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Abstract

Text of abstract

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# Introduction

Here is a citation (Marwick, 2017)

# Background

## Aims

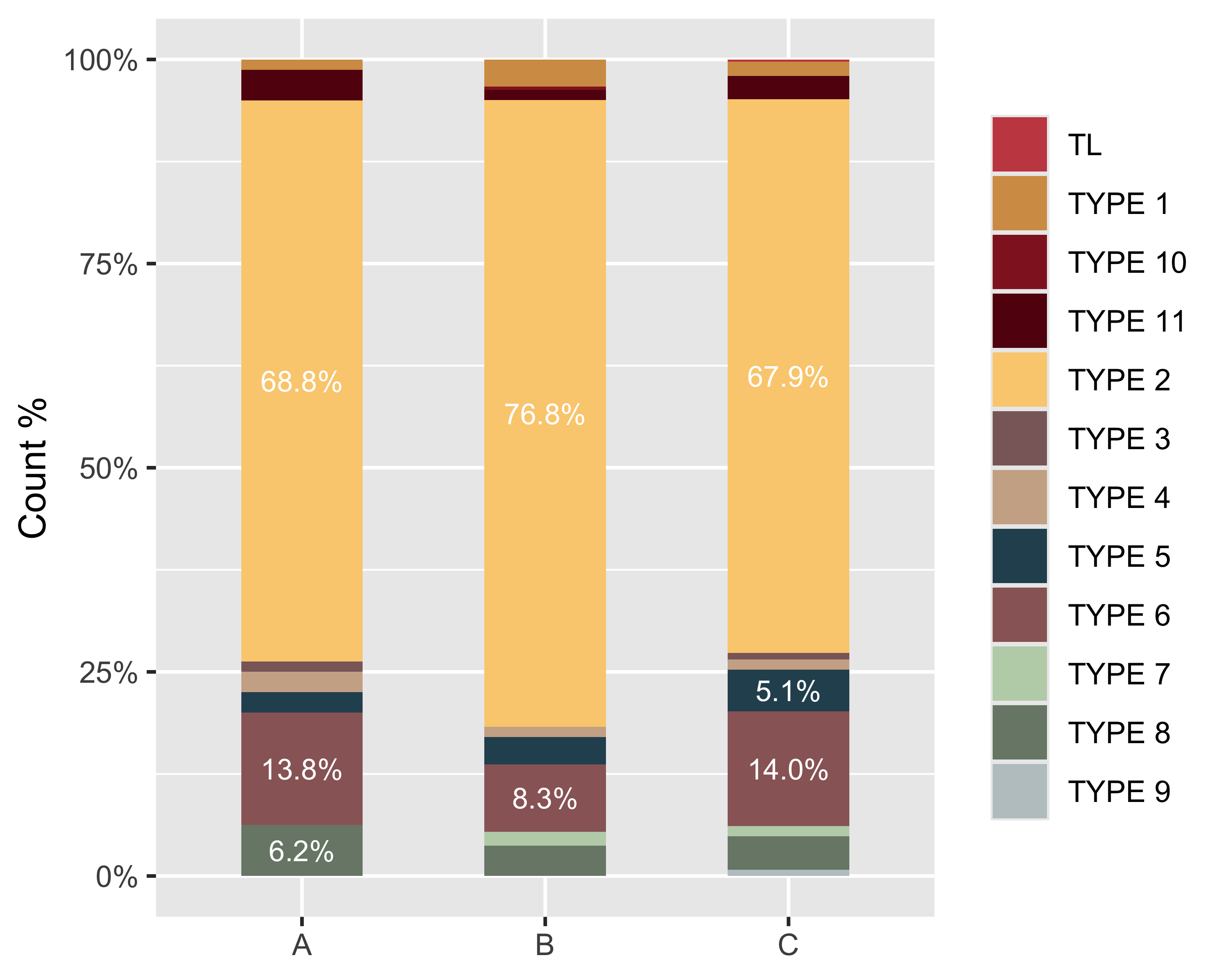
Our goal is to understand the provisioning, use and management strategies of chert lithic resources of the hunter-gatherer groups of Vale Boi during the Upper Paleolithic. We focus on the technological characteristics of the two broader groups of cherts identified at the site: local and non-local, based on the notion that local raw materials will show technological patterns different from those which are non-local. Expanding upon our previous works on chert types present throughout the UP sequence in the Terrace and Shelter area of Vale Boi, and their possible interpretations, and following the previously mentioned studies and models about raw material management and lithic technology organisation focusing mainly on the different management of local and non-local raw materials, associated with mobility and occupation length, we derive two main expectations (fig. 1):

