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BETWEEN TOOLS AND ENGRAVINGS: TECHNOLOGY AND EXPERIMENTAL ARCHEOLOGY TO THE STUDY OF CACHÃO DO ALGARVE ROCK ART

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Abstract: *This paper aims to present an experimental work developed under the studies about the Cachão do Algarve rock art (Central Portugal). In this context, we tested the feasibility of producing rock art engravings on greywacke supports through the use of lithic tools formatted according to characteristics of macrolithic industries found in the archaeological context of the Tagus Valley. The results of this work allowed us to create hypothetical operative chains through which could had been produced the rock art of the site, what is absolutely important for an attempt to understand the technological behavior of prehistoric populations that occupied the region during the Holocene.*

Keywords: *Rock Art, Technology, Experimental Archaeology, Tagus Valley*

Résumé: *Cet article vise à présenter un travail expérimental développé dans le cadre des études sur l'art rupestre du Cachão do Algarve (Portugal Centrale). Dans ce contexte, nous avons testé la faisabilité de la production de gravures rupestres dans grauwacke à travers l'utilisation d'outils lithiques formatées en fonction des caractéristiques des industries macrolithiques trouvés dans le contexte archéologique de la Vallée du Tage. Les résultats de ce travail nous a permis de créer hypothétiques chaînes opératoires par lesquelles pourrait avaient été produites l'art rupestre du site, ce qui est absolument important pour tenter de comprendre le comportement technologique des populations préhistoriques qui ont occupé la région pendant l'Holocène.*

Mots clés: *Art Rupestre, Technologie, Archéologie Expérimentale, Vallée du Tage*

INTRODUCTION

The experimental work which led to this paper was developed as part of a master's thesis entitled "Contribuição para o estudo do Complexo de Arte Rupestre do Vale do Tejo (Portugal): o sítio Cachão do Algarve". Its main goal was to test the feasibility of producing rock art engravings on greywacke supports, using to engrave, lithic tools of quartzite and quartz knapped according to the characteristics of the macrolithic industries found in Tagus Valley, flakes from the production of those tools and natural pebbles of the same raw materials.

The observation of the empirical data generated by such technical action allowed us to analyze important aspects of the technological process (behavior of raw materials during the procedure, percussion techniques more efficient, morphologies tools more appropriate for the work, etc.), enabling to propose hypothetical operative chains through which could have been produced much of the Cachão do Algarve rock art.

It is worth noting in this regard the importance of this approach, since the study of rock art technology through Experimental Archaeology provides a more accurate and concrete approximation of the artistic phenomenon in prehistory, minimizing the "subjectivism and free interpretations without empirical support" which, unfortunately, are so recurrent in this field of study (Sanchidrían, 2001:14).

THE CACHÃO DO ALGARVE SITE

Located in Vila Velha de Ródão, central Portugal, the Cachão do Algarve is one of the seventeen sites that are officially part of the known Tagus Valley Rock Art Complex (TVRAC), certainly one of the biggest and most important exponents of Post-Paleolithic rock art in Europe.

Identified on the greywacke from the right bank of the Tagus River during the first half of August 1972, since the beginning the Cachão do Algarve drew attention for

Figure 1. On the left, the rock 101 from Cachão do Algarve (Baptista, 1986:44) and on the right, an example of latex molds produced over the engravings

its large platforms in position predominantly horizontal or gently sloping, red-brown staining and polished over millennia by the waters of the river, thus becoming excellent supports to production of a large amount of engravings by pecking (Fig. 1) (Baptista, 2011; Serrão, 1978).

But the construction of two dams (Fratel Dam and Cedilho Dam) in the stretch of river where were located the first sets of engravings would cause the Cachão the Algarve to be submerged by the waters of the Tagus in the end of the 1970s, together with the most other rock art sites of the complex.

However, before this event, members of the Group for the Study of the Portuguese Paleolithic were able to perform the rescue, with expressive urgency, of most engravings identified, something unprecedented in the country.

To accomplish this work, the methodology used was based on the record of that rock art by creating molds of liquid rubber (latex), a technique learned in France with Michel Brézillon, who had used that method for the study of prehistoric engravings in the Sahara desert (Fig. 1) (Baptista, 1974; Sande Lemos, 2011).

Thus, under the aforementioned thesis, the 301 molds from Cachão Algarve site were traced through direct tracing, according to a methodology developed by Abreu *et al.* (2010) and Abreu & Jaffe (1996). From this activity, we performed a typological classification of the rock art engravings and built the corpus formed by these. In total, we identified 18 anthropomorphic figures (1.10%), 21 zoomorphic figures (1.29%) and 1592 ideomorphic figures (97.61%).

