

LO MICRO Y LO MACRO, EL PAISAJE Y SU CONTEXTO: TEORÍA, MÉTODOS Y POSIBILIDADES DE APLICACIÓN DE REGISTROS MICROSCÓPICOS EN ESTUDIOS ARQUEOLÓGICOS

THE MICRO AND THE MACRO, THE LANDSCAPE AND ITS CONTEXT: THEORY, METHODS AND POSSIBILITIES OF APPLICATION OF MICROSCOPIC RECORDS IN ARCHAEOLOGICAL STUDIES

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RESUMEN: La microarqueología emerge ahora al centro del escenario en la arqueología contemporánea al posibilitar una articulación innovadora entre las escalas microscópicas y macroscópicas al estudiar sitios, paisajes y contextos arqueológicos. Esta aproximación amplía de forma significativa el entendimiento del registro arqueológico. El enfoque incorpora pruebas que suelen pasar desapercibidas a ojo, incluyendo rastros moleculares, botánicos y sedimentarios. Estos datos resultan fundamentales a la hora de desentrañar las costumbres diarias, los fenómenos ambientales, y las interacciones socioculturales del pasado. En cuanto metodología, este manuscrito se desarrolla por medio de una sistemática revisión bibliográfica que permite comparar diferentes contextos, problemáticas y estudios de caso latinoamericanos y angloamericanos, profundizándola discusión en cuatro áreas clave de la microarqueología: los análisis moleculares, los estudios de isótopos estables, la microbotánica y la micromorfología de los suelos. Examinando el ADN antiguo, se cuestionan críticamente modelos sobre el poblamiento inicial de América, valorando tanto su potencial interpretativo como las limitaciones inherentes a los procesos tafonómicos, particularmente en entornos tropicales. El análisis isotópico, de por sí, habilita la reconstrucción intrincada de patrones dietéticos, la movilidad a través del tiempo, y hasta la estacionalidad, aportando resultados considerables en entornos costeros del sur brasileño, donde se encuentran los sambaquis, por ejemplo. La microarqueobotánica, al mismo tiempo, facilita la reconstrucción de paleoambientes y las diversas prácticas involucradas en el manejo de vegetales, la micromorfología del suelo permite reconocer actividades humanas, los complicados procesos de ocupación, junto a transformaciones postdeposicionales mediante el minucioso análisis microscópico de los sedimentos. En definitiva, se establece que la integración de estos diversos métodos metodológicos impulsa notablemente los estudios arqueológicos regionales, sobre todo en investigaciones de cazadores-recolectores, tecnologías líticas, así como, paisajes culturales. Lo anterior, consolida a la microarqueología como un enfoque absolutamente esencial para la generación de interpretaciones más certeras, contextualizadas, y por supuesto, multiescalares del pasado.

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Palabras clave: *Microarqueología, métodos arqueológicos, análisis microscópico, paleoambientes, registro arqueológico*

ABSTRACT: Microarchaeology now emerges at the center of the scene in contemporary archaeology to enable an innovative articulation between microscopic and macroscopic scales to study sites, landscapes and archaeological contexts. This approach significantly expands the understanding of the archaeological record. The approach incorporates tests that go unnoticed by the eye, including molecular, botanical and sedimentary traces. These data are fundamental when it comes to unraveling daily customs, environmental phenomena, and sociocultural interactions of the past. In terms of methodology, this manuscript is developed through a systematic bibliographic review that allows comparing different contexts, issues and Latin American and Anglo-American case studies, deepening the discussion in four key areas of microarchaeology: molecular analysis, stable isotope studies, microbotany and the micromorphology of seeds. Examining ancient DNA, models of the early population of America are critically questioned, valuing both their interpretative potential and the limitations inherent to taphonomic processes, particularly in tropical environments. The isotopic analysis, in itself, enables the intricate reconstruction of dietary patterns, movement over time, and up to seasonality, providing considerable results in coastal areas of the Brazilian countryