X
320	2b4	Blade-fractured/Stem-blade fragment	X	X	
321	2b4	Stem-fractured/Stem fragment	X	X	

This work focuses on analysis of a particular projectile point morphological type (MT), that results from the comparison and description through segmentation of individual specimens. Following Aschero (1975), the definition of these particular attributes is based on the identification of regularities and recurrences in specific morphological variants (technical and/or functional) or features that particularize a design, making it distinguishable from the rest of the assemblage.

The projectile points analyzed were subjected to extensive maintenance through retouch so as to provide a new working edge, and/or reworking, renewing a broken implement into functional tool (Towner and Warburton, 1990; Knetch, 1997). Such reworking can lead to great morphological variability within a type. It is useful here to distinguish between "basic" and "transformed" designs (Aschero, 1988a). The former refers to pieces whose morphology has not changed by maintenance or reworking of blades or bases, while the latter refers to pieces that have gone through intensive maintenance/reworking, resulting in a substantial transformation of the original morphology.

The differentiation of MT was performed on the basis of Hocsman (2006, unpublished doctoral thesis), which requires: a) a "typological characterization," defining the points as stemmed or non-stemmed pieces and describing the general shape and morphology of the blade, barbs and stem; b) the "dimensions" of artifacts, including the maximum length, width, and thickness of the point as well as stem length, neck width, thickness and basal width; and c) "observations," comments relevant to a better classification and identification of items.

3.3. Residue and microwear use traces analysis of blades and stems by Reflected Light Microscopy (RLM)

The complete and broken artifacts were analyzed using RLM with different objectives. First, areas with residues and substances adhering were identified. This allowed the registration of the exact location and surface characteristics of the use-residues, and guided subsequent sampling for microfossils. Second, the microwear use traces and post-depositional processes that affected the artifacts were characterized in order to correlate these observations with the adhering material. Third, the use-residues were recovered. The stem fragments were also inspected with this technique to retrieve data related to hafting or kinematics.

The artifacts were first sampled for residue and then cleaned with soapy water and acetone. Microwear use traces were analyzed using an experimental reference collection of tools made from vulcanites and used for 5, 15, 30 and 60 min on different types of materials: fresh and dry bone, hard and soft wood, fresh and dry leather, different types of tubers and meal made from tubers (*Oxalis tuberosa*, dehydrated *O. tuberosa* or "caya" and dehydrated *Solanum tuberosum* or "chuño", not reported here). After that, the experimental traces were compared with the ones observed on archaeological tools. *In situ* use-residues were assigned according to literature references (Torrence and Barton, 2006; Lombard and Wadley, 2007).

A stereoscopic microscope (Motic, magnifications 5× to 100×) was used to investigate tool use and surface damage, according to the principles set out by Tringham et al. (1974) and further elaborated by Odell (1977). The tools were further analyzed with a metallographic microscope (Motic, magnifications 100× to 500×), using bright field illumination as described by Keeley (1980). After that, the traces were classified according to different types of attributes as in Cattáneo and Fernández Ordóñez (2006).

3.4. Microfossil analysis of blades and stems by Transmitted Light Microscopy (TLM)

TLM was used to characterize microfossils possibly attributable to use-residues on blades and stems of the complete instruments and fragments. It followed a dry extraction of samples in selected sectors of the artifacts (Babot, 2007), considering if possible, *in situ* observation of residues, that was previously made by RLM, as mentioned at 3.3 (Loy, 1994).

A stratified sampling was conducted by separating blades from stems. An area was demarcated for sampling within the total length of each edge within a blade or stem; the remainder was reserved for further analysis. Surface irregularities resulting from the natural rock features (pores, blisters and cracks) and from the flaking (fracture lines and flake scars) were sampled because they are potential areas for residue capture. The extractions were performed by means of the gentle scraping and scratching of the micro-topography of the artifacts with a pointed metal implement. This procedure scratches the artifact's surface, creating marks that can be distinguished from use-traces, and so the exact location of the procedure was recorded. Due to dry sampling, it was possible to collect samples that refer to exact places of location in the artifact (each edge for a blade or stem sampled).

Due to the absence of surface sediment, brushing of the artifacts prior to sampling was not necessary. Nor was deflocculation and diaphanisation of the artifacts necessary considering the sandy-silty nature of the sedimentary matrix and the absence of macro-scopic charred residues.

The samples were extracted directly onto slides previously cleaned and mounted in immersion oil, and scanned at 100–400× with a petrographic microscope; the analyst was not aware of from which tool the sample came (blind analysis). Observations were recorded alternatively with parallel and crossed Nicol prisms. Full scans were made using horizontal parallel transects. All micro-particles of interest were photographed for later comparison with databases and reference literature, including starch grains, silica phytoliths, calcium crystals, diatom frustules, plant tissue (dried and carbonized), animal tissue, and aggregates of particles (resinous and non-resinous). Total counts were made to reach 200 particles. The description of the silica phytoliths followed the provisions of the ICPN (Madella et al., 2004).

The presence of “signals” that could be attributed to the natural environment and the archaeological context, that could had been captured in use-residues, was controlled. In addition, a taphonomic study on the microfossil assemblages was conducted to identify cultural practices related to plant processing (Babot, 2003).

The macroscopic resinous samples from stems attributed to adhesives were mechanically extracted with a metallic instrument and stored for further analysis by means of Fourier-Transformed Infrared Spectroscopy (Babot et al., 2009; not reported here).

3.5. Lipid residues on blades: Gas Chromatography-Mass Spectrometry (GC-MS)

The complete and broken artifacts that had a significant representation of blade were selected for study by GC-MS for identification of chemical residues following methodological guidelines set by Babot (2004).

The solid–liquid extractions with chloroform were carried out in an ultrasonic bath, by means of dipping for one minute each of the edges of the blades. These extracts were filtered on filter paper of 45 microns previously washed with chloroform for the time necessary to obtain free sediment samples, and were dried with nitrogen. The extracts were scanned in a Hewlett Packard HP 6890 Series GC System coupled to a Hewlett Packard 5973 Mass Selective Detector, using the scanning method TTP with a running time between 0–60′ and 0–30′ (Babot, 2004). The particles retained on the filter paper were studied for microfossils.

4. Results

4.1. Techno-typological analysis of projectile points

The lithic pieces considered in this study were produced on various vulcanites of very good quality for knapping (Table 2). These raw materials are all available within 15 km of QS3 (Aschero et al., 2002–2004). Knapping methods involved the use of techniques which worked the faces of the artifacts and not just the edges. The available evidence suggests that flakes were used as blanks, according to the presence of remnants of the ventral and/or dorsal face. However, in most cases these blanks were bifacially thinned, leading to complete coverage of the faces with flake scars.

From a typological point of view, the artifacts can be defined as projectile points with prominent (“destacado”) stem and shoulders or non prominent (“esbozado”) stem (Fig. 4, Table 2). The latter is the most common, because of the loosing of a prominent stem due to maintenance/reworking. The blade is triangular with straight edges. The stem has two variants: a) with converging straight lateral edges and attenuated convex base and b) with attenuated to very attenuate converging convex lateral edges and attenuated convex base. The latter is predominant. These pieces can also be classified as stemmed convergent retouched blade knives with an active or blunt tip.

Several studies have raised the possibility that the artifacts analyzed, instead of being projectile points, were hafted knives (Aschero, 1988b; Aschero et al., 1991, 1993–94). As projectile points, they were defined by Martínez (1997) as functioning as part of a weapon system, more specifically, hafted hand-held spears thrown at short distances. Aschero and colleagues present the idea of a transformation, where maintenance had operated on an initially lanceolate (Aschero, 1988b) or stemmed with a convex base forms (Aschero et al., 1993–94). Forms recovered in QS3 could be a result of this maintenance. Note that these important morphological changes would be independent because they established that: “…podría tratarse de puntas de lanzas o cabezales de armas de impulsión manual o bien de instrumentos tipo cuchillo con alto grado de mantenimiento y utilizados enmangados…” (Aschero, 1988b, pp. 12). That is, a tool's definition as a projectile point or knife is not linked to the presence of evidence of a transformation of the morphology of the artifact itself.