But, as the main objective was the technological approach about the engravings, we also proceeded to the analysis of the technical aspects of each engraving and developed the experimental work presented here.

A HYPOTHESIS TO BE TESTED

Assuming that "an experiment is, by definition, a method to establish a reasoned conclusion, against an initial hypothesis, by trial or test," we focused our experimental procedure on the problem relating to the possible tools used as engraver elements in the production of Cachão do Algarve rock art (Reynolds, 1999:157).

This is, however, a matter markedly problematic because in any rock art engraving study the tools used to engrave are rarely found, either due to their absence in the archaeological context, for different reasons, or because the lack experience of researchers to identify them among other lithic artifacts recovered (Alvarez *et al.* 2001).

In the study of Cachão do Algarve, this is precisely the case. Having the engravings been produced on the greywacke banks of the Tagus River, it was not possible the formation of an archaeological context near the engraved supports, where could be found the tools used to produce that rock art.

Without any material evidence about the tools and the characteristics of the formative action of the engravings, we had only a few information from the literature produced about TVRAC, in which some authors eventually voiced their opinions on what kind of tools could have been used to perform the pecking on the rocky support close to the river. Serrão (1972), for example, believed that the engravings had been produced with any pointed tool, while Santos (1985) claimed be lithic or metal tools (without any opinion about the morphology) and Baptista (1986) advocated the use of quartz or quartzite pebbles (not defining if they would be knapped or used in its natural state).

Understanding the Cachão do Algarve engravings predominantly as Neolithic representations – according to the chronological framework proposed by Baptista (1981)

– we observe the characteristics of lithic industries of this period found in archaeological context of the region.

Immediately, we direct our attention to the so called macrolithic industry, strongly characterized by the exploration of quartzite and quartz (in a lower frequency) to produce knapped pebbles, mainly choppers.

This lithic industry, initially known as Languedocense, is very present in Neolithic contexts existent along the Tagus Valley, where is always found on the surface, either alone (in concentrations varying density) or in association with pottery elements, polished tools and other findings of Holocene chronology (Oosterbeek, 1994; Grimaldi, 1998; Cruz *et al*. 2000).

Such lithic artifacts were produced by direct percussion with a hard hammer, on pebbles usually of rounded morphology, abundant raw material in the area and whose origin is related to processes of formation and erosion on the conglomeratic levels of the fluvial terraces present in the region (Grimaldi, 1998).

Thus, emerged the following main question:

- It would be possible to produce rock art engravings on greywacke supports using lithic tools of quartz and quartzite knapped in accordance with the techno-morphological characteristics of the macrolithic industry found in the Tagus Valley?

Considering this possibility and finding on the macrolithic industry of Tagus Valley the techno-morphological features that, we believed, would be *a priori* fundamental to allow efficient use in the production of rock art engravings, we decided to set up the lithic tools necessary to carry out our experiment according to the characteristics evident in that industry.

Another issue that contributed to this choice, was the fact that in the course of a field work conducted in 2011 on the rock art site of Cachão de São Simão were identified macrolithic tools in the area close to where the engravings are, just 3 km from the Cachão do Algarve.

Appeared, then, some other questions:

- Regarding the raw materials, would be more efficient for the work the tools of quartzite or quartz?
- Based on your techno-morphological characteristics, what would be the tools more efficient for the work?
- Between the techniques of direct percussion and indirect percussion, which one would be the more efficient with respect to the results obtained in the pecking and investment of time and energy necessary to complete the action?
- The occurrence of impact points with distinct morphological characteristics in the same engraving would be more connected to wear the active zone of the same tool or the use of various tools to get the work done?
- The record of rock art engravings by molding latex is reliable?

Obviously, we were aware that, probably, the Cachão do Algarve rock art was not produced according only a single model of operative chain. However, for reasons of time, would not be feasible to test a large number of other operative possibilities to achieve the same goal. So, we focused our efforts on trying to prove, or disprove, the viability of some of the many possibilities.

Thus, the production of the Cachão do Algarve engravings through a technological process in which were used macrolithic tools would be the hypothesis experimentally tested by us.

THE EXPERIMENTAL WORK

Intending to rigorously test the hypothesis constructed and seeking to answer the questions that arose, we developed the experimental work.

We selected nine distinct morphologies of tools (Grimaldi, 1998), which had a good prehension to perform the technical gestures involved in pecking and morphology of the edge between pointed and convex.

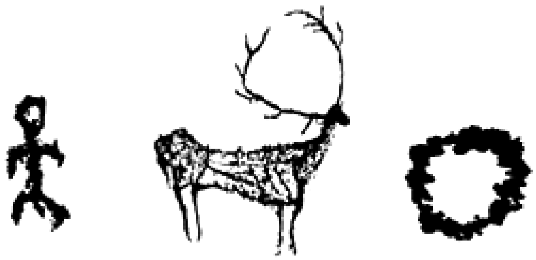

Figure 2. Rock art motifs selected to be engraved during the experimental work. Respectively, from left to right: 16.4 cm x 7 cm (CAL63B M664), 60 cm x 50 cm (Gomes, 2007:93) and 8 cm x 7.5 cm (CAL103 M165)

The obtaining of the raw materials to produce the experimental lithic tools and the selection / procurement of the rocky supports to be engraved occurred in a location with the same geological characteristics of the area where is located the Cachão Algarve.[1]

In such a place were collected 28 pebbles (14 of quartz and 14 of quartzite) and selected nine supports of greywacke, fixed and with large dimension – that would be engraved there – and 2 platforms of the same raw material that would be transported to be engraved in the area of experimental activities of the Instituto Terra e Memória (ITM).

Then,were knapped 16 tools (8 in quartzite and 8 in quartz). The remaining 12 pebbles were kept in their natural forms. To complete the experimental collection, it

[1] The place selected was the Ocreza Valley, integrated in the CARVT and where is located an area for activities of Experimental Archeology, duly registered in the IGESPAR.

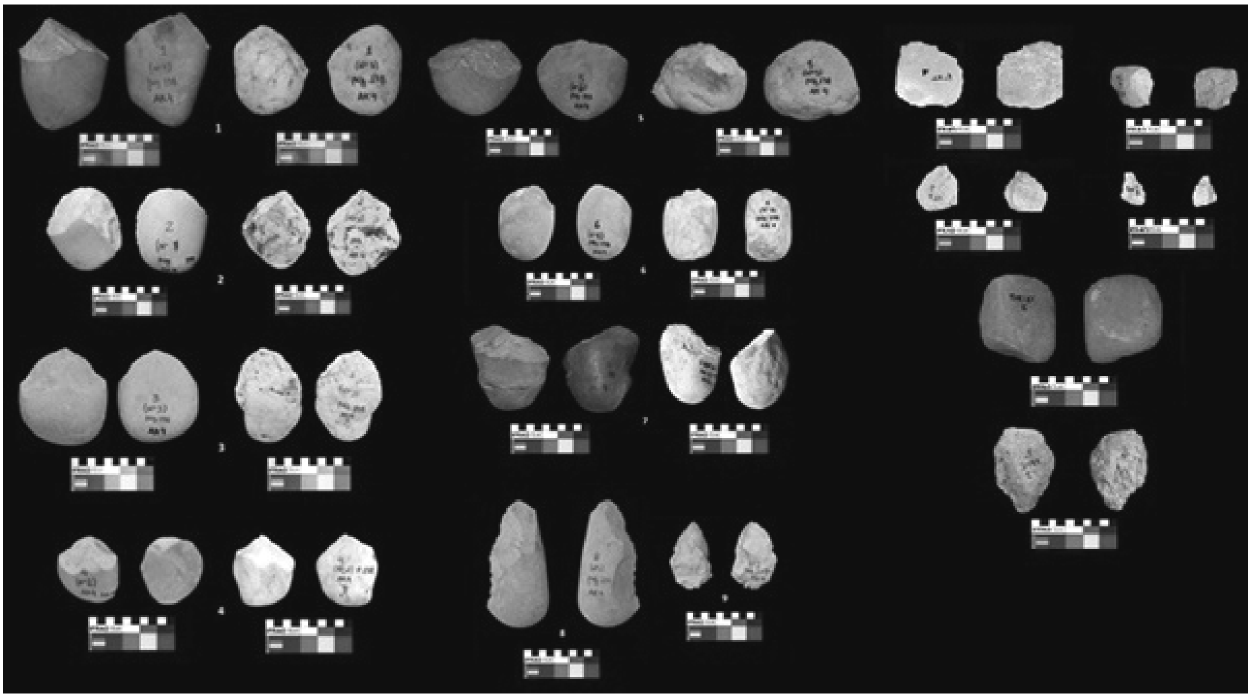

Figure 3. Lithic material used in the experimental work. On the left and center, choppers and knapped pebbles. On the right examples of flakes and natural pebbles

was selected 15 quartzite flakes and 15 quartz flakes for use in indirect percussion. We prioritized the choice for cortical flakes, since such flakes are the most present on the macrolithic industries evidenced in the archaeological context of the region (Fig. 3).