1. Local raw materials are expected to present a) low use-lives, with knapping strategies characterised by manufacture, use and discard; b) a decreased reduction intensity and low tools to debitage ratio; c) larger cores and lower blank-to-core ratio; d) less extensive reduction and reworking of tools; e) higher tool typology diversity. This may be related to the abundance of local raw materials which leads to less intensive life-use extension, but also to the residential characteristics of the site and low mobility, which increases the reliance on local raw materials.
2. Non-local raw materials are expected to present a) a majority of formal tools, in the case of individual provisioning or higher use-lives, with knapping strategies characterised by the manufacture, use and maintenance; b) an increased reduction intensity and high tools to debitage ratio; c) smaller cores and higher blank-to-core ratio; d) more extensive reduction and high presence of retouch and/or tool maintenance; e) lower tool diversity, characterised by less specialised tools, such as the presence of retouched blanks as multipurpose tools. This may be related to scarcer or poorer quality of raw materials which leads to the prepared transportation of lithic resources to a site, but also related to more mobile settlement patterns as well as short-term site occupations.

Despite these expectations, it is important to notice that, especially in occupations with a high percentage of non-local cherts at the site (e.g., Gravettian occupations of level 7 and 6 of the Terrace at Vale Boi), these technological may not reflect a preoccupation with intensive management of a scarce and limited non-local resource, and be more a reflection of the type of provisioning applied following the suggested model by Kuhn (2004). In this sense, distance from source may have had little intrinsic meaning in the past, especially regarding non-local raw materials. There are several ways in which raw materials may be transported to a site, and the relationship between distance and cost may vary depending on how this takes place (Kuhn, 2004). When non-local raw materials are as abundant as local ones, the difference in the technological organization between these materials may be less obvious (Andrefsky, 2004).

# Methods

# Results



## Assemblage description

For the Gravettian assemblage, local cherts show similar patterns, with T2 and T5 being the types with higher numbers of artefacts (n=110 and n=72, respectively). For all local cherts, blanks represent more than 50% of the artefacts. Cores and core maintenance products are only present in T2 and T5, although in small frequencies. For T2, cores represent 13.6% of the group and core preparation and maintenance products represent 1.8% (n=2). For T5 only 4 core fragments and 1 core preparation and maintenance product are present. Retouched tools seem to be especially relevant in T2 (~18%), being the most frequent class after blanks. The presence of burin spalls (8.1%) in T2 also hints at the production of burins. In comparison, T5 shows similar percentages of retouched tools and shatter (~12% and ~14%, respectively). T1 (chalcedony) shows similar patterns, although with higher percentages of shatter (34.3%). In comparison, non-local chert types (especially T6 with n=169 and T7 with n=86) show similar percentages of blanks (~40-50%) but higher percentages of retouched tools (~30%). Cores, core fragments and core preparation and maintenance products are also present even if in small percentages (<4%), as well as shatter (~12%). In both types burin spalls are also present (7.1% for T6 and 4.6% for T7). The TL cherts show, as expected, blanks and blank fragments (n=3 and n=2, respectively), and retouched tools (n=4). The presence of core maintenance products in TL is possibly related to the limited knapping of TL01 (jasper).

Regarding the Proto-Solutrean assemblage, the local types show high frequency of blanks (>50%, including blank fragments), followed by shatter (~11-27%), cores (~9-12%) and retouched tools (~5-15% ). A single burin spall was identified in T4. There is also the absence of core preparation and maintenance products across all local cherts. T1 (chalcedony) is composed mostly of blanks and a retouched tool (Vale Comprido point). The absence of cores but presence of shatter may hint at the knapping of this raw material at the site, but the absence of formal cores perhaps due to the quality of nodules/lenses, which are characterised by fractures. For non-local types, especially those with higher number of artefacts (T6-T8), blanks and blank fragments are the most frequent class (48.3%, 53.1% and 69.2%, respectively). For T6 the absence of cores but the presence of shatter and a single core preparation and maintenance product suggests knapping on site. Similarly, T7 shows the presence of cores and core fragments (8.4%), shatter (17.0%) and a single core preparation and maintenance product. In comparison, T8, despite more limited in number (n=13), shows only one core, with the rest of the artefacts being blanks (as previously noted) or retouched tools (23.1% and n=3). Aside from the TL artefacts, all non-local cores show at least 1 core and frequently the presence of shatter. As expected, the TL artifacts include a blank and a retouched. However, a shatter was also identified.

The Solutrean assemblages show similar patterns to those observed in previous assemblages. For local cherts, especially T2 (n=506) which accounts for the majority of local chert present in the studied samples, the majority of the debitage is composed of flakes and elongated blanks (83.9%). Cores are also present (10.5%), alongside a small percentage of core preparation and maintenance products (1.3%). In comparison to debitage products, retouched tools are scarce in the sample (~3%). The non-local cherts most present in the Solutrean of the Shelter area are T6 (n=86) and T8 (n=30). These show similar patterns to the local cherts, with high percentages of blanks (>50%). Cores and core preparation and maintenance are also present in small percentages (<10%), as well as retouched tools (<10%). However, these specific results are truncated by the lack of shatter, which were not present in the sample used for the study. It is important to notice, however, that alike previous results from the Solutrean assemblages of the Terrace area, a large portion of the studied sample was altered and did not allow for a chert type attribution (21.9912473%).

## Measurement and weight descriptive statistics

In the Gravettian assemblages, blanks and retouched tools show little differences in the measurements of artefacts of local and non-local chert types. The only exception are T6 and T7 blanks, which show slightly lower weight means and lower maximum length (~35 mm) than the other types. For cores, T2 shows bigger (heavier) values than T6 (means of 21.3 and 12.6, and maximum weight of 37.2 gr and 22.5 gr, respectively), even if they seem to vary in morphology, with little patterns regarding thickness, width and length.

In the Proto-Solutrean assemblage, blanks show lower values for length and weight in non-local cherts (T6-T8), varying between a mean of ~19-20 mm and maximum of <30 mm for length, and mean of <3 gr and maximum of <7 gr for weight. In retouched tools, weight also shows smaller means for non-local cherts (~3-2 gr), although with higher standard deviation (~1.6). Regarding cores, the sample size for non-local cherts is small and only T7 statistics could be obtained. Despite this, when compared to local cherts (T2-T5), T7 cores show smaller mean and maximum values (7.3 gr and 8 gr, respectively).

For the Solutrean assemblage, there seems to be no clear difference in the measurements and weights of artefacts between local and non-local cherts. This is true especially for the most represented classes (flakes and elongated blanks). Regarding cores, many of the local and non-local cherts are not available for the statistics due to missing data. However, the smallest weight mean seem to be for cores of T6 (16.5 gr), although with high standard deviation and maximum value (16.5 and 48.6 gr, respectively).