The possibility of a combined use, projectile point and knife, should be considered, since large hafted projectile points can also be used secondarily but effectively as knives or to perform multiple tasks (Ellis, 1997; Knetch, 1997). In short, the artifacts could be specialized or multipurpose tools. The analysis presented in this paper sheds light on this issue.

Dimensionally, these artifacts are, on average, approximately 60 mm long, 33 mm wide and 10 mm thick, which means good-sized tools (Table 3). The variation in the length of pieces is perhaps a result of maintenance and/or re-working of the blades and stems.

In fact, whole pieces or pieces with fractures in the blades have stepped, irregular flaking or asymmetry in the frontal view, irregular edges, a shortening of the length of the blade and a marked point of inflection between the stem and the blade – all suggestive of maintenance/reworking. These pieces correspond to transformed designs (Aschero, 1988a). This transformation is observable also from variations of the angles of the edges of blade when considering the measured and estimated angles (Table 2).

The maintenance of the blades was made possible with the hafted pieces (Aschero et al., 1993–94) that led to the creation of

Table 2
General characterization of projectile points.

Artifact number	Description	Condition	Raw material	Design	Left blade edge		Right blade edge	
					Measured angle	Estimated angle	Measured angle	Estimated angle
283	Undifferentiated retouched point + Short retouched edge cutter + Restricted edge raclette over recycled Stem-blade fragment of projectile point with outlined stem and short triangular blade	Fractured (stem)	Vulcanite 4	Transformed	80°	38°	68°	37°
292	Projectile point with prominent stem and shoulders and short triangular blade	Complete	Vulcanite 1	Transformed	A3vwx: 52° A3u1x: 64°	– A3u1x: 52°	A4vwx: 52° A24ux: 64°	– A24ux: 48°
506	Blade-stem fragment of projectile point with outlined stem and undifferentiated blade	Fractured (blade)	Vulcanite 2	Transformed	–	–	–	–
508	Blade-stem fragment of projectile point with outlined stem and short triangular blade	Fractured (stem)	Vulcanite 5	Transformed	59°	45°	73°	40°
510	Blade-stem fragment of projectile point with outlined stem and undifferentiated blade	Fractured (blade)	Vulcanite 4	Transformed	65°	41°	72°	40°
34	Mesial-basal stem fragment of projectile point	Fractured (stem)	Vulcanite 4	Undifferentiated	–	–	–	–
109	Projectile point stem fragment	Fractured (stem)	Vulcanite 2	Undifferentiated	–	–	–	–
58	Projectile point with outlined stem and long triangular blade	Complete	Vulcanite 4	Transformed	48°	38°	53°	45°
320	Blade-stem fragment of projectile point with outlined stem and undifferentiated blade	Fractured (blade)	Vulcanite 2	Transformed	–	–	–	–
321	Basal stem fragment of projectile point	Fractured (stem)	Vulcanite 2	Undifferentiated	–	–	–	–

projectile points with marked curvature, narrowing forms at the contact between stem and blade, with blades very restricted in width relative to their stems (Fig. 4). In only one case (N° 283) the stem edges were recycled in a short retouched cutting edge (left border) and in a restricted "raclette" edge (right border), that could have functioned as the passive part of the first. As much the cutting knife as the raclette were assembled against a previous fracture in the base. This implies that the piece was de-hafted and "turned" in order to be used. Therefore, the system of holding and use of the artifact changed completely.

In most cases, these artifacts have abrasion on the edges and the base of the stem, so as to avoid cutting the hafting material. This abrasion is accompanied by a regular alternate retouch and/or micro-retouch in restricted sectors of the edges of the stems that has the same purpose as the abrasion. Variability in the stems is due, at least in part, to repair work of the broken basal end of the stems. This is evident in N° 292, which suffered a fracture at the base of the stem, and was reduced by a bifacial marginal work that generated a sinuous ridge. Therefore, the length of the stem is much smaller than in the rest of the pieces.

Unfortunately, in QS3 there are no cases that account for the basic design (Aschero, 1988a). Aschero (1988b) argues that the basic design could be a lanceolate of considerable size or a stemmed piece with a rounded base (Aschero et al., 1993–94). The latter possibility seems more viable. From N° 292 (Fig. 4), the basic design seems to have a prominent stem, but it cannot be established with certainty since the artifact in question has shoulders.

Surface finds from various sites of Antofagasta de la Sierra, as well as other areas of the Puna of Argentina, as at the site of Rio Grande in the El Aguilar area (Puna of Jujuy) (Fernández, 1983–84, pp. 69, Fig. 9b), suggest that the basic design had a prominent stem, obtuse or straight barbs and a triangular blade with convex or straight sides.

In this context, these artifacts can be considered in terms of life history in two ways:

a) in a diachronic and sequential sense: first, as projectile points, with a specific basic design that with the intensive maintenance of blade edges become retouched hafted knives;
b) simultaneously and alternately as projectile points and as hafted knives.

From a morphological-descriptive point of view, and following the guidelines of Aschero (1975), the analyzed artifacts meet the requirements of a retouched edge knife, that is, those with long edges with symmetrical bevels below 50 degrees. Thus, the blades should be characterized as converged retouched blade knives with active or blunt tips. This would be consistent with the possibility "a".

4.2. Morphology, microwear use traces and use-residues

Table 4 contains data on microfossil and other residues that have been registered on the projectile points/knives that were analyzed; Table 5 shows chemical results from GC-MS. Fig. 5 shows the microfossil and other residue examples that have been recovered from blades and stems, and Figures 6–8 show some examples of microwear use traces registered in the analyzed artifacts.

4.2.1. Artifact N° 283

4.2.1.1. Blade. Use residues. Microfossils: undifferentiated starch grains of micro-termic tuber or root, complete and fractured with cracks, and damage to the extinction cross; micro-charcoal; aggregates with occluded silica phytoliths, starch, micro-charcoal and calcium phytoliths; stem/leaf silica phytoliths of Poaceae (epidermal long cells and prickles or sub-rectangular elongate silica phytoliths and acicular hair cells); silica phytoliths of Dicots (opaque scrobiculate cells); angled resinous aggregates with occluded polyhedral calcium phytoliths aff. Fabaceae (Babot, 2009), crystalline sand and micro-charcoal (Fig. 5a–j). Other residues observed *in situ* by RLM: animal tissue, and collagen or fat (Lombard and Wadley, 2007) at the boundary between the blade