All supports selected were further marked with a red ink with long durability, to avoid that the experimental engravings being confused with archaeological ones.

Thus, were produced 34 experimental engravings, in accordance with different combinations of tools and techniques, aiming to test the viability of the technical operation in question.

To perform this action, we used the following materials: 7 choppers in quartzite, 7 choppers in quartz, 1 knapped pebble in quartzite, 1 knapped pebble in quartz, 5 flakes in quartzite, 11 flakes in quartz, 6 natural pebbles in quartzite, 6 natural pebbles natural in quartz, 1 soft hammer (*Buxus simper virens*), 1 hard hammer (quartz).

With this tools were produced 10 experimental anthropomorphic figures, 10 zoomorphic ones and 10 ideomorphic ones, according to the following combinations of tools and techniques:

- quartzite chopper + direct percussion.
- quartzite chopper + indirect percussion.
- quartz chopper + direct percussion.
- quartz chopper + indirect percussion.
- quartzite flake + indirect percussion.
- quartz flake + indirect percussion.
- quartzite natural pebble + direct percussion.
- quartzite natural pebble + indirect percussion.
- quartz natural pebble + direct percussion.
- quartz natural pebble + indirect percussion.

Given the characteristics of the zoomorphic motif, with some traces thicker and other thinner, were also produced 4 further engravings by the following combination:

- quartzite chopper + direct percussion and quartzite flake + indirect percussion.
- quartzite chopper + indirect percussion quartzite flake + indirect percussion.
- quartz chopper + direct percussion and quartz flake + indirect percussion.
- quartz chopper + indirect percussion and quartz flake + indirect percussion.

Then, we reproduced the three rock art motifs selected with the same dimensions and traits of the archaeological ones (Fig. 4).

During the actions, the experimenter struck the rocky support in perpendicular and oblique directions, always in bidirectional movements. His gestures ranged between 70º and 90º in relation to support, having been the first angle to extracting a greater quantity of matter of the rocky surface and the second employee in order to give more depth to the pecking.

The whole process was recorded in detail before, during and after his execution by filling in forms created specifically for the experiment and making photographs and videos.

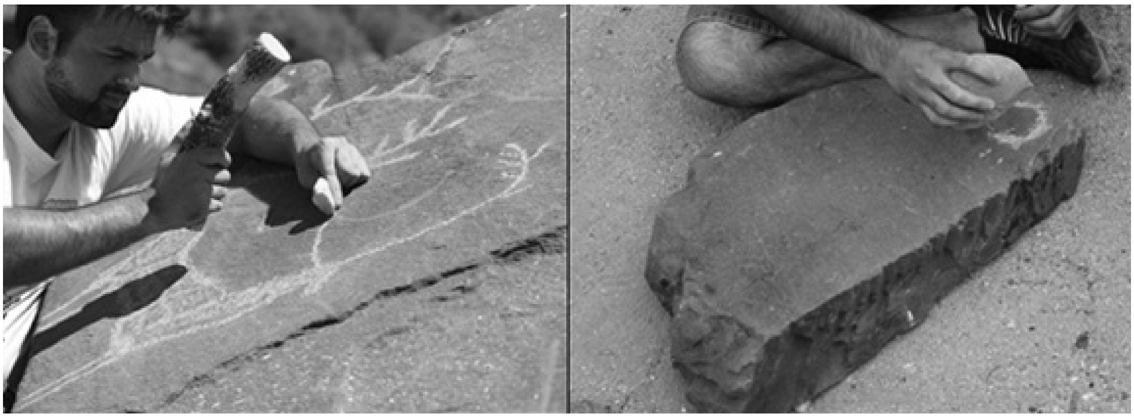

Figure 4. Productionof the experimentalrock art engravings

Besides the lithic tools have been properly measured and weighed before the experiment, their active zones were photographed, measured and had their angles information on their conservation status recorded after 1.200, 1.000 and 2.000 impacts. Any revivals that were able to eventually change their morphology has also been recorded.

After action is complete, these tools were photographed under the same perspective that were before and during the experiment, while the engravings were carefully recorded in the general scope and focuses more on the specific characteristics of pecking performed and traces of engraving.

In the list of materials used to record the experimental processes are: specific forms to the lithic tools and engravings, 2 photographic cameras Canon 600D, 1 photographic camera Nikon D80, 1 caliper, 1 scale, 1 meter angles and 1 stopwatch.

Then all experimental engravings were recorded by direct tracing, which, besides setting up a formal record, allow us to compare them with the tracings made later on the latex molds produced in the next stage.

Finally, in a last stage of the work, we did the production of latex molds of the experimental engravings (Fig. 5), and also their record by direct tracing, at the laboratory. We used this activity: 10 kg latex, 1 brush roll, 4 brushes 30 m gauze.

To produce the molds, we follow exactly the same methodology used by the researchers who have shaped the rock engravings of the Tagus Valley in the 1970s, which is described in detail in Baptista (1974) and Querol *et al.* (1975). Briefly, we can describe the procedure as follows: after the rock surface has been cleaned with water, was awaited and after drying it was applied a first layer of latex.

After approximately 30 minutes, when the first layer was dry, we proceeded to the application of a second one. This process being repeated until the fifth layer of latex, when was applied a layer of gauze over the entire surface.

Figure 5. Mechanical damage suffered by the quartzite and quartz tools after their use in the engraving of the zoomorphic figures by direct percussion

After this last application, the process performed for the initial layers again be repeated until the tenth layers were completed. After complete drying, the mold was carefully removed from the rock surface, to thereby prevent occurrence of tearing.

RESULTS

Having successfully produced 34 experimental rock art engravings on greywacke supports, we consider absolutely feasible to produce that kind of representation through the use of lithic tools in quartz and quartzite knapped according to the characteristics of the macrolithic industries of the Tagus Valley, the flakes from the production of those tools and natural pebbles of the same raw materials.

However, it is worth noting that although has been possible to produce engravings with all tools tested under direct and indirect percussion, the level of efficiency shown by each of them was quite different, varying mainly according to the type of raw material that were composed and the morphology of its active zone.

Observing the behavior of quartzite and quartz, it was possible to identify a large difference between them, because the tools produced in quartzite responded much more satisfactory with regard to the occurrence of mechanical damages generated by the impacts resulting from the activity performed.

The quartzite choppers suffered little changes in their active zones, usually only a few small detachments (on average 0.5 cm x 0.5 cm) on the lower face of the edge, after 2000 impacts. In turn, the quartz choppers presented shredding, occurrence of large chipping (on average 2 cm x 1.5 cm) and fractures on the active zones already after suffering 10 impacts, until the completion of the engraving and making the edges constantly abrupt (80° / 90°), which reduced its efficiency and required frequent revivals. In some cases, there was even a complete fracturing of the tool (Fig. 5).

This fact was reflected in the characteristics of the pecking performed with quartz tools, which were less deep (0.1 cm or less) and more imprecise than those made by quartzite tools, because the steadily fragmentation of the artifact during the action hampered the realization of accurate technical gestures.

Such behavior was also evident on the flakes and natural pebbles. In the case of the flakes, the high level of fragmentation of the quartz made it necessary to use a larger amount of raw material. While to produce fully a zoomorphic figure only under indirect percussion using flakes, for example, was required 1 quartzite flake, to perform the same action it was necessary to use 4 quartz flakes.

Based on these data, although the use of quartz for the production of engravings is feasible, quartzite is much more able to perform that action.

Among the most effective tools stood out the quartzite choppers with active zone of pointed morphology and angle between 55º and 60º. Such tools were used by direct percussion and produced accurate and incisive pecking up to 0.2 cm deep.

Regarding the flakes, those in quartzite with semi-circular edge morphology and angle of the active zone between 35º and 45º were the ones with a better result. With an excellent performance when used under indirect percussion to perform finer traits as legs andantlers of zoomorphic figures, with these flakes could easily produce traces with an average thickness of 0.5 cm, depth 0.2 and U section.

But when used to engrave full zoomorphic figures the efficiency decreased, because its active zone rather narrow (0.2 cm) was not adequate to fill large areas by pecking. To fill the torso area of that kind of rock art motifs through their points of impact of linear morphology and under indirect percussion, for example, it was necessary 100 minutes and around 15,000 impacts, namely, a high investment of time and energy.

To engrave the anthropomorphic and ideomorphic figures under the same technique that flakes showed once again large efficiency, producing precise and regular lines, being also efficient to eliminate the cortex layer of rock surface.

About the two pebbles knapped on both faces, used under indirect percussion, that one of quartzite (active zone whit convex morphology and angle of 60°) has been more effective in the action, producing a pecking depth (0.3 cm) and regular, although his great length (19.5 cm) has made it become difficult to control during the performance of the movements.

Finally, between natural pebbles, quartzite were also the most effective, although they produced a pecking shallow and too “rough” in achieving the zoomorphic, quite different from the original pecking. Its dominance was conditioned also by the aforementioned weakness of quartz to damage caused by the impacts.

Another interesting finding from the results of the experiment is that before to be a product of the use of different tools in a single engraving, or a large variation in the angles of gestures used by the engraver, the occurrence of pecking with different morphologies are much more connected to the wear process of the active zone of the engraver tool. That is valid for both quartzite and quartz.

For example, in the case of a tool with a pointed active zone morphology and angle of 50°, the occurrence of damage could remove its pointed shape and change the angle to 70°. This change will to modify the morphology of the pecking from a rounded morphology to a straight morphology, also presenting a lesser depth.

Regarding the techniques of direct and indirect percussion, we measure their effectiveness in comparing both the quality of pecking obtained on the support and investment of time and energy necessary to complete the intended action.

Thus, according to the parameters it was evident the higher efficiency of the pecking technique by direct percussion.

Using as an example the pecking through that technique and with the use of choppers of both raw materials, it is possible to realize that the result is more precise, smooth, controlled and also deeper (average 0.2 cm) (the dimensions of traces vary depending of the active zone dimensions). On the other hand, the pecking made by indirect percussion results more inaccurate, irregular, with large amount of cortex within the traces and with an average depth that tends not exceed 0.1 cm.

In our view, this is due to the fact that by direct percussion the engraver is able to control more

Table 1. Summary of average time and average of impacts necessary to perform each rock art engraving according different combinations of tools and techniques

Average time of production/ Average of impacts for production	Anthropomorphic figure	Zoomorphic figure	Ideomorphic figure
Chopper dir. perc.	11 min./1.840 impacts	31 min./6.150 impacts	8 min./1.590 impacts
Chopper ind. perc.	22 min./4.200 impacts	94 min./15.950 impacts	14 min./2.240 impacts
Chopper dir. perc. + flake ind. perc.	–	65 min./14.445 impacts	–
Chopper ind. perc. + lasca ind. perc.	–	116 min./16.975 impacts	–
Nat. pebble dir. perc.	5 min./1.220 impacts	27 min./5.250 impacts	3 min./580 impacts
Nat. pebble ind. perc.	23 min./3.855 impacts	89 min./13.800 impacts	7 min./1.155 impacts

adequately both made gestures as the intensity of the applied force, thus producing a pecking more controlled, precise and incisive.

Regarding the investment of time and power is glaring the difference seen between the two techniques, as can be seen in the Tab. 1.

Based on these data, it is clear that in addition to better results with regard to the quality of pecking, the direct percussion require a smaller investment of time and energy, as require the completion of a smaller number of impacts to achieve the same goal in a shorter space of time.

The last of the results presented here concerns the level of reliability of the record of engravings by molding latex, widely discussed topic in the studies about the molds of the Tagus Valley rock art.

With the production of the experimental molds, their record by direct tracing and the comparison of these tracings with those made directly on the experimental engravings, was possible attest to a considerable degree of reliability for this type of record. Elevenmolds were produced and nine of them recorded the engravings completely and with detail.

The other two remaining molds were not able to record the engravings completely. Some of their traits become invisible and, therefore, was not possible to carry out the direct tracing decal. We believe that such failure on the record can be related to the presence of a shallow pecking (less than 0.1 cm) forming the engravings on which the molding was unsuccessful.

However, it is very important to draw attention to the damage on the rock surface by the molding process in latex. Upon withdrawal of all experimental molds after they are dry, parts of the rocky surface, and of the engravings, were uprooted and remained glued on the latex. This fact demonstrates why this is a method already in disuse and which should be avoided to the maximum by researchers. From what we can see, their use on archaeological engravings can cause a great risk of destruction.

HYPOTHETICAL OPERATIVE CHAINS OF PRODUCTION FOR THE CACHÃO DO ALGARVE ROCK ART

First, in the words of Lévi-Strauss (1975), we must remember that it is always valid to form hypotheses, if they are coherently constructed and based on empirical data. In this context, we consider much more useful hypothesize about a problematic issue than simply not doing and to close the investigation when it is still far from its possible limits, blaming for this investigative lethargy the lack of an archaeological context in perfect condition to perform the work, a condition that in prehistoric archeology, and even more in rock art, we know, is pretty rare.

