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Keep it in your own Backyard: New Experimental Perspectives on Domestic Iron Age Lithic Industries in the Northwestern Iberian Peninsula

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Both knapped and polished lithic industries have traditionally been given great regard within the archaeological studies of northwestern Iberian Peninsula, mostly focusing on their typologies and the materials used. However, this has not been the case with other stone objects, such as rolling stones, that tend to appear in certain prehistoric contexts - especially when they do not show signs of intentional knapping. We propose the study of a set of pieces of this type coming from an Iron Age context with the objective of categorizing its use, multifunctionality, and importance within the domestic sphere. For this, we will elaborate on the given article in three parts: firstly, carrying out a morpho-typological study based on the existing bibliography, secondly, trying to establish the corresponding ethnoarchaeological equivalents, and, finally, experimenting with the use of utensils of the type proposed in various domestic applications.

> “ The granite showed the worst thermal qualities of the three materials, due to its high specific heat. It is feasible to assume that the fire did not adequately heat the interior of the stone and that the measurement we obtained on the surface of the same gave us a false idea of the heat that actually stored the sample.

Introduction

Generally speaking, it is common during archaeological interventions that not all recovered materiality is given the same relevance, especially when dealing with lithic artefacts. Usually those pieces with clear intentional alterations receive more attention.

It is in these domestic contexts where samples of this type of lithic industry, not knapped or with few modifications, usually appear. These samples present not only traces of use but also evidence of a process of selection of the raw material, carried out in a fully conscious way, as an undertaken and controlled action which obeys precise technological and economic goals. According to those goals, resources are selected from the environment so that they meet the needs of the user, that is, the medium imposes a specific offer in which various economic solutions fit. But this has its limitations, defined by the individual's ability to obtain the best benefits by developing the most appropriate technique and economic strategy in each situation (Villar Quintero, 2004, pp. 77-78).

Chrono-spatial context

The present study relates to the northwestern area of the Iberian Peninsula, specifically to the territories located in Portugal, north to the Douro River, including the Spanish regions of Galicia, Asturias and the provinces of Zamora and León. In this area the Castro culture developed starting in the Late Atlantic Bronze Age. Given the great extension of the territory we dealt with, it was decided to limit the area to the castro of Santa Trega: *A Guarda, Pontevedra*, because it presents the following characteristics: its material culture and building pattern typical of the Iron Age in the Castro area andits proximity to raw material sources - considering the difficulty associated to collection and transport.

The chronology of the sites in this area extends from the Late Bronze Age well into Roman Era, reaching the 3rd and 4th centuries AD and even later. It is not wise to discard the survival of these tools since the end of the Upper Paleolithic in Europe, with many samples present in Neolithic contexts, it being a long surviving and traditional system (Bernal Casasola, 2008, p. 188).

State of the question

This type of industry poses two problems. On the one hand, its identification is useful and, on the other, being categorized within other, better known, and more consolidated industries (Pino Pérez, 1997, p. 61). This is due to having been located in diverse environments, mixed with other industries of very different chronologies and technologies.

The first research works on lithic industries in our area go back to the 1920s , in which some cataloging was carried out, as well as morphological, typological and chronological studies,with which it was intended to categorize the first paleolithic tools found in Camposancos *A Guarda, Pontevedra* and its surroundings.

It was not until the 1950s that a catalogue of Paleolithic lithic industries was published in the counties of Condado and Baixo Miño, written by Álvarez Blázquez and Bouza Brey (Cuevillas, 1980). In 1975, Vázquez Varela wrote the then-state of the art text while carrying out a separation between the Camposanquian and the Asturian pick-axes within the lithic industries of the coast of Pontevedra (Vázquez Varela, 1975).

During the following decade, research continued to focus on both new and existing findings. Samples were analyzed, categorized and classified in order to address morphological and technological issues.

It is worth highlighting the research carried out by Cano Pan, throughout the 90s, which not only made new contributions to the study of Camposanquian, together with Vázquez Varela, but also for the materialization of a new description of coastal tools, applying a classification system that established six horizons for the lithic industry of southern Galicia (Cano Pan, 1991).

Noteworthy are other authors equally relevant in the study of the lithic industries of the Northwest such as Pino Pérez (1996), Rodríguez Rellán and Fábregas Valcarce (2011), and Sánchez Nicolás and Sastre Blanco (2014).

Hypothesis

The prospect of settlements that are close to secondary, rolling stone deposits in fluvial or coastal zones, and primary pockets that are sources of raw material entails an energetic expenditure in their collection and transport and manifests a clear intentionality in the selection and use of this type of instrument. This presents little or no evidence of transformation, although with patent signs of use that results in a multifunctionality associated with domestic contexts.

Morphological-typological and techno-functional study

Starting on the morpho-typological and functional analysis of this type of artifacts, we intend to establish an adequate characterization of the set. This first approach will allow us to establish a connection between the decisions and technological strategies taken by the original users, in order to infer the existence of different production procedures for each of the raw materials recovered.Thus, using the methodology of functional analysis on a macroscopic basis, it is sought to identify traces of use and taphonomic alterations in the lithic artifacts studied. This is in addition to the identification of the raw material and the location of the potential supply areas.

Raw materials

Firstly, a geological identification was made of the different types of rocks collected during the archaeological survey.

In the general set, of the raw materials quartzites are found in greater quantities, followed by granites and amphibolites. The reason why this type of material is chosen is determined not only by their availability but also by thermal properties, and calorific capacity, which is related to its physical-chemical structure and which confers characteristics as important as good conductivity or ability to transfer heat (Palacio Sanz, 2013-15, p. 176). The next most important feature of a stone used for heat absorption is its thermal density: the stone with the highest energy density will have a greater capacity to absorb heat, for a given thickness or size (Kreith, 2012, p. 509).

In the case of the representative sample collected, it responds more to the first property - availability from the most immediate resources - than to its absorption capacity and thermal conductivity, not exceeding in any of the three cases (1) quartzite (690 J/Kg·°K), (2) amphibolite (800 J/Kg·°K) and (3) granite (790 J/Kg·°K), the barrier of 800 J/Kg·°K.

Morpho-typological classification

Given the similarity of forms that differ from their possible uses, a basic first approach is given based on the morphometry of the sample and the features of transformation that resulted in the following classification. In the first place are tools that do not present any type of transformation, the so-called manuports, that is natural objects that have been moved from their original context by human action, but are otherwise unchanged (Fábregas Valcarce, 1990, p.138). Secondly, those that show little work, that is tools that require minimum energy expenditure to achieve their functionality. Lastly, instruments that show a greater intentional alteration in their morphology.

It should be noted that this classification does not take into account the traces that artefacts can show that are derived from use and manipulation. In that sense, the tool could be considered fully functional before it started showing any evidence of wear.

Techno-functional classificatio

Once the classification has been determined and considering the morphological criteria adopted, it is wise to deepen into issues of a technological and functional nature. Thus, subcategories are established within each of these cataloged morphological groups in order to refine each element in the most holistic way possible.

Lithic tools with no clear transformation

The manuport MP category encompasses all stones, of similar shape and size, with scarce traces of intentional wear due to use, and which generally tend to appear in domestic environments and in a grouped manner. Within this subcategory we can distinguish two other subgroups:

- Stones that apparently do not show traces of use, but it can not be specified that at the time of collection had such form, such is the case of certain polishers and sharpeners, which we will call Worn Out Manuports (MPD).
- Stones, by their possible function and similarity of shape with those found in rolling stone deposits, are devoid of any morphological transformation after their use. Is the case of pebbles and bigger rolling stones associated with heat storage and transmission, we will distinguish them as Manuport With Traces of use (MPCH).

It should be noted that the MPCH, despite not showing any signs of attrition, do shows traces of use at the macroscopic level and at the surface level in the form of "haloes", circular obscurations in those parts of the rock that possibly were in direct contact with the source of heat, resulting in changing in color.

Little worked lithic tools

There is an intermediate stage between elements which are worked and not worked. It is possible to mistake this type of tool with the so-called preforms (FP) (Nuevo Delaunay, 2013, p. 472). We can also group within this subcategory of lightly worked stones (CTS) those tools identifyed as weights either forlooms, for fishing or thatching- that, a priori show traces of transformation and evidence of wear from its use, such as the edges with a notch (Bernal Casasola, 2008, p. 189).

Worked lithic tools

This last group comprises all those small tools of associated with domestic contexts, which show more work investment in their morphological transformation. These have a certain complexity in their elaboration, pointing to a considerable degree of specialization in comparison to the previous cases. These also have a greater standardization of shapes and sizes. These are the characteristics that grant this type of tool more attention both in archaeological sites and in scientific research.

This group includes spindle whorls and circular weights intended for use in fishing nets and looms. This category is predominated by small-sized, more or less flattened stones having a toroid shape with an oblique central perforation and have indications of work in both their outer and inner contours.

Ethnographic parallels

In order to contrast our hypothesis and to make the results of the research as conclusive as possible, we decided to consult with a professional potter/ceramist, Pablo Barreiro, with the hope of gathering as much information as possible related to the set of study.

The potter was presented with a set of selected lithics, mostly composed of those pieces that are traditionally described in archaeology for tools related to ceramic work, such as burnishers and smoothers.

He then continued with a preliminary macroscopic study of the samples without any guidance regarding their functionality. In many cases, he identified some of the artifacts proposed as possible burnishers/smoothers, pointing to the methods of holding and manipulating them.

Afterwardsthe potter was presented with our observations about the samples through a brief questionnaire. The purpose was to find out about the following aspects.

- Multifunctionality: in which traces of use, and different ways of handling show this quality. In this regard Mr Barreiro raised the possibility that larger samples could have been used as pestles used for food preparation or for for grinding grog or clay bodies.
- Ways of handling: derived from the fact that many of the concavities shown by some of the manuports could be interpreted as traces of use, but not resulting from the friction of the tool with the ceramic, but as a result of the wear produced by the hand that operated the tool.
- The relevance of this type of tools in pottery: taking into account its geomorphology, its importance beyond the aesthetic, and its application during the manufacturing process.

In this regard, Mr Barreiro explained that different types of minerals with different shapes and granules could have had very different usesas a result of resulting in similar shapes. In addition, he pointed out that these tools are part of the manufacturing process, which go beyond the decorative. Its use takes place after forming and prior to firing, while the piece is drying and has a leather-hard texture. The function of the tool was to seal and smooth out the surfaces of the vessel, thus closing its pores to increase the hardness and waterproof the container.

Experiment

In order to establish an empirical basis to support the proposed hypothesis, an experiment was designed regarding the use of rolling stones as possible cooking stones. We argue that they were used to heat water as a basic way of cooking various foods, through containers and not from direct contact with the heat source.

Material samples

Samples of different morphologies and materials - quartzite, granite and amphibolite - were collected in similar coastal contexts close to those found in the vicinity of Castro de Santa Trega (A Guarda).

Material	Thermal Properties
Quartzite	690 J/Kg·ºK
Granite	790 J/Kg·ºK
Amphibolite	800 J/Kg·ºK

TABLE 1. THERMAL PROPERTIES OF THE SELECTED MATERIALS.

Three samples of similar size and shape were chosen among the three indicated materials, which were measured and described in order to be able to contrast the variations suffered throughout the experimental process.

Sample	Material	Length (mm)	Width (mm)	Thickness (mm)	Weight (gr)	Volume (cm3)	Notes
#1G	Granite	85.6	69.6	32.4	301	140	The surface was smudged in contact with the gas fire. As soon as it contacted with water, it presented a fissure.
#2C	Quartzite	98.1	69.9	33.9	320	150	It got a dark shade in contact with the gas fire. After contacting water, it presented a superficial fissure and a reddish color change.

#3A	Amphibolite	109.6	53.8	35.5 - 16.5	305	130	It does not present special color changes on contact with fire or water. Showed no fissures prior to contact with water.

TABLE 2. PHYSICAL CHARACTERISTICS OF THE BOULDERS CHOSEN AS EXPERIMENTAL SAMPLES.

Tools and other means of experimentation

Four cylindrical containers made of glazed ceramic with walls approximately 1cm thick and a capacity of 1l each were used to contain the water.

A domestic electric oven, with a maximum range of ~ 250°C and a gas burner were used for heating the stones. The temperature measurements of the water were taken with a digital thermometer with a maximum limit of 300°C and an IR-laser thermometer with a maximum limit of 1000°C. A chemical kit was used to measure pH, one that in the end did not yield conclusive data because its measures did not show determining variations.

Other tools used were: a digital caliper with an accuracy up to the tenths of millimeter, a plastic container with precision up to dl, and a scale with precision up to 1 gr.