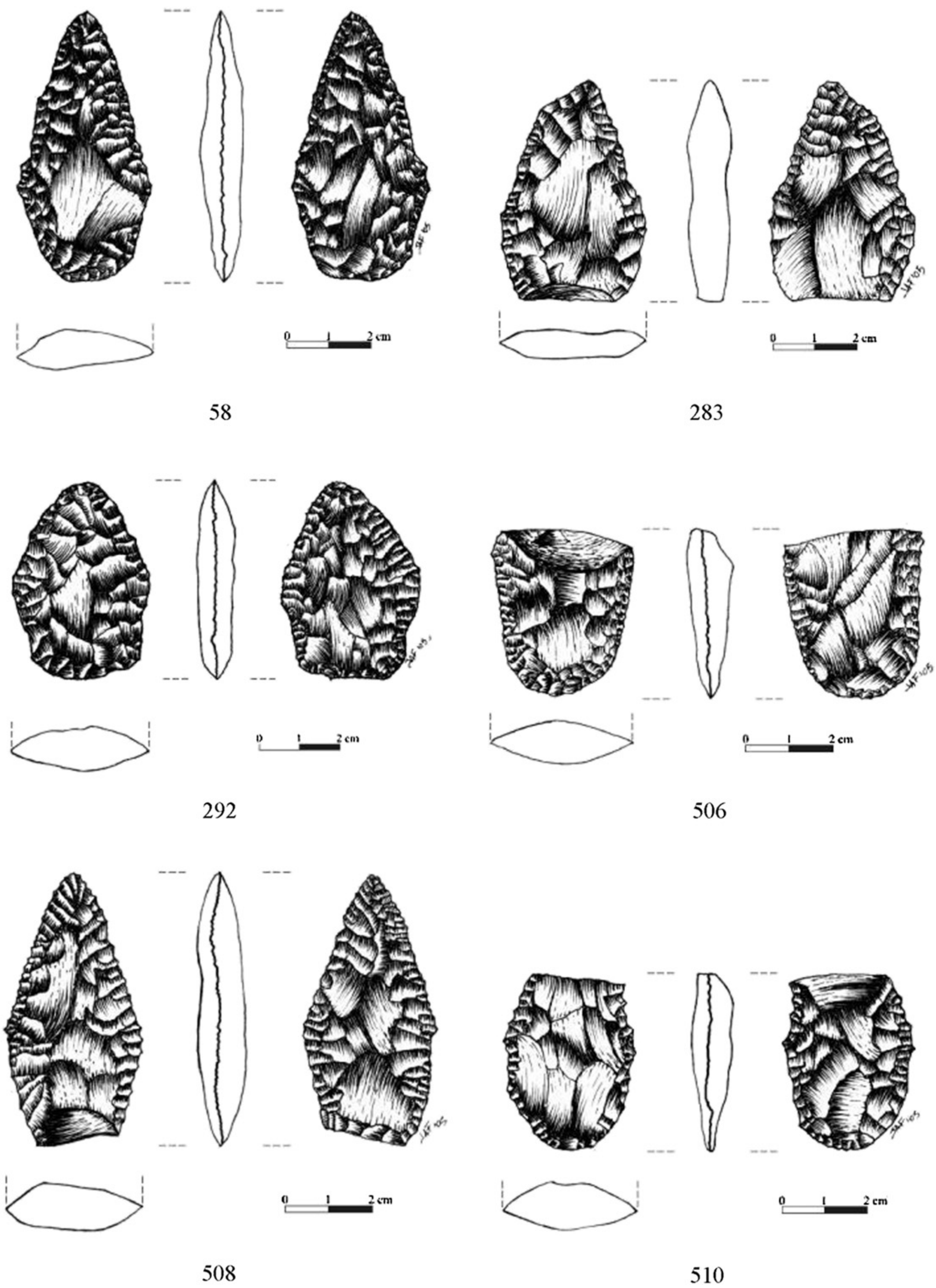

Fig. 4. Projectile points designs from Quebrada Seca 3 site.

and the stem. GC-MS: 1-octadecene -majority-, Stearic acid, 5β-etenil-A-norcholestan-3-one, 3.5-cholestadien-7-one, 7-oxo-cholesterol (Table 5).

Microwear. Side A: Fresh micro-fractures over the largest edge were observed, and no microwear use was determined. On side B, the edge showed evidence of the cutting of hard substances. Because of two large and penetrating scars of flaking, it was not possible to recover evidence of previous use over the internal region of the blade (Fig. 6a).

4.2.1.2. Stem (recycled edges included). Use residues. Microfossils: angled resinous aggregates with occluded polyhedral calcium phytoliths aff. Fabaceae (Babot, 2009), crystalline sand and micro-charcoal; isolated micro-charcoal. Other residues observed in situ by RLM: animal tissue, and collagen or fat (Lombard and Wadley, 2007) on the cutter manufactured on the stem; resinous particles on both sides.

Microwear. Over a horizontal fringe between the blade and the stem, on both sides, micropolishes were developed, assigned that

Table 3
Measurements of projectile points.

Measures	Size range		Mean (mm)	Standard deviation
	Maximum (mm)	Minimum (mm)		
Maximum length	64.60	49.30	60.60	6.24
Maximum width	36.20	30.40	32.93	1.88
Maximum thickness	13.50	7.70	10.12	2.11
Stem length	29.90	14.70	22.26	7.81
Neck stem width	36.20	26.90	31.03	2.88
Neck stem thickness	12.40	7.40	9.28	1.91
Base stem width	27.30	21.60	24.65	2.21

to hard hafting. Also, at 200–400×, micropolishes over the edge and on the micro-spurs were observed (Fig. 6a).

4.2.2. Artifact N° 34

4.2.2.1. Stem. Use residues. Negative for microfossils.

Microwear. Evidence of weathering on both sides, so it was not possible to recover any functional data referred to hafting or kinematics.

4.2.3. Artifact N° 506

4.2.3.1. Blade. Use residues. Negative for microfossils.

Microwear. The artifact shows two states, one with non-diagnostic traces of micropolishes and oblique grooves on the edge, and the other, on side B, with raw material removed by abrasion and micro-flaking (Fig. 6b).

4.2.3.2. Stem. Use residues. Other residues observed *in situ* by RLM: unidentified starch grains (Torrence and Barton, 2006).

Microwear. Three types of evidence exist: a) the effect of friction or abrasion inferred as the product of hafting, which would be transversal to the maximum length of the piece, b) development of micropolish fields for the action of cutting woody plant material, and c) evidence of the working of woody plant material through micro-wear produced at the base of the stem (Fig. 6b).

4.2.4. Artifact N° 508

4.2.4.1. Blade. Use residues. Microfossils: undifferentiated starch grains of micro-termic tuber or root, isolated, or in clumps of starch with damage to the birefringence and extinction cross, and relief alterations, due to dehydration and heating in the presence of moisture; micro-charcoal; silica phytoliths of Dicots

Table 4
Microfossil and other residue record on the analyzed projectile points/knives from QS3 site, registered by means of transmitted and reflected light microscopy.

Microfossil and other residues	Artifact number												
	283		292		506	508	510		58		109	320	321
	B	S	B	S	S	B	B	S	B	S	S	S	S
Undifferentiated starch grains of micro-termic tuber or root	$N = 6^1$ T					$N = 5^3$ T	$N = 12^3$ T						
Unidentified starch grains				$N = 1^4$ T	X R	X R		$N = 4$ T					
Isolated micro-charcoal	$N = 44$ T	$N = 10$ T				$N = 57$ T	$N = 51$ T	$N = 60$					
Epidermal plant tissue							$N = 1^5$ T						
Aggregates with occluded silica phytoliths, starch, micro-charcoal and calcium phytoliths	$N = 9$ T												
Stem/leaf silica phytoliths of Poaceae – epidermal long and short cells, prickles	$N = 5$ T						$N = 8^6$ T		$N = 2$ T				
Silica phytoliths of Dicots -opaque scrobiculate cells-	$N = 12$ T					$N = 23$ T	$N = 20$ T						
Translucent epidermal scrobiculate cells								$N = 4$ T,R					
Angled resinous aggregates with occluded polyhedral calcium phytoliths aff. Fabaceae (Babot, 2009), crystalline sand, and microcharcoal	$N = 23$ T	$N = 45$ T,R						$N = 32^7$ T,R		$N = 11$ T,R	$N > 200^7$ T,R	$N = 6$ T	X^8 R
Dehydrated plant tissue, translucent, with calcium phytoliths of crystalline sand type							$N = 8$ T						
Diatoms							$N = 1$ T						
Animal tissue from skin, meat, bone marrow and/or bone (Pedrosa Raya et al., 2011)							$N = 13$ T		$N = 4$ T				
Fat or bone collagen (Lombard and Wadley, 2007)			X R				X R						
Animal tissue, and fat or collagen (Lombard and Wadley, 2007)	X R	X^2 R		X R								X R	

Abbreviations: B: blade; S: stem; T: Transmitted light microscopy; R: Reflected light microscopy. (1) Complete or fractured, cracked and with damage to the extinction cross; (2) Registered on a cutting edge manufactured on the edge stem; (3) Complete and isolated or in clumps, with damage to birefringence and extinction cross, and relief alterations; (4) Cracked and with damage to the extinction cross; (5) Carbonized; 6) Some of them, carbonized; (7) Also occluded there were rosette-like druses and translucent epidermal scrobiculate cells; (8) Inclusions were not observed within the resin; (9) Complete or fractured and isolated or in clumps, with damage to birefringence and extinction cross, and relief alteration.

Table 5
Molecular markers for animal and plant material processed with projectile points/knives from QS3 site, registered by means of GC-MS analysis.

Lipidic residues	Artifact number				
	283	292	508	510	58
Tetradecane		0.6%			
Lauric acid		1.4%			
Miristic acid		11.7%			10.9%
1-Octadecanol				8.7%	
Octadecane		1.1%	4.0%		
1-octadecene	15.2%				
Nonadecane			3.1%		
1-hexadecene					6.2%
Pentadecanoic acid		7.2%			
15-hexadecanolide		5.0%			
Palmitic acid		49.9%			46.4%
Heptadecanoic acid		1.7%			
Metil hexadecanoate			3.6%		
Eicosane			2.8%		
1-docosanol			5.6%		
Docosane			13.8%		
Undecil dodecanoate			47.4%		
Oleic acid		4.7%			3.6%
Stearic acid	4.6%	5.0%			7.8%
5β-etenil-A-norcholestan-3-one	1.7%				
3,5-cholestadien-7-one	5.5%				
7-oxo-cholesterol	2.3%				
Heptacosane				4.1%	
Dotriacontane				6.4%	

(opaque scrobiculate cells) (Fig. 5k–n). Other residues observed *in situ* by RLM: unidentified starch grains on the apex and at the boundary between the blade and the stem (Torrence and Barton, 2006). GC-MS: Octadecane, Nonadecane, Metil hexadecanoate, Eicosane, 1-docosanol, Docosane, Undecil dodecanoate -majority (Table 5).

Microwear. Areas of deep striations in the center, parallel to the maximum length of the piece, resulting from penetration kinematics; this is supported by the depth and width of the grooves. This suggests penetration into the body of prey. In the apical region were a rounding area and a field of micropolishes. Around the edges the polish produced is of the same nature and intensity as leather polish, but no further conclusions can be made (Fig. 6c).

4.2.4.2. Stem. Use residues. Negative for microfossils.

Microwear. Side B: in the boundary between the blade and the stem, there is evidence of hafting with plant material-medium materials. There are generally large areas with some indication of linearity on the traces, transverse to the piece. On the stem an important development of polishes were found near the edges, presumably caused by contact with hard materials (Fig. 6c).

4.2.5. Artifact N° 510

4.2.5.1. Blade. Use residues. Microfossils: undifferentiated starch grains of micro-termic tuber or root, isolated, or in clumps of complete and fractured starch with damage to the birefringence and extinction cross, and relief alterations, due to dehydration and heating in the presence of moisture; micro-charcoal; carbonized epidermal plant tissue; stem/leaf silica phytoliths of Poaceae (epidermal long and short cells and prickles or sub-rectangular elongate and rondel silica phytoliths and acicular hair cells), some of them, carbonized; silica phytoliths of Dicots (opaque scrobiculate cells); fragments of dehydrated plant tissue, translucent, with calcium phytoliths of crystalline sand type; diatom frustules; animal tissue from skin, meat, bone marrow and/or bone (Pedrosa Raya et al., 2011) of three types (brown fibrous birefringent, brown and translucent non-fibrous nor birefringent, brown translucent birefringent porous non-fibrous) (Fig. 5o–y). Other residues observed *in situ* by RLM: fat or bone collagen on the blade on face A (Lombard and Wadley, 2007). GC-MS: 1-octadecanol-majority, Heptacosane, Dotriacontane (Table 5).

Microwear. Left edge, side A: an intense development of micropolishes with greasy brightness appears that is probably a product of working hard materials, such as bones. Side B: the limit of the presumed hafting area was observed. Right edge: another dome with intense micropolishes was observed, but it was different from the other edge of the blade. In this case, given its characteristics, it seems to correspond to leather work. In all cases, the damages are from general cutting kinematics (Fig. 7a).

4.2.5.2. Stem. Use residues. Microfossils: angled resinous aggregates with occluded polyhedral calcium phytoliths aff. Fabaceae (Babot, 2009), rosette-like druses, crystalline sand, translucent epidermal scrobiculate cells, bubbles, polyhedral starch grains, and micro-charcoal. Other residues observed *in situ* by RLM: resinous residues with occluded polyhedral crystals; isolated translucent epidermal scrobiculate cells.

Microwear. Stem: evidence of crushing and spalling over the edges, possibly because of the process of hafting and unhafting (Fig. 7a).

4.2.6. Artifact N° 292

4.2.6.1. Blade. Use residues. Microfossils: negative for microfossils post-microwear use traces study. Other residues observed *in situ* by RLM: fat or bone collagen (Lombard and Wadley, 2007) on the blunt apex on face B. GC-MS: Tetradecane, Lauric acid, Miristic acid, Octadecane, pentadecanoic acid, 15-hexadecanolide, Palmitic acid majority, Heptadecanoic acid, Oleic acid, Stearic acid (Table 5).

Microwear. Blade extremely maintained, with no evidence of use on the lateral edges. Around the blunt apex, evidence of action on leather was observed at an angle relative to the axis of the piece which may indicate its use as a knife (oblique kinematics). Streaks and areas of major micropolishes attributable to a hard substance, probably bone, were observed there. Given the characteristics of re-sharpening, in this case it is not possible to establish its history of previous use. For the last action, only its use as a knife can be inferred (Fig. 7b).

4.2.6.2. Stem. Use residues. Microfossils: unidentified starch grains, with cracks, and damage to the extinction cross. Other residues observed *in situ* by RLM: animal tissue, and collagen or fat (Lombard and Wadley, 2007).

Microwear. Under the spur that denotes the beginning of the stem, there is evidence of hafting based on a centralized distribution (Roots, 2010). Also described are abrasion, microfractures and a chipping area that could potentially come from re-sharpening, maintenance or hafting (Roots, 2010) (Fig. 7b).

4.2.7. Artifact N° 58

4.2.7.1. Blade. Use residues. Microfossils: just a few microfossils post-microwear use traces study. Stem/leaf silica phytoliths of Poaceae (epidermal long cells or sub-rectangular elongate silica phytoliths); animal tissue from skin, meat, bone marrow and/or bone (Pedrosa Raya et al., 2011) (brown translucent birefringent porous non-fibrous) (Fig. 5z–b′). Other residues observed *in situ* by RLM: fat or bone collagen (Lombard and Wadley, 2007). GC-MS: Miristic acid, 1-hexadecene, Palmitic acid -majority-, Oleic acid, Stearic acid (Table 5).

Microwear. This piece has a part of the surface altered by post-depositional processes. However, features were recognized in domes and on part of the edges. In general, the distinction between the altered and unaltered area of micropolishes is gradual and smooth. In the apex area, rounded domes can be interpreted as contact with soft material, like fresh leather or something even softer like flesh (Fig. 7c).

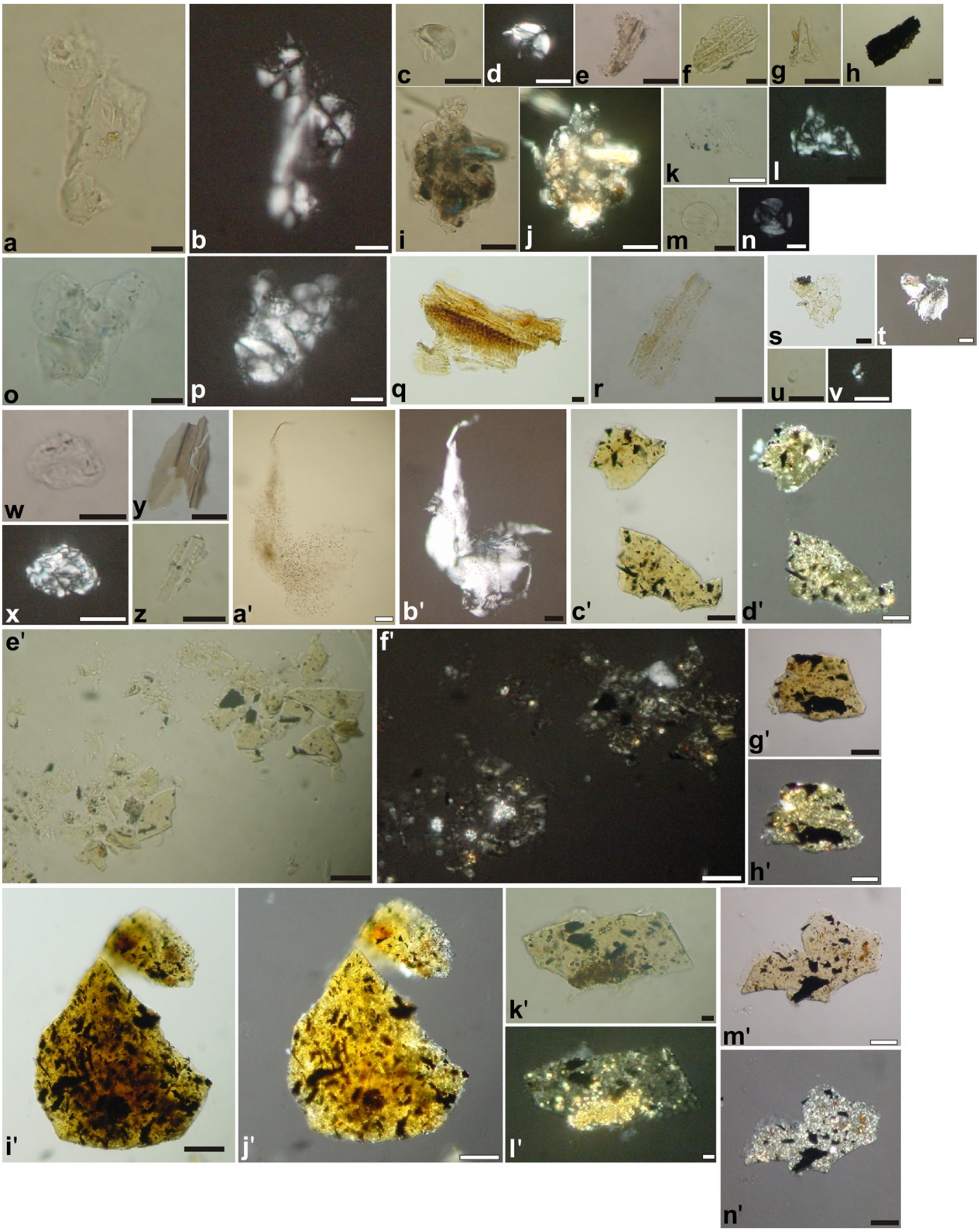

Fig. 5. Microfossil and other residues from projectile points/knives of Quebrada Seca 3 site. a–j) Artifact N° 283. a–b) Undifferentiated starch grains of micro-termic tuber or root; c–d) undifferentiated starch grains of micro-termic tuber or root, fractured; e–g) stem/leaf silicaphytoliths of Poaceae (epidermal long cells and prickle); h) silica phytoliths of Dicots (opaque scrobiculate cells); i–j) Aggregate with occluded silica phytoliths, starch, micro-charcoal and calcium phytoliths. k–n) Artifact N° 508. k–l) clump of damaged and undifferentiated starch grains of micro-termic tuber or root; m–n) isolated undifferentiated starch grains of micro-termic tuber or root, cracked. o–y) Artifact N° 510. o–p) Undifferentiated starch grains of micro-termic tuber or root, complete and cracked; q–t) animal tissue from skin, meat, bone marrow and/or bone; u–v) undifferentiated starch grains of micro-termic tuber or root, fractured; w–x) clump of damaged and undifferentiated starch grains of micro-termic tuber or root; y) epidermal plant tissue. z–b′) Artifact N° 58. z) Stem/leaf silica phytolith of Poaceae (epidermal long cells); a′–b′) animal tissue from skin, meat and/or bone; c′–n′) Artifact N° 109. Angled resinous aggregates with occluded polyhedral calcium phytoliths aff. Fabaceae (Babot, 2009), rosette-like druses, crystalline sand, and micro-charcoal. Approximate scale bar = 20 μm.

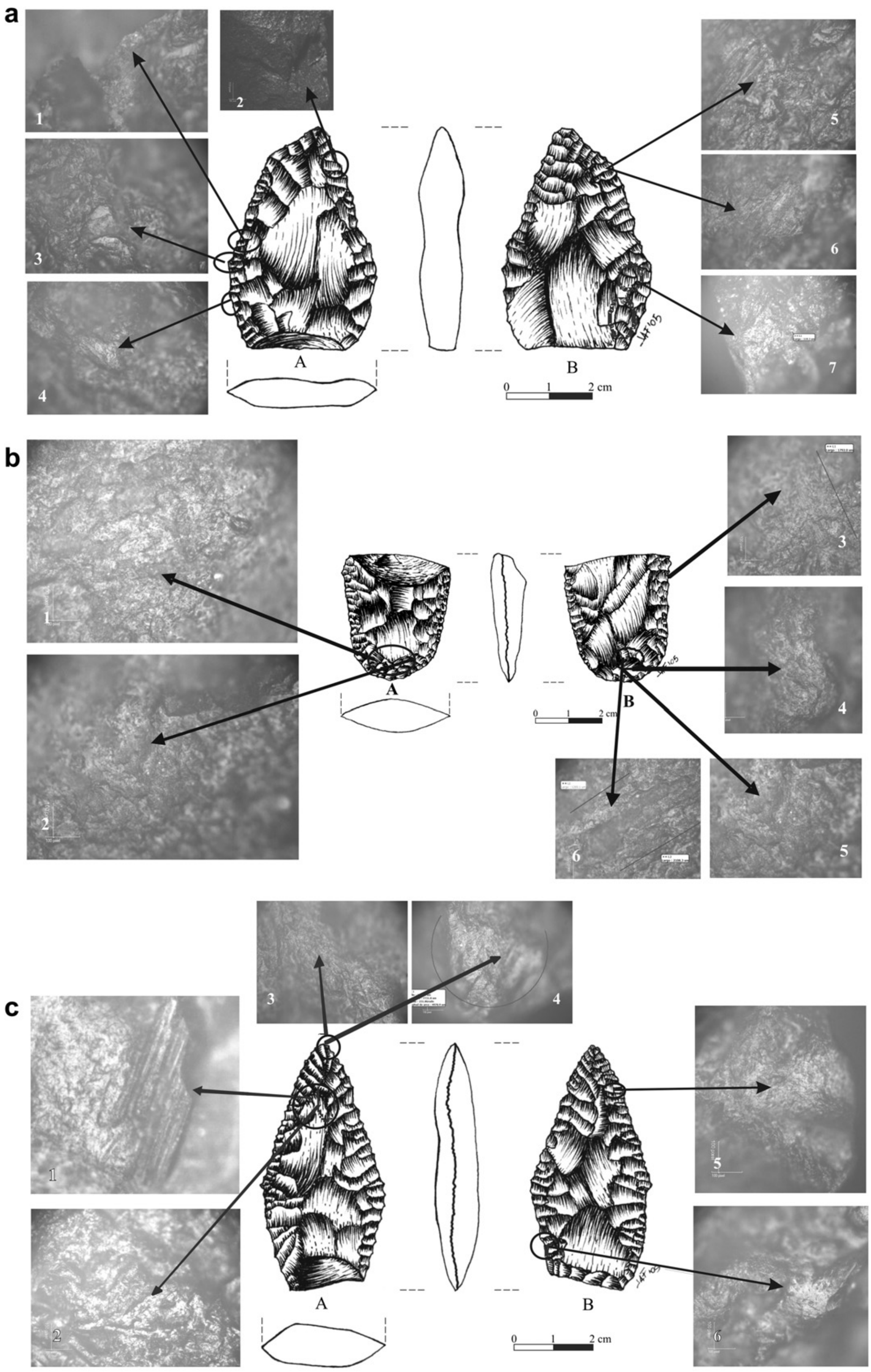

Fig. 6. Microwear use traces registered in projectile points/knives from QS3 site. a) Artifact N° 283. 1) Fresh microfractures over the largest edge close o the hafting area, 200×; 2) fresh edge, 40×; 3) micropolish over the edge, 200×; 4) a hafting area, 200×; 5–6) estriations, 200×; 7) micropolish on the hafting area. b) Artifact N° 506. 1–2) Microtraces related with action on plant material, 200×; 3) oblique striations on the edge, 200× and unidentified starch grains (Torrence and Barton, 2006); 4) dome with polishes, 200×; 5–6) micropolishes for contact with woody plant or other hard material and unidentified starch grains (Torrence and Barton, 2006). c) Artifact N° 508. 1) Estriations, 400×; 2) micropolishes, 100×; 3–4) apex with rounding and micropolishes, and unidentified starch grains (Torrence and Barton, 2006) at 200×; 5–6) dome with micropolish over the edge, 200×.