The Experimental Archaeology, more than a study procedure, is a method of contrasting hypotheses through experimentation, which when rigorously developed from a clear issue of work, permits to support (or to deny) the viability of interpretative hypotheses about prehistory, built with base on technical processes developed today (Baena, 1997; Coles, 1979; Reynolds, 1999).

Therefore, from the results obtained by the experimental work, which sustained the viability of the tested hypothesis, we now present, in a summary way, the proposal of three hypothetical operative chains by which could had been produced a large part of the Cachão do Algarve engravings. Before that, however, it's important to remember that we understand the term "operative chains" as the series of operations involved in any transformation of matter carried by humans (Lemonnier, 1992).

To build such proposal, we performed a comparison between the original molds and the experimental ones, with the intention of identifying which combinations of techniques and tools generated the experimental engravings most similar to the archaeological ones.

Analyzing first the anthropomorphic figures, the experimental engraving that result more similar to the archaeological one on technical aspects, was that produced by direct percussion with gestures variants between 70º and 90º and through the use of a quartzite

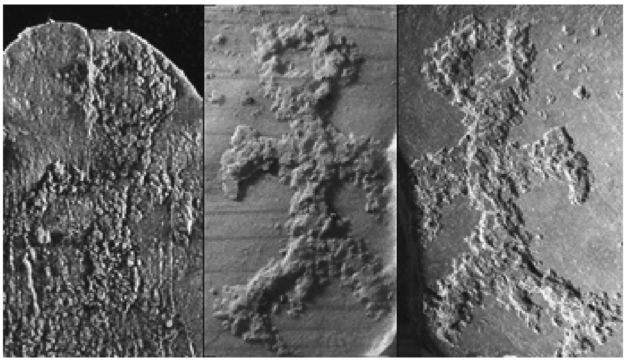

Figure 6. Comparison between the archaeological anthropomorphic figure present in the original mold CAL63B M664 (left) and the experimental one (center and right)

chopper with pointed edge morphology presenting angle of 60° (Fig. 6).

In this case the pecking that forms this experimental engraving, as that which forms the original anthropomorphic figure appeared prominently deep (0.25 cm), indicating the achievement of precise and incisive impacts on the rocky surface which promoted the complete removal of the cortex within the traits. Being that rock art motif representative of the typological category to which it belongs, both in figurative as regarding the technical characteristics of the pecking, we can extrapolate this comparison for at least 44% of anthropomorphic figures analyzed in the study of the site.

Regarding the zoomorphic figure, the experimental engraving most similar to the archaeological one was that produced by two different combinations of techniques and tools.

This engraving was made through the techniques of direct and indirect percussion, having been used for the direct a quartzite chopper with pointed edge morphology and angle of 55º and for the indirect a quartzite flake with semi-circular edge morphology and angle of 35º. In the first case, the gestures of the experimenter varied between 70º and 90º, while in the second were performed perpendicularly (90º) to the rocky support.

Through direct percussion were recorded the torso, neck and head of the animal, creating a pecking wider (about 1 cm), thick, with irregular section and impact points higher and deeper. By indirect were performed the legs and antlers of the zoomorphic figure, through a pecking that formed continuous lines with thickness of 0.5 cm, depth of 0.2 cm and U section.

Finally, the experimental engraving performed with a natural quartzite pebble (pointed active zone an angle of 90°), used under direct percussion using gestures between 70º and 90º, was the most similar to the archaeological ideomorphic figure. The pecking produced appeared markedly irregular, discontinuous and shallow, which can be extrapolated to 65% of the circles identified in the Cachão do Algarve.

It can be seen, therefore, the occurrence of a different operative chain different for each type of rock art motif. But although they differ in the course of its stages, with regard to obtaining raw materials the process would be the same for all of them.

In the area close to the Cachão do Algarve can be seen a vast presence of pebbles of quartz and quartzite, being the first most abundant. Thus, there would be a selection of a specific raw material for the activity, namely the quartzite instead of quartz, probably because the latter present a low efficiency (what has been proven during the experimental work).

Therefore, the production of lithic tools could be performed locally, without needing to transport raw materials or pre-formatted tools from another areas.

Regarding the morphology of the tools, would be privileged the production of choppers with pointed edge morphology and angle of approximately 60º, creating active zones efficient to produce an accurate and incisive pecking, being simultaneously resistant to mechanical damage caused by the impacts. Such tools would be used by direct percussion to perform impacts in angles between 70° and 90° relative to the surface of the rocky support.

The flakes from their production would also be utilized, preferably the cortical flakes with dimensions suitable to the realization of a good prehension. These would be used under indirect percussion with wood hammer, through gestures predominantly perpendicular to the engraved surface, producing continuous and detailed lines such as antlers of deer.

To realize engravings structurally simpler which not require a high technical improvement, it would be possible to use natural quartzite pebbles with pointed active zones to strike directly on the rocky surface obliquely and perpendicularly.

After the action has been completed, the tools could be discarded or reused on site to produce more engravings, if they had even a satisfactory level of efficiency or were undergoing some revival.

Below is a summary of the three hypothetical operative possibilities related to use of macrolithic industries in the production of the three types of engravings typical of the Cachão do Algarve (Fig. 7):

FINAL CONSIDERATIONS

Given all that has been exposed so far, we can conclude that the results of our experimental work reinforce the possibility of a relationship between the Cachão do Algarve rock art and the macrolithic industries present in

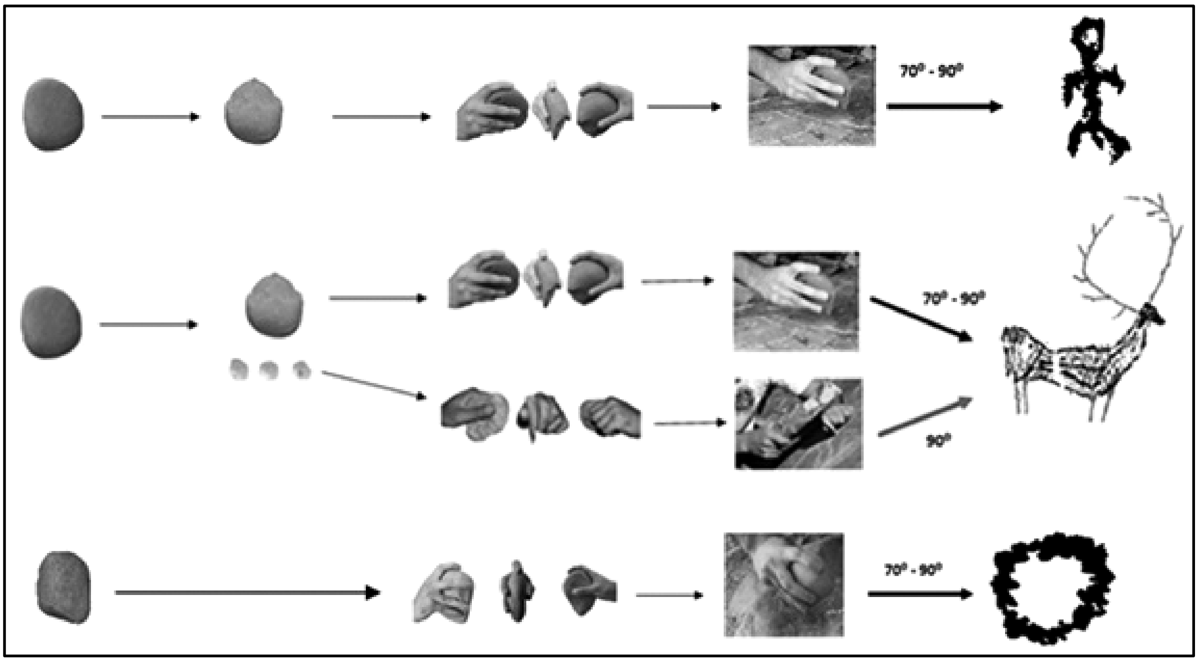

Figure 7. Operative possibilities for the production of the Cachão do Algarve rock art engravings in a hypothetical technological process in that would be used macrolithic tools to engrave

the archaeological context of the Tagus Valley, contributing to a better understanding of the possible technological behavior of prehistoric populations that occupied the region.

Obviously, the information generated by Experimental Archaeology, however useful they may be, absolutely not set a "bridge" to the minds of prehistoric men, since we belong to a culture very different from that in which were immersed the societies of the past (Sampaio & Aubry, 2008). However, it is once again important to emphasize the need to conduct experimental approaches in the context of technological studies, because like would say Leroi-Gourhan (1986:11), the technology must first be experienced, only after being conceived.

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