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| Figure 1 |

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| Figure 2 |

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| --- |
| Figure 3 |

## Blank to core ratios

The analysis shows different patterns in the blank to core ratios not only between chert types, but also between assemblages. For the Gravettian, local types (T1 and T2) show lower ratios (<4) of blanks to cores, although other local types (T3-T5) have no identified cores. The non-local types, especially T6 and T7 show higher ratios (~8) of blanks to cores. In the Proto-Solutrean occupation, T2 and T4 show the lowest ratios (8.7 and 6.2 respectively) of blanks per cores, while the non-local T7 shows the highest ratios (11.0) of blanks to cores. Unlike the Gravettian, T1 (local chalcedony) and T6 (non-local chert) have no cores. Finally, the Solutrean assemblage shows similar patterns, with the local cherts showing lower blank to core ratios (<7), while the non-local cherts show higher ratios (>9). Similar to the Proto-Solutrean, chalcedony cores were also not identified in the studied sample.

## Retouched tools to debitage ratios

Throughout the different assemblages, the difference in retouched tools to debitage ratios by chert types, especially between local and non-local types, seem to show similar patterns. In this sense, in general, non-local types seem to consistently show the higher ratios when compared to local cherts. In the Gravettian assemblages this pattern is the most accentuated since T1 to T5 show low ratios (0.25-0.5) of retouched to debitage, while TL and T6-T8 show higher ratios (0.9-1.0). The exception is T10 (non-local type), which shows a lower ratio (0.28), more akin to local cherts. In the Proto-Solutrean assemblage, the lowest ratio of retouched to debitage is seen in T1 and T4, with values below 0.1, while other local types show slightly higher values (0.1-0.2). Following the same trend as the Gravettian, the non-local cherts show slightly higher ratios (0.3-0.5) of retouched to debitage. In the Solutrean assemblage, all local cherts (T2-T5) show low retouch to debitage ratios (<0.1), with the exception of T1 (chalcedony), which shows a ratio of 1.8. Other non-local cherts (T6-T7 and T11) show slightly higher retouch to debitage ratios (0.1-0.3).

## Tool typology diversity

Solutrean has a total of 43 retouched tools (complete and fragments), with a high variety of retouched tools (11), ranging from 5 (11.6%) to 4 (9.3%) per tool type. The typologies which are most frequently present in the studied sample are bifacial blanks and bifacial fragments, amounting to a total of 23.2% of products related to bifacial tool/point production. Two types of points were identified: shouldered points (2 complete and 1 fragment, amounting to a total of 6.9%) and tanged and 4 winged points (9.3%). Other frequent retouched typologies are end scrappers (9.3%), notches (11.6%), retouched blanks (~14%) and splintered pieces (11.6%). Regarding chert type, a substantial portion of retouched tools are of unidentified chert types (n=13), mostly due to alterations (fire and post depositional). Most retouched tools with identified chert are local (n=13, accounting to 30.2325581%), followed by Type 6 cherts, previously suggested to be from Central Portugal (n=7, accounting to 16.2790698%). Local types show a higher variability retouched typologies (9 types), although this may be related to the higher amount of tools. In comparison, Type 6 shows only 5 different typologies.

For the Proto-Solutrean, 65 chert retouched tools were identified, with 23.0769231% (n=15) having an unidentified chert type. A total of 26 retouched tools correspond to local cherts, while 23 correspond to non-local cherts. Regarding the typology, 14 different types of retouched tools were identified. Endscrappers (26.2%), splintered pieces (17%), burins (12.3%) and retouched flakes (7.7%) were the most prevalent. In comparison to the high frequency of point-related technology observed during the Solutrean, Vale Comprido points are barely present in chalcedony and chert (n=1), as they are mostly present in dolerite and chert was mainly used for other tools as seen in previous studies (\*\*). Regarding the types of chalcedony and chert, local raw materials show 9 different typologies, with Vale Comprido points, Solutrean retouch and notches being present only in the local types, even if in small numbers. Non-local cherts show 10 different typologies of retouched tools. Perforator-endscrapper, truncation, backed bladelet and retouched blades typologies can only be found in non-local varieties, albeit also in small numbers.