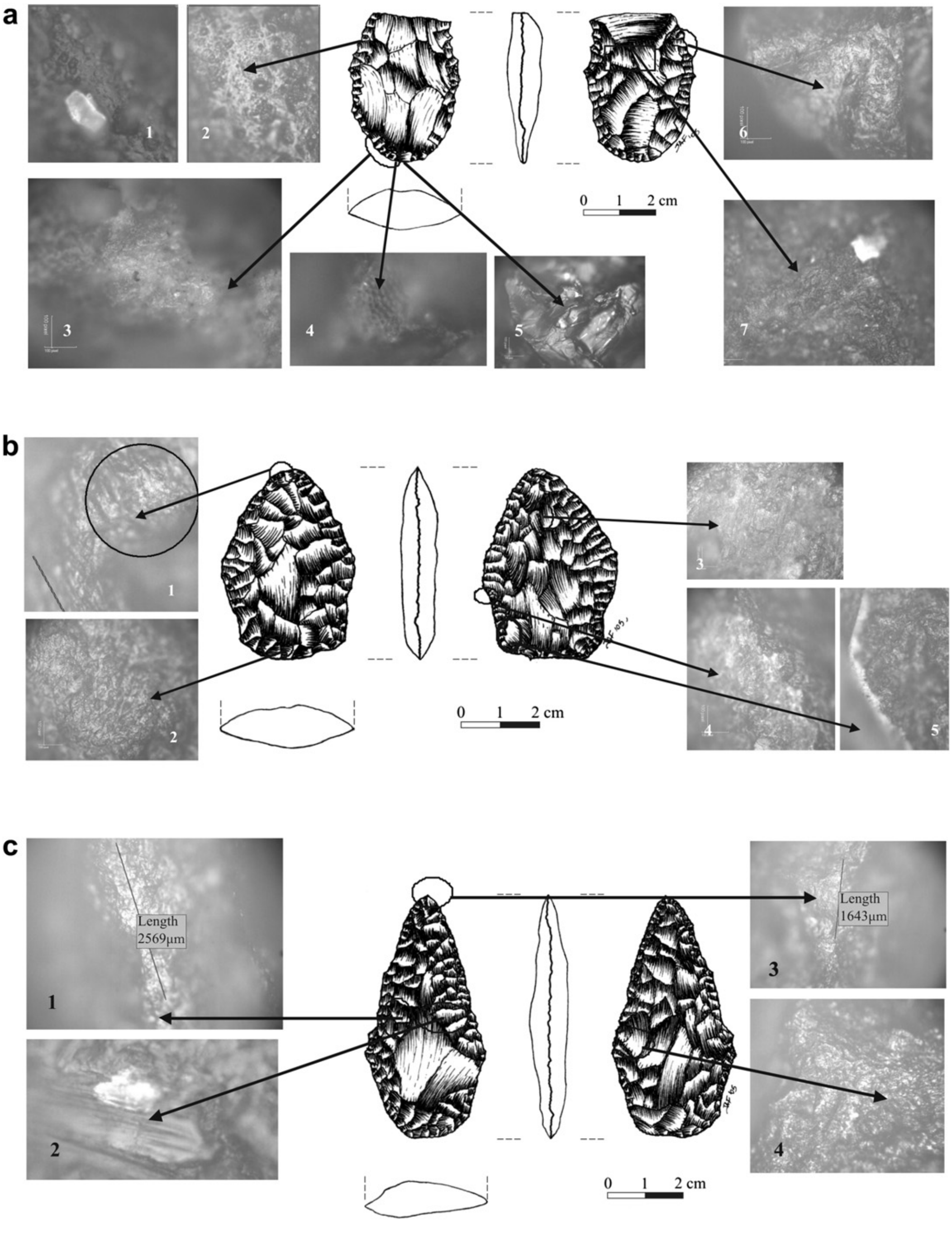

Fig. 7. Microwear use traces registered in projectile points/knives from QS3 site. a) Artifact N° 510. 1) Residues of at or bone collagen (Lombard and Wadley, 2007); 2) diagnostic micropolishes for working hard materials, 200×; 3) crushed on edge, 200×; 4–5) resinous residues with occluded polyhedral crystals, and isolated translucent epidermal scrobiculate cell, 200×; 6) micropolish on edge, 200×; 7) boundary of the hafting area, 200× and fat or bone collagen (Lombard and Wadley, 2007). b) Artifact N° 292. 1) Polishes and striations closet o the rounded apex, 200×; 2) initial development of polish, 200×; 3) polish and crushed, 200×; 4) chipping area under micro-spur, 200× and fat or collage non the edge (Lombard and Wadley, 2007); 5) fat or collagen on the edge (Lombard and Wadley, 2007) at 200×. c) Artifact N° 58. 1) Dome with micropolish over the edge, 200×, 2) Estriae and fat or bone collagen (Lombard and Wadley, 2007) at 200×; 3) polished area, 200×; 4) attrition over hafting area, 200×.

4.2.7.2. Stem. Use residues. Microfossils: angled resinous aggregates with occluded polyhedral calcium phytoliths aff. Fabaceae (Babot, 2009), crystalline sand and micro-charcoal.

Microwear. Blade: Fresh scars of flaking linked to maintenance over the edges and a smooth area in the internal zone possibly because of the hafting, which is slightly above the limit defined as stem area, on both sides. Transverse striations were also recorded. Below this area, there is evidence of friction of hard material with a loss of vitreous material of the rock (Fig. 7c).

4.2.8. Artifact N° 109

4.2.8.1. Stem. Use residues. Microfossils: angled resinous aggregates with occluded polyhedral calcium phytoliths aff. Fabaceae (Babot, 2009), rosette-like druses, crystalline sand and micro-charcoal (Fig. 5c′–n′). Other residues observed *in situ* by RLM: resinous residues with occluded polyhedral crystals.

Microwear. Evidence of weathering on both sides, so it was not possible to recover any functional data referred to hafting or kinematics (Fig. 8a).