Procedure

Of the four ceramic containers, only three were used to heat water through the use of stones, while the fourth remained as a control sample. The control sample was heated to ~100°C and then allowed to cool naturally at room temperature, taking measures at pre-established intervals.

The established experimental procedure was structured in three phases: an initial preheating phase where the stones were placed in the electric oven for 30 min. A second phase in which the samples were exposed directly to the gas fire for 15 min -measuring its temperature both at the beginning and at the end, as well as every five minutes with the help of the laser thermometer.

Finally, a third phase in which the samples were placed into each one of the containers, measuring water temperature every 1, 5, 10, 15, 30, 45, 60 and 120 min; and also taking on the temperature of samples every 15, 30, 45, 60 and 120 min.

The pH was measured at the beginning and end of the whole process, although the results were not as conclusive, and they did not present significant variations.

Results and interpretation

Based on the experiments carried out, the results are as follows: first, and taking into account the control container as a mean of comparison, in none of the three cases were changes at the macroscopic level in water coloring – it stayed transparent in each of the four containers, although, in the case of the container that housed the granite sample, it showed traces of sediments in the bottom of the container.

The maximum temperatures reached during the first phase were 242.6ºC for the amphibolite, 193.5ºC for the granite and 142.9ºC for the quartzite (See Graph 1 & 2).

During the second phase of the experiment, the maximum temperature for each Stone was recorded after exposure to the direct source of heat during 15 minutes, with the amphibolite reaching the highest degree at 539.2ºC, followed by the quartzite with 490.3ºC and finally the granite with 477.9ºC (See Graph 1).

Comparing the temperature obtained when taken from the oven to that recorded after exposure to direct heat, the quartzite reached 347.4ºC, compared to the amphibolite 296.6ºC and the granite with 284.4ºC (See Table 3).

	1º Stage (oven) (°C)	2º Stage (After contact with the stove) (°C)	Thermal difference (°C)
Granite	193.5	477.9	284.4
Quartzite	142.9	490.3	347.4
Amphibolite	242.6	539.2	296.6

TABLE 3. EVOLUTION OF THERMAL CHANGES DURING THE EXPERIMENTATION PROCESS.

There was a change at the chromatic level of the stones, since all the samples acquired a blackish tone that is characteristic of the soot resulting from the exposure to the direct heat source. Only the quartzites showed dark rings, although this may be due to the fact that their lighter color may show more contrast.

Quartzite showed changes in tone both in the area in contact with the heat source, resulting in aureolas of dark color on the outside and a reddish color at the center, and as ruby-hued spots on the rest of the lithic surface (See Figure 8).

In addition, in the sample of the amphibolite a transverse fracture was observed that followed the line of the laminate, as a consequence of the heating of the rock in the stove.

When the lithics were submerged, it was observed that the quartzite conserved a temperature of 469ºC, the granite 426ºC and the amphibolite 416.3ºC. The steepest thermal drop of lithics in contact with water is recorded in the case of amphibolite (122.9ºC), followed by granite (51.9ºC) and quartzite (21.3ºC) (See Graph 3).

At the chromatic level of the lithics, changes were observed only in the case of quartzites, which reddened after exposure to water, while the dark aureoles showed no changes in any of the samples (See Figure 9).

The macroscopic observation of the sample showed the presence of cracks in the granite and quartzite, the result of thermal shock in contact with water. In the first case, the fracture covers almost the entire surface and in the second it appears on one of its faces.

It was found that the highest temperature was reached in five minutes: the quartzite reached 45.3°C, the amphibolite 43.2°C and, the granite 40.5°C. Thus, a temperature loss was recorded every 5 minutes, in the case of quartzite (1.47ºC), amphibolite (1.31ºC), and granite (1.15ºC) (See Table 4).

Sample	T initial (°C)	T 15' (°C)	T 30' (°C)	T 45' (°C)	T 60' (°C)	T 120' (°C)
#1G	426.0	35.2	32.4	28.4	28.3	22.4
#2C	469.0	37.2	33.3	31.3	28.0	23.5
#3A	416.3	36.7	32.8	29.7	28.7	23.1

TABLE 4. EVOLUTION OF THE TEMPERATURE OF THE SAMPLE SONGS DURING THE 3RD EXPERIMENTAL PHASE.

Note that the quartzite loses less temperature when in contact with water and it transmits more heat to water. The temperatures reached by the lithics did not reach the boiling point of the water in any of the cases. It was deduced that the quartzites showed the most promising results in terms of their use as cooking stones, which would justify the fact that they were the most abundant material found in the study set. Amphibolites initially reached higher temperatures but did not transfer as much energy to the water, possibly due to their thermal density. The granite showed the worst thermal qualities of the three materials, due to its high specific heat. It is feasible to assume that the fire did not adequately heat the interior of the stone and that the measurement we obtained on the surface of the same gave us a false idea of the heat that actually stored the sample.

Conclusions

Based on the above, we believe it is necessary to vindicate the importance of this set of lithic materials that a priori tend to be discarded. These can provide relevant and accurate information about the settlements and the economic and cultural activities developed in them, highlighting the significant number of pieces use in cooking, textile tools, including spindle whorls and loom weights, pottery (as burnishers and smoothers), construction (thatching weights), and fishing (net weights).

In conclusion that there is a clear intention in the search, selection, transportation and use of these materials. There are several aspects to consider. Firstly, the distance and the difficulty in transporting the materials from the extraction and collection sites to the settlement. The exploitation of the local raw materials implies a supply chain of the resources within their reach.

Secondly, there is a specificity in the selection of optimal materials for necessary tools. In spite of existing more easily accesible raw materials that could fulfill the same function, the most efficient ones are chosen.

Finally, another indication that shows intentionality and use is the frequency and concentration with which they appear in the deposits associated with domestic contexts.

Thanks to their conductivity and thermal density, the rocks capture and retain the heat generated by more rapidly combusting fuel. Heat from combustable fuels, such as wood or coal would dissipate in the air or through the ground before many foods had time to cook. Cooking stones, due to their relative non-combustion nature and because they are high density materials, have the potential to capture and retain heat in an effective and evident way, which translates into a considerable saving in time and resources necessary for that task. In this regard, it has been found that in most cases where there are apparently no traces of transformation or traces of use derived from mechanical actions that cause wear -that is, those that apparently do not seem to differ from their original appearance, as it happens with the manuports - macroscopic changes in the external aspect can be appreciated, both related to their coloration and to thermal fracturing.

From the observation of this type of tools, a multifunctionality is established in the relationship between their chromatic changes and wear in their morphology, associated with transformation, use or handling. It is the case of burnishers, hammers, or small sharpeners (whetstones?), which can present wear caused by their continued use and, in turn, show changes in their exterior coloration caused by use in cooking.

Keywords stone
stone working
knapping

Country Spain

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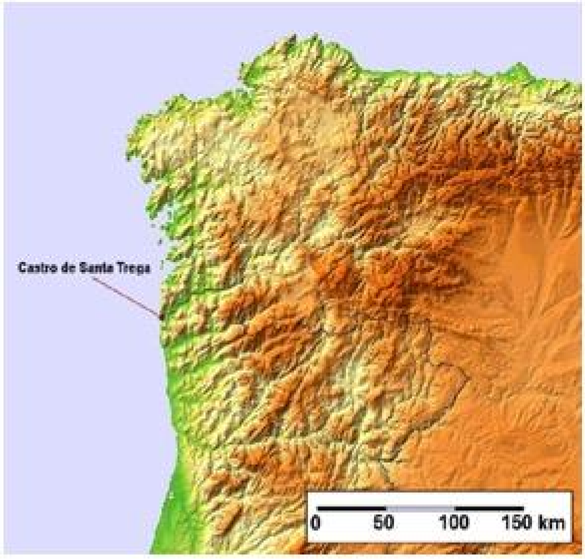


FIG 1. PENINSULAR ATLANTIC COAST AND LOCATION OF CASTRO DE SANTA TREGA. IMAGE BY M.J. MARTINEZ GONZALEZ

FIG 2. MANUPORTS WITH TRACES OF USE

FIG 3. SELECTED SET OF TOOLS

FIG 4. USE OF TOOLS AND HOLDING MODES

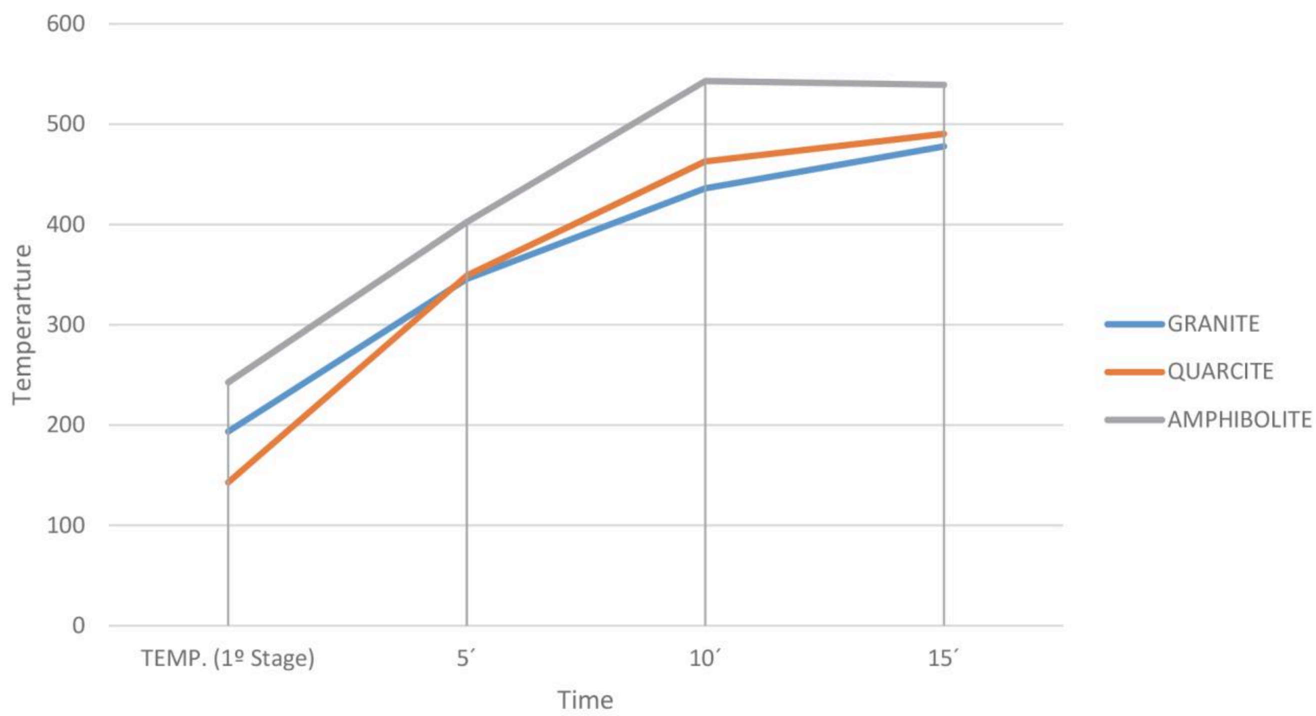
FIG 5. CONTAINERS AND MATERIALS

FIG 6. SECOND PHASE

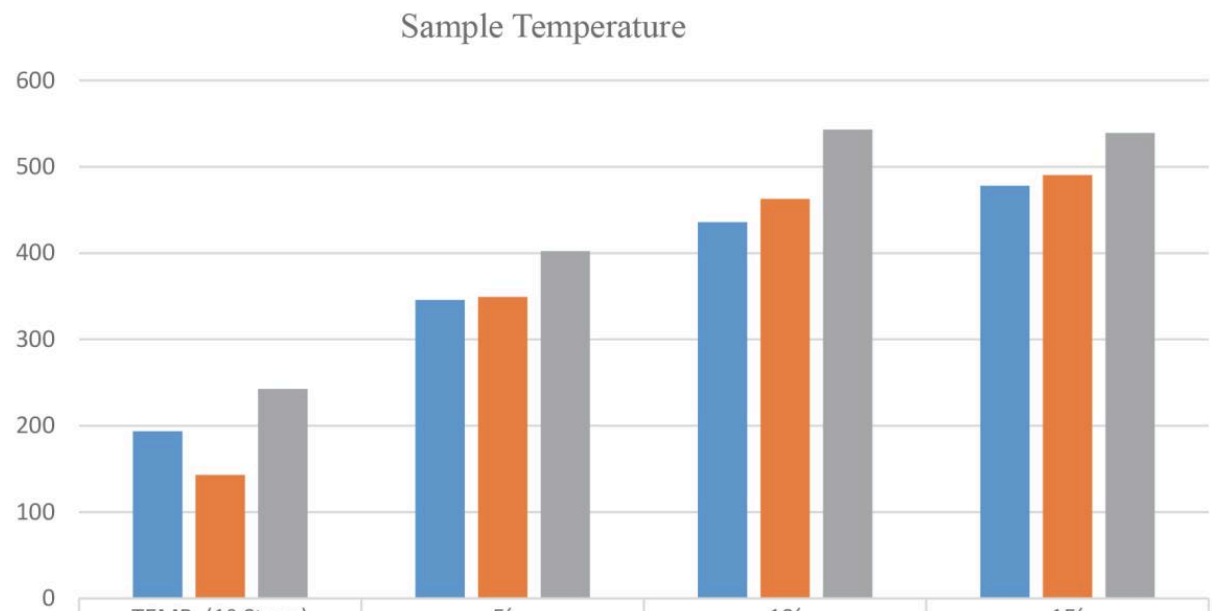
FIG 7. THIRD PHASE

FIG 8. CHROMATIC CHANGE OF GRANITES

FIG 9. CHROMATIC CHANGE OF QUARTZITES



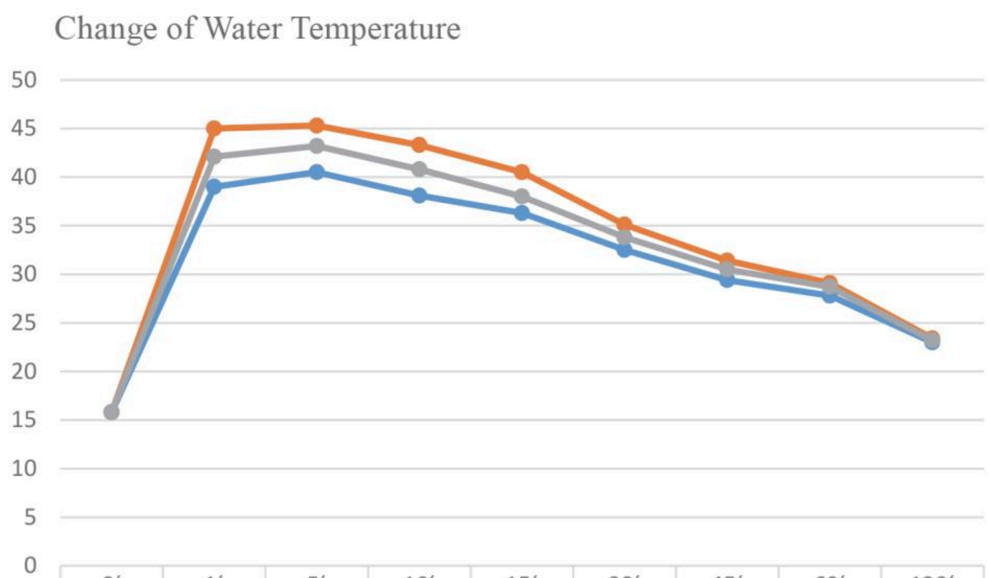
GRAPH 1. INTERPRETATION RESULTS 2ND EXPERIMENTAL PHASE.



	TEMP. (1º Stage)	5´	10´	15´
GRANITE	193,5	345,7	435,9	477,9
QUARCITE	142,9	349,2	462,8	490,3
AMPHIBOLITE	242,6	402,3	542,9	539,2

GRANITE QUARCITE AMPHIBOLITE

GRAPH 2. EVOLUTION OF THE TEMPERATURE OF THE LITHICS DURING THE 2ND EXPERIMENTAL PHASE.



	0´	1´	5´	10´	15´	30´	45´	60´	120´
CONTAINER 1 (Granite)	15,8	39	40,5	38,1	36,3	32,5	29,4	27,8	23
CONTAINER 2 (Quartzite)	15,8	45	45,3	43,3	40,5	35,1	31,4	29,1	23,4
CONTAINER 3 (Amphibolite)	15,8	42,1	43,2	40,8	38	33,8	30,5	28,7	23,2

CONTAINER 1 (Granite) CONTAINER 2 (Quartzite) CONTAINER 3 (Amphibolite)

GRAPH 3. EVOLUTION OF THE TEMPERATURE OF THE WATER IN THE DIFFERENT CONTAINERS DURING THE 3RD EXPERIMENTAL PHASE.