In the Gravettian assemblage, 170 retouched tools were identified, with 22.9% (n=39) having an unidentified chert type. From the identified chert types, 24.1% of retouched tools are from local types and 52.9% from non-local cherts, with 34.1% of these being from T6 and 14.1% of T7. Regarding typologies, 15 types of retouched tools were identified (excluding fragments). All these typologies were found in the non-local chert group, while only 7 retouched tool typologies were identified in local cherts/chalcedony. The most common typologies identified in the assemblage were burins (n=52), endscrappers (n=17), retouched flakes (n=30) and splintered pieces (n=26). From all these, the majority were produced in non-local chert, mainly T6 and in lesser numbers T7. Although in lesser numbers as well, backed bladelets were also identified (n=6), but only present in non-local chert types (T6 and T7).

# Discussion

Hypotheses to test: a) use lives derived from knapping strategies; b) reduction intensity and tools-to-debitage ratios; c) core size and blank-to-core ratios; d) reduction intensity and tool reworking; e) tool typology diversity and specialization.

To test these hypotheses, the following parameters were evaluated for each assemblage and compared between chert types: P1) frequency of retouched tools; P2) frequency of maintenance products; P3) debitage sizes; P4) tools-to-debitage ratios ; P5) core sizes; P6) blank-to-core ratios; P7) retouched tool sizes; P8) tool diversity; P9) tool specialization. The results may be summarised as follows:

Retouched tools are present in higher percentages in the Gravettian assemblages. Within the assemblage, retouched tools (P1) are present in higher frequencies in the non-local cherts, as well as in core preparation and maintenance products (P2). Debitage sizes (P3) show no differences between local and non-local cherts. Tools-to-debitage ratios (P4) are significantly higher in non-local cherts. Core sizes (P5) are slightly smaller in T6, a non-local chert, and the blank-to-core ratios (P6) are higher in non-local cherts. Alike blanks, retouched sizes (P7) show no relevant differences between local and non-local cherts; however, tool diversity (P8) is higher in non-local cherts, although with high frequency of less specialised tools such as notches and retouched tools, alongside hunting implements such as backed bladelets (P9). The high frequency of burins seen in this assemblage may be related to their use as cores, representing a knapping strategy more than the presence of retouch.

The Proto-Solutrean assemblages show a smaller presence of retouched tools than the Gravettian, and within the assemblage, retouched tools (P1) are slightly more frequent in non-local cherts. Core preparation and maintenance products (P2) are only present in non-local cherts, albeit in very small numbers (n=2). Debitage sizes (P3), core sizes (P5), and retouched tool sizes (P7) are slightly smaller in non-local cherts. Regarding the ratios, tool-to-debitage ratios (P4) are higher in non-local cherts, albeit smaller than those seen in the Gravettian assemblage, and blank-to-core ratios (P6) are also higher in non-local cherts. Little differences were observed in tool diversity (P8) and specialisation (P9) between local and non-local cherts.

Finally, the Solutrean shows no relevant differences in the frequencies of retouched tools (P1) and core preparation and maintenance products (P2) between local and non-local cherts. In general, the retouch frequency is lower than that observed in the previous assemblages. Debitage (P3), core (P5), and retouched tool (P7) sizes show no differences between local and non-local cherts. Similarly to the Proto-Solutrean, tools-to-debitage ratios (P4) and blank-to-core ratios (P6) are slightly higher in non-local cherts. Both tool diversity (P8) and tool specialization (P9) are higher in local cherts.

How the results fit or do not fit within the hypothesis, and possible reasons why.

Focus on the high presence of retouch and burins during the Gravettian.

Fitting the technological data with the suggested interpretations from article 2.

# Conclusion

# Acknowledgements

# References

Marwick, B., 2017. Computational reproducibility in archaeological research: Basic principles and a case study of their implementation. Journal of Archaeological Method and Theory 24, 424–450. <https://doi.org/10.1007/s10816-015-9272-9>

### Colophon

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