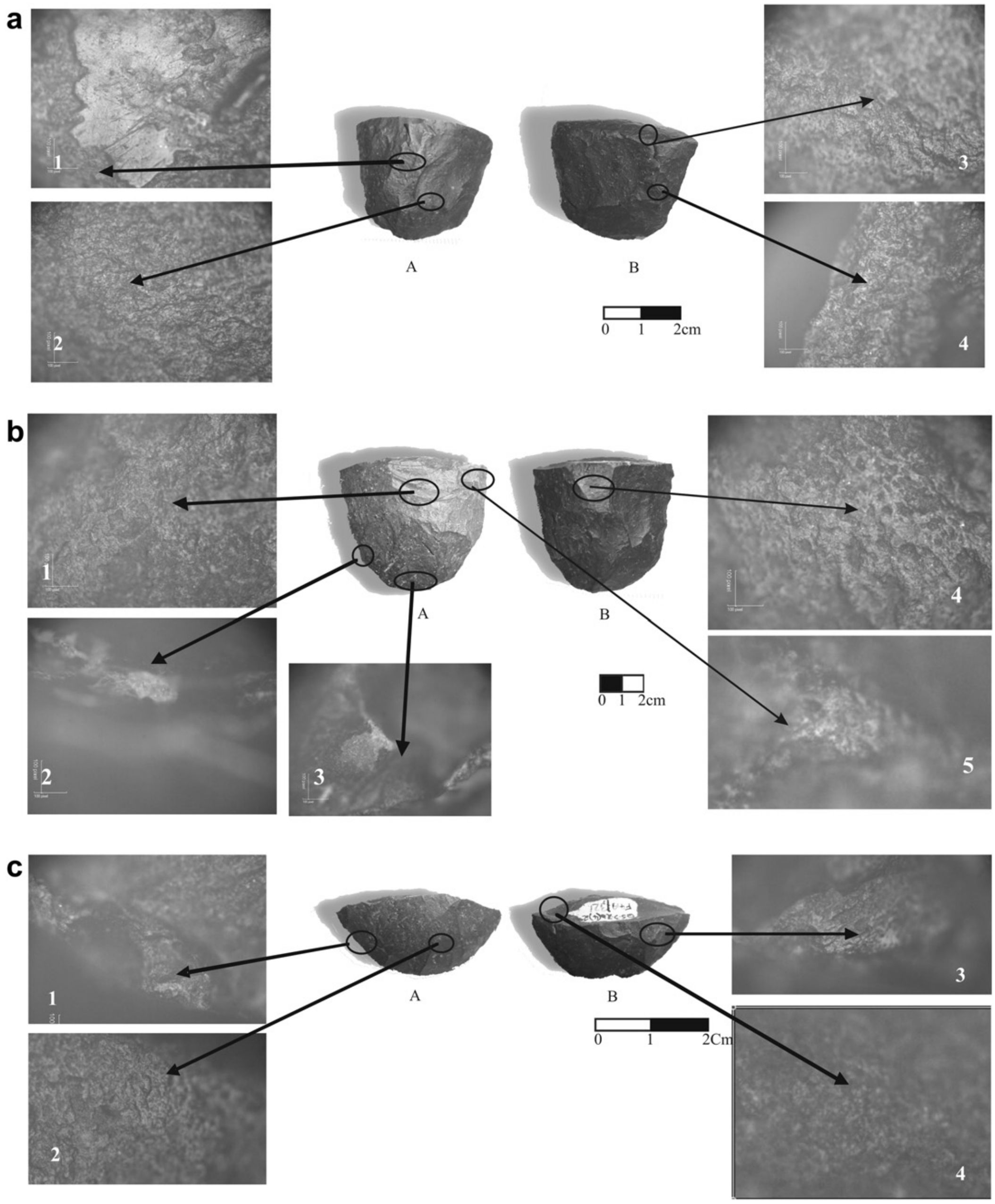

Fig. 8. Microwear use traces registered in projectile points/knives from QS3 site. a) Artifact N° 109. 1) Resinous residue, 200×; 2) no functional evidence, 200×; 3) weathering over the fracture, 200×; 4) no functional evidence, 200×. b) Artifact N° 320. 1) Micro-traces of probable hafting, 200×; 2–3) micropolishes, over the edge and residues of animal tissue, and fat or bone collagen (Lombard and Wadley, 2007) at 200×; 4) hafting evidence, 200×; 5) dome with micropolish, 200×. c) Artifact N° 321. 1–2) Attrition over the edge, 200×; 3) attrition and micropolishes, 200×; 4) unused texture over the fracture, 200×.

4.2.9. Artifact N° 320

4.2.9.1. Stem. Use residues: Microfossils: angled resinous aggregates with occluded polyhedral calcium phytoliths aff. Fabaceae (Babot, 2009), crystalline sand and micro-charcoal. Other residues observed *in situ* by RLM: animal tissue and fat or bone collagen (Lombard and Wadley, 2007).

Microwear. The artifact was made on the variety 2 of vulcanite, with a major component of volcanic glass, then, the rock is brittle and tends to fracture rather than develop micropolishes. This stem has attrition, dents and micropolishes on the edges on both sides of the piece on side A and B product hafting attrition. No other traces were found (Fig. 8b).

4.2.10. Artifact N° 321

4.2.10.1. Stem. Use residues. Negative for microfossils. Other residues observed *in situ* by RLM: possible resinous residues.

Microwear. There is attrition with displacement of material on the edges. No other traces were found (Fig. 8c).

5. Discussion

Results obtained here indicate that the projectile point/knives from QS3 were used in several functions, for plant and animal processing. Especially important is the cutting of roasted microtermic tuber or roots, probably to access its inner part for food.

This is demonstrated by elongated starch grains with distinct lamella, eccentric and distinct hilum, that are associated with micro-charcoal, and dehydrated epidermal plant tissue, as seen in artifacts N° 283, 508 and 510. This tuber or root-like starch was in the most of cases affected by damaging processes that negated its precise taxonomic identification. Just a few were recovered as complete grains, but they cannot be identified. In some cases, damage attributable to heating in the presence of moisture were not visible (Artifact N° 283), but still they showed cracks, fractures and damage to the extinction cross (Babot, 2003). In other cases (Artifacts N° 508 and 510), starch was observed isolated or in clumps together with micro-charcoal, but it was too damaged to identify. The injured starch showed damage to the extinction cross and birefringence, and had alterations in its relief, as can be expected by heating (Babot, 2003). In blade N° 508, starch was observed *in situ* by means of RLM (Torrence and Barton, 2006) before being sampled for microfossil analysis.

Other general indicators for plant processing are the aggregates with occluded starch grains, micro-charcoal, silica phytoliths and calcium crystals observed on the blade of tool N° 283, and the carbonized epidermal plant tissue and fragments of dehydrated plant tissue (translucent with calcium phytoliths of crystalline sand type) as on tool N° 510. The same is suggested by the presence of waxes, that generically indicate the contact of artifacts with the epidermis of fruits, leafs, stalks and seeds instead of micro-termic tubers and roots (N° 283, 292, 508, 510, and 58). The waxes were identified by means of the long chain alkyl compounds, mostly saturated hydrocarbons as alkanes, and to a lesser extent unsaturated as alkenes and others (Sánchez Vizcaíno and Cañabate Guerrero, 1998). Other chemical residues found in artifact N° 508 could be related to plant processing, as it is the case of Undecil dodecanoate that can be interpreted as relative to the Lauric acid, in turn a common constituent of plant sources (Beyer and Walter, 1987; Beare-Rogers et al., 2001). In addition, the 1-docosanol can be considered a relative to Docosanoic acid (22:0), suggesting its origin in oily plants (Beyer and Walter, 1987; Beare-Rogers et al., 2001).

These results are consistent with previous and contemporaneous archaeobotanical data for QS3 that indicated the occurrence of plant processing at this site by hunter-gatherers (Babot, in press). Microfossil studies on grinding stones showed that people were using several wild and domesticated plants around 5000 cal BP in levels 2b3 and 2b2 (Aschero et al., 1991). It could be mentioned the undifferentiated micro-termic tuber or roots non-differentiated, and species of Amaranthaceae and Cactaceae (Babot, in press). Starting *ca.* 4800 cal BP in level 2b2 (Aschero et al., 1991), new data suggest that tubers from species of Cyperaceae and *Zea mays* were also consumed (Babot, in press).

Other microfossils of plant origin found in the blades may be interpreted as signals of contemporary cultural practices that occurred within the site, and as of current vegetation. They could have been randomly trapped within use-residues. Because of that, they cannot be interpreted as remains of the processed useful plants. They comprise the stem/leaf silica phytolith of Poaceae (epidermal long and short cells, prickles or sub-rectangular elongate and rondel silica phytoliths and acicular hair cells), because they were used for preparation of occupation floors (blades N° 283, 510, 58). They are poorly represented in use-residues. The silica phytoliths of Dicots (opaque scrobiculate cells) are assigned locally to aereal parts of shrub species of Dicots such as *Adesmia* sp., *Hoffmanseggia* sp. (Asteraceae) and *Baccaris* sp. (Asteraceae) (blades N° 283, 508, 510). They can be considered with silica phytoliths of Poaceae as main indicators for plants used for fuel, according with macro-remains studies of Rodríguez (2004). In this sense, its high count in samples that showed the presence of roasted tubers or roots makes sense.

Animal processing is registered by means of various indicators in the projectile points/knives. By means of microwear use traces on blades, evidence of working with oblique kinematics relative to the main axis of several artifacts, were recognized. This evidence indicates the use as knives for this kind of lithic artifacts. Additional observations included micro-polishing due to leather work (N° 292), grooves, areas of development of micro-polishing that can be attributed to hard substances, probably bone, associated with residues of fat or bone collagen (Lombard and Wadley, 2007; N° 292, and 510). In addition, the presence of micro-polishing related to leather was observed in the artifact N° 510. The blade of this tool showed the presence of three kinds of animal tissue, fibrous and non fibrous, probably from the skin, meat, marrow and/or bone (Pedrosa Raya et al., 2011). This kind of residue, and also fat or bone collagen (Lombard and Wadley, 2007), were observed in artifact N° 58. Here the presence of rounded domes created by contact with soft materials is attributed to leather or meat processing. Artifact N° 283, had residues from animal tissue and fat or collagen (Lombard and Wadley, 2007), trapped in the boundary between the blade and the stem.

Artifact N° 283 recorded damage due to the working of hard substances, on a cutting edge manufactured on the stem. At the opposite edge of the stem, for prehension, *in situ* residues were observed that may be attributed to animal tissue and collagen or fat (Lombard and Wadley, 2007). These data are unique for the assemblage and implies the removing of the haft, the recycling of the stem edges, and use of the recycled stem without the haft. Animal tissues and collagen were also found in the stems of artifacts N° 292 and 320. The latter cases did not imply the recycling of stems into active edges, whereas they may suggest the use of the tools without a haft. Random contaminations during the exchange of hafts cannot be dismissed.

Only artifact N° 508 bore evidence of use as a projectile point. This tool shows areas of deep and wide grooves at its center with longitudinal direction, parallel to the maximum length of the artifact. Its final use as a knife is documented by means of the rounding and soft oblique micro-polishing areas, which is suggestive of the processing of soft raw materials by cutting.

Several lipid residues that were recovered from blades may be interpreted as having an animal origin, probably in terrestrial mammals. This is the case of artifacts N° 292 and 58, which contained higher proportions of Palmitic acid (16:0) than of Stearic acid (18:0). This is common in the decaying of several animal fats (Spangenberg et al., 2006). Moreover, branched acids of odd numbers of carbon atoms (15:0, and 17:0) are present in fats of ruminants such as camelids, because of the rumen bacterial metabolism (Hansen et al., 1957; Dudd et al., 1998; Spangenberg et al., 2006). The Miristic acid (14:0), is a minor component of the majority of animal fats, and because of that, this is a constituent of the "guanaco" bone marrow (Maier et al., 2007). The Stearic acid is more common in animal fat than in plant sources (Beare-Rogers et al., 2001). This, along with the presence of several degradation products of the cholesterol, occurs in artifact N° 283. In the case of N° 510, the presence of 1-octadecanol, is a relative of Stearic acid, showing its origin in an animal source.

Besides plant and animal food remains, in one case (N° 283) the blades showed adhesive residues that originated in the random contact between active edges and fluid resin during the hafting and the removing of hafts (Lombard and Wadley, 2007). They were recorded as resinous aggregates with occluded polyhedral calcium phytoliths aff. Fabaceae (Babot, 2009), crystalline sand, and micro-charcoal.

The hafting and adhesives in stems were recorded by means of the presence of the resinous aggregates described previously (Artifacts N° 283, 510, 58, 109, 320). In some cases, rosette-like druses, translucent epidermal scrobiculate cells, bubbles, and polyhedral starch grains (N° 510) were also observed isolated or immersed in the adhesives. Adhesives were recorded *in situ* by RLM as residues in several artifacts (N° 283, 321, 510, 109); additionally, starch was recorded in association with micro-polishing suggestive of contact with woody material at the stem of artifact N° 506. Probably, these microfossil assemblages of adhesives were enriched by material from the stem in addition to the resin itself.

The scanning of stems by means of RLM, showed the use of hafting, too. Hafts leave abrasions, micro-polishing, micro-wear and/or dents in spurs and edges in the case of artifacts N° 283, 320, and 321. Artifacts N° 506 and 508 showed three kinds of hafting evidence: the direction of friction damage due to a haft that was transverse to the maximum length of the artifacts; micro-polishing areas due to the processing of woody material, and microwear at the base of the haft due to contact. Artifacts N° 292 and 510 show areas of dents, crashes and micro-fractures that could correspond to the hafting and removing of hafts. Artifact N° 58 has fresh flakes related to the maintenance and removing of hafts, and has micro-wear and transverse grooves plus loosening of vitreous material of the rock due to the friction with hard material from the haft. The dynamics of hafting impacted each stage of the life cycle of the studied tools (raw material procurement, haft manufacture, hafting procedure, tool use, tool manufacture, re-hafting, tool recycling, and discard) and strongly influences the archaeological record.

Data recorded here regarding the hafting, the removing of hafts and the use of adhesives for that process, are consistent with previous evidence that suggests the replacement of lithic projectile points at QS3 site (Aschero et al., 1993–94). At level 2b4, the complete artifact N° 58 and several discarded basal fragments (N° 109, 320, and 321) were recovered near a hearth, together with a proximal fragment of a foreshaft of *Chusquea lorentziana* that contained adhered adhesives, plus a tendon of a similar to the foreshaft diameter (Aschero et al., 1993–94).

Some active edges showed general and non-typical microwear use traces (N° 506) or the absence of a record due to weathering processes (N° 34 and 109). Other artifacts did not contain micro-fossils or microwear due to the absence of or the short length of blade fragments (N° 506). Several artifacts showed fractures located at the stem, avoiding the study of the blades, preventing establishment of a life history as projectile points or knives. In other cases, it is assumed that the negative record for microfossils is in fact a methodological negative, post-cleaning of artifacts for RLM study (N° 292). Nevertheless, the absence of evidence of plants could also be related to the absence of plant processing, brief processing time or the processing of plant material that not tend to generate microwear or residues. In general, microfossils were rarely preserved due in part to the smooth nature of the lithic raw material of the projectile points/knives (Babot and Bru de Labanda, 2005). Moreover, the occurrence of diversified uses, and a lower intensity of use should be considered, compared to other kinds of artifacts like grinding stones. Because of that, negative evidence from microfossil or microwear is not necessarily evidence of the absence of the activities that could produce them.

The results allow speculation on the life history of artifacts from QS3, and their identity as projectile points or knives. It is possible to argue that the latest uses that have been recovered for these artifacts, are strongly consistent with usage as hafted knives. In all of the cases, this use it is coincident with transformed designs that resulted from intensive maintenance. The basic design that belongs to stemmed artifacts with incoming bars, and asymmetrical blades, similar to that of projectile points that come from other places in the region (such as Northern Puna) is in fact absent at QS3. Here, there are only transformed/maintained designs. Because of the difficulty of recovering evidence belonging to the first uses, due to the intensive maintenance that affected the blades, it is highly possible based on typological considerations that the basic design worked as projectile points. That could be asserted in only one case at QS3 (N° 508) in which the microwear use traces analysis of the transformed design showed a first use as projectile point followed by a final use as knife. This case can be explained by the obliteration of initial surfaces of artifacts by maintenance and reworking. In no case could it be established that the hafted knives were used at the same time as projectile points. Simultaneous and alternating uses for the same artifact were not recorded.

6. Conclusions

The results obtained in this paper indicate that the projectile points/knives from QS3 site were used for several purposes. Tools were used as projectile points for penetration of animal prey and then transformed into knives. In their later state as generalized artifacts (knives), they were employed to process plant and animal materials. The plant material processed includes tuberous or root plants (roasted or dehydrated) for human consumption and other plant materials as showed by the evidence of general lipid residues and plant tissues. These results are consistent with previous and contemporaneous archaeobotanical data for QS3 that indicate the occurrence of plant processing by grinding at this site by hunter-gatherers (Babot, in press). The negative results for microwear use traces of soft plant processing, are experimentally explored at present. Evidence for the processing of animal material (skin, flesh and/or bone) developed when the artifacts were used as knives. Microwear use traces, chemical and residue analysis showed consistent evidence of this type in most of the artifacts analyzed.

Artifacts could have started their life histories as projectile points (only one positive case in this study from microwear use traces), but then continued use as hafted knives in processing tasks, as was suggested for numerous evidence incompatible for the projectile point function. These results are strongly consistent with the techno-typological analysis of the blades and stems. The artifacts from QS3 were multitask tools but they did not work simultaneously as projectile points and knives, at least in the cases analyzed here that belong to the transformed design (asymmetric blades). The last uses of these tools are strongly consistent with hafted knives.

The analysis of stems contributed to the techno-typological data related to the hafted use of the projectile points/knives to the point of its discard in most of the cases. The microwear use traces and use residue showed the presence of hafts and plant adhesives for hafting. Besides, the replacement of projectiles, the hafting and removing of the handles, and application of adhesives was documented, consistent with contextual evidence from 2b4 level (Aschero et al., 1993–94). With regard to the interdisciplinary task, given the fragility of the evidence, it is important to be able to complement the individual data with various lines of evidence.

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