Quartz and Quartzite lithic raw material studies: problems and challenges.

Ana Abrunhosa[1,2], Manuel Santonja[1,3,] Alfredo Pérez-González[3], Joaquin Panera[3,4], Eduardo Méndez-Quintas[3,5], Susana Rubio-Jara[1,3,4], Thierry Aubry[6,7], Maria dos Anjos Ribeiro[8,9], Luca A. Dimuccio[10,7]

[1] CENIEH -Centro Nacional de Investigación sobre la Evolución Humana, Spain. ICArEHB - FCHS, University of Algarve, Portugal. ana.abrunhosa@cenieh.es
[2] 2 ICArEHB - Interdisciplinary Center for Archaeology and Evolution of Human Behaviour, FCHS - Universidade do Algarve, Faro, Portugal
3 Instituto de Evolución en África (IDEA), Madrid, Spain,
4 Departamento de Prehistoria, Historia Antigua y Arqueología, Universidad Complutense de Madrid, Madrid, Spain,
5 Grupo de Estudos de Arqueoloxía, Antigüidade e Territorio (GEAAT), University of Vigo, Ourense, Spain,
6 Côa Parque, Fundação para a Salvaguarda e Valorização do Vale do Côa, Vila Nova de Foz Côa, Portugal
7 UNIARQ - Centro de Arqueologia Universidade de Lisboa, Faculdade de Letras, Lisboa, Portugal
8 Department of Geosciences, Environment and Spatial Planning, Faculty of Sciences, University of Porto, Porto, Portugal
9 ICT - Institute of Earth Sciences, Porto pole, Portugal
10 University of Coimbra, Centre of Studies in Geography and Spatial Planning, Department of Geography and Tourism, Coimbra, Portugal

***Abstract* – Most of the lithic tools made during Prehistory in the Iberian Peninsula are mainly composed of three main siliceous rock types: chert, quartzite, and quartz. While the methodologies for the characterization and provenance of raw materials made on chert (and obsidian) have been developed with well-established and widely used protocols, the same does not apply to quartzite and quartz veins. Here we present recent developments in characterization and provenance analysis of quartzite and quartz through two case studies: (1) establishing and testing an analytical protocol for the quartzite available in the Côa River Valley region (Portugal) to be applied in future archaeological studies; (2) understanding the quartzite variability within the archaeological assemblage of the El Sotillo site (Spain). These two case studies allow us to highlight some of the main problems and challenges linked to the study of quartzite (raw material and lithic industry) in Paleolithic contexts.**

I. INTRODUCTION

The first step in the lithic *chaîne operatòire* corresponds to the resource procurement, evaluation of available nodules and selection of the ones that best fit the needs of the knapper to undertake the desired final product (Frick & Herkert, 2014). The first sporadic studies date from the early XX century and were based mainly on aesthetically appealing pieces due to their rarity and/or techno-typological characteristics that set them apart from the rest of the assemblage. This paradigm lasted for almost 100 years and is still partially applied by selecting pieces for study with aesthetic or subjective interest to the observer. In general, until the 1980s, raw material procurement studies predominantly focused on exotic raw materials. The major methodological and theoretical developments occurred after the 1980s, largely due to the realization of the potential of raw material procurement studies to determine movements or areas of resource exploitation in the landscape (Geneste 1985, 1991). These studies focused on the determination of provenance areas of microcrystalline or cryptocrystalline varieties of quartz, such as chert, jasper, and opal, providing important information about the mobility or exchangeability between different human groups and the reconstructions of movements and interaction with the landscape (Feblot-Augustins, 1993).

Prehistoric knapped lithic assemblages in the Iberian Peninsula are mainly composed of fine-grained quartz (chert, flint or silcrete) and quartzite and quartz veins. Despite recent advances, the study of lithic raw materials is still scarce and limited to areas where chert is abundant. The evolutionary typological method of study of lithic technology (from simple to complex) had an impact on the understanding of Prehistory and technological developments (Andrefsky & Goodale, 2015; Knutsson, 2014). Intense use of quartz veins, quartzite, and other coarser-grained raw materials was sometimes ignored in the literature (Lombera-Hermida & Rodríguez-Rellán, 2016). Even today it is common practice to select just the microcrystalline or cryptocrystalline varieties of quartz, in an archaeological assemblage, to carry out a robust characterization and provenance analysis.

The term "Flint Syndrome" first appears mentioned by Knutsson (1998) referring to approaches to the techno-typological study of lithic industries on quartz and flint according to the same methodology and theoretical framework, without recognition of the differences in the properties of different raw materials (K. Knutsson, 1998). Some authors call the study of quartz the "quartz problem" as a reference to the difficulty of studying it due to the lack of study protocols, difficulty in differentiating between sources of supply, and scarcity of reference data (Driscoll, 2007; Spry et al, 2022).

Except for hyaline quartz (MacCurdy, et 1931 Morgado et al, 2015), quartz and quartzite are many times mistakenly considered synonymous with more archaic or expedient archaeological industries (Knutsson, K. 2014). For this reason, among others related to the degree of specialization needed to carry out such study, these raw materials were seldomly observed, at least with the same degree of detail of chert (Callahan, 1987; Driscoll, 2011). Nevertheless, recent studies are revealing the potential of the analysis of “the other” raw materials, to understand resource exploitation and quartz (e.g. ten Bruggencate et al. 2014, 2013) and quartzite (e.g. Prieto et al. 2019, 2020) selection.

Methodologies and protocols of analysis are mostly experimental because there is a preference for non-destructive methodologies to study archaeological assemblages and these methods are constantly under development and being tested. Nevertheless, over the last 10 years, the raw materials studied are more diverse as are the perspectives of the study that can provide interesting information regarding the characteristics that influence the selection and use of these materials. Because no method works in isolation, it is common to find studies that report combinations of geochemical analysis methods and analysis of their mechanical characteristics that may influence the tool manufacturing process (e.g. Abrunhosa et al. 2020, de la Torre et al. 2021). However, a problem arising from the recurrent experimentation of methodologies and the absence of a defined protocol is the lack of comparable data.

II. SAME MATERIAL - TWO CASE STUDIES, TWO PERSPECTIVES

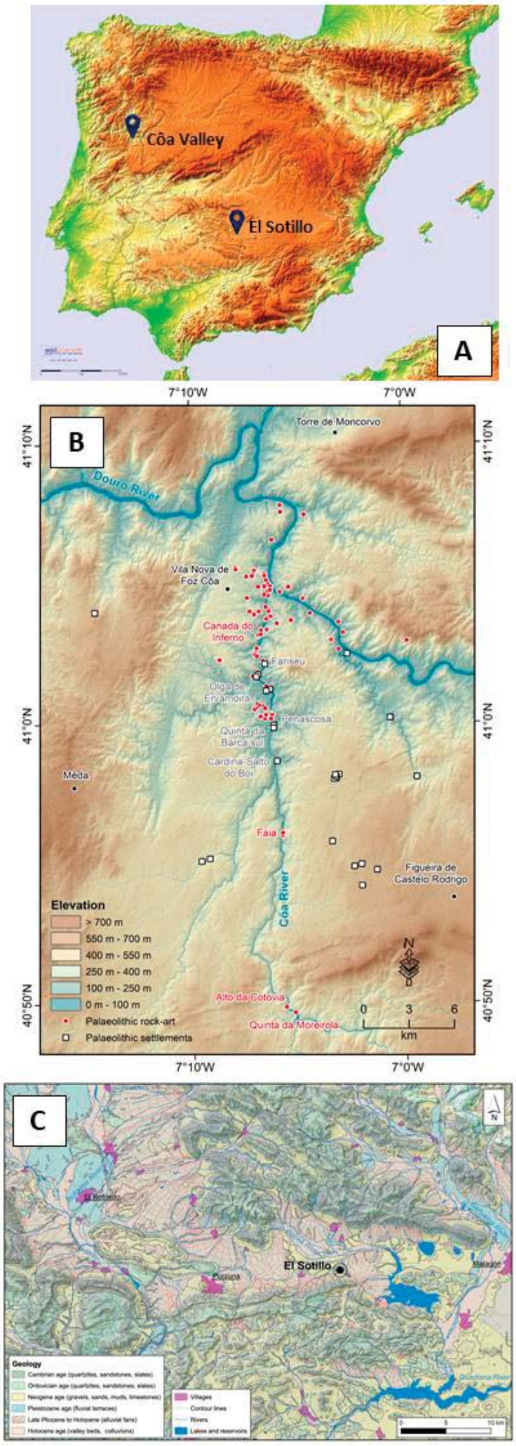

Fig. 1. Location of study areas in the Iberia Peninsula (A); detail of the lower valley of the Côa river (B) and El Sotillo (C) .

In this work, preliminary results from the analysis of quartz veins and quartzite from two archaeological assemblages in the interior of the Iberian Peninsula are used as case studies: the Côa River Valley region (Vila Nova de Foz Côa, northeast Portugal) and El Sotillo site (Ciudad Real province, central Spain).

Despite the physical distance (approximately 450 km), these two places have parallelisms concerning their geological and geomorphological characteristics. They are both located on the banks of river valleys in a specific geotectonic zone - the so-called Central Iberian Zone (Ribeiro, 2013) - where the landscape is dominated by metasediments, granites, quartz veins and quartzite ridges. Concurrently, the soils in these regions tend to have a higher acidity, so the preservation of organic material is lower. The traces of fauna, which are often sources of information about the exploitation of resources in the landscape or seasonality of site occupation, are many times absent from the archaeological record. This fact is even more true in older chronologies (particularly the Palaeolithic). The study of raw materials can tackle difficulties resulting from the lesser variability of archaeological material and can be many times the only source for mobility and landscape use.

The Palaeolithic sites of these regions are also characterized by a lithic industry with abundant exploitation of quartz and quartzite, particularly but not exclusively, during the Lower and Middle Palaeolithic. Because in the Upper Palaeolithic seems to be an important shift in procurement strategies and an increase in the use of a wider variety of exogenous resources (Prieto et al, 2019), quartz and quartzite were often considered indicators of more archaic technologies, abilities and cultures or used to fill the scarcity of other microcrystalline or cryptocrystalline rocks (Aubry et al 2015).

In the Côa River Valley region, there are already intensive studies about the probable provenances of varieties of flint that appeared, for example, at the Cardina I and Olga Grande sites (Aubry et al. 2012, 2016a, 2016b). Studies about quartz and quartzite are still preliminary and require further methodological development. In this sense, within the framework of the CLIMATE@COA project (COA/CAC/0031/2019), a protocol for the study of quartzites available in the Côa River Valley region with the potential to be exploited in Prehistory is being developed. This study foresees the detailed study of geological samples from three local geological units. The aim is to test destructive and non-destructive methods, compare results between methods, cross-reference mesoscopic observations with microscopic data, as well as to fingerprint the available quartzite. A local quartzite database will be constructed that can later be used in the studies about procurement strategies in the region.

The Acheulean site of El Sotillo is framed to the north and south by Palaeozoic hills with quartzite rocks, in the Porzuna-Malagón depression (Santonja et al., 2022, Ugarte, 2022). The archaeological assemblage is composed of 99% of quartzite that was studied to understand internal variability, to determine if there are local and/or non-local sources, as well as to understand possible patterns in the quartzite selection. This study followed a reversed version of the protocol applied to the Côa region in the sense that it started with the application of non-destructive techniques to understand the potential of the study by other possible destructive techniques, such as petrographic thin-section and geochemical analysis (using handheld spectrometer - pXRF). Most of the material exploited by hunter-gatherers would come from pebbles naturally transported by watercourses or available in slope deposits associated with the relief of the surroundings.

III. PRELIMINARY RESULTS OF ONGOING STUDIES

Petrographic analysis and X-ray diffraction (XRD) remain the most reliable methods to define the mineralogical composition, compare data and define possible catchment areas. However, these methods are destructive. Most of the time, the materials which exist in smaller quantities in an archaeological assemblage are also the ones which have a higher probability of obtaining data regarding the mobility and preferential use of raw materials. In these cases, destruction or loss of the archaeological sample is avoided as much as possible. For this reason, petrography and XRD does not often allow direct comparison between data obtained from the analysis of geological samples, which can be destroyed without risk of data loss, and the analysis of archaeological samples.

As indicated above, the aim of the analysis of quartzite samples from the Côa region is to develop a protocol to be applied in future geoarchaeological studies of raw material provenance. A combination of analyses (e.g., petrography, colourimetry, geochemistry) was carried out to characterise the geological materials and, on the other hand, it was observed whether it was possible to correlate data obtained by destructive methods with non-destructive methods. In this way, the non-destructive analyses carried out on archaeological samples according to this pre-established protocol can be comparable and replicable.

The data collected resulted in the elaboration of raw material identification sheets that serve as an identity card or fingerprint that can be used to characterise and eventually determine the origin of the lithic raw materials found in the context of archaeological excavations. In short, it is intended that this approach will result in a robust database with comparable and replicable results.

In the case of the El Sotillo site, we started with a mesoscopic analysis that allowed us to define a higher textural variability within the quartzite assemblage. It demonstrates the importance of detailed mesoscopic observations at least for the first definition of groups based on colour, texture, grain size, fracture, and cleavage. These are factors that can influence on the one hand the selection of the material and, on the other hand, they have repercussions on the knapping process and the technology developed/employed as they have a direct influence on the behaviour of the material during fracturing. Macroscopic analysis (at regional/supraregional scale) can also be an important indicator for material identification, correlation with geological cartographic data and planning of field surveys for sampling to be compared. The relationship of the types and proportions of raw materials within a group with the data from the techno-typological analysis also allows the identification of the presence or absence of preferential selection processes of raw materials.

IV. CONCLUSIONS

The minor compositional and textural variability of quartz and quartzite hinder the study of acquisition areas of these lithic resources. The recent development of new hypotheses, protocols, and methodologies to answer questions related to the establishment of strategies for the acquisition of raw materials has confirmed the potential of the study of quartz and quartzite to understand technological variability and resource selection over time during the Palaeolithic.

The geochemical analyses that are commonly used in the study of chert, which allow the definition of clusters that may correspond to different sources, are not applied with the same efficiency to the study of quartzite. Although geochemical results often serve to corroborate petrographic data, we must highlight how thin-section analysis is still the best technique for the characterization and differentiation of lithic materials with less geochemical variability. However, the non-destruction of samples is most often an essential component in the study of archaeological materials.

Though quartz and quartzite are difficult materials to pinpoint to a given source, their regional differences and internal variability can be perceived in a detailed macroscopic analysis, especially followed by a combination of mesoscopic, petrographic, and geochemical analysis. Differences in grain size, texture, and degree of metamorphism, as well as the size and shape of associated minerals, interfere with the mechanical characteristics of these raw materials.

The thorough analysis of quartz and quartzite assemblages has revealed, so far, the existence of patterns of procurement and selection of these raw materials that were previously masked under the argument of them being local expedient sources.

These studies contribute to the definition of protocols for the analysis of quartz and quartzite by obtaining replicable and comparable data that are useful for the analysis of archaeological assemblages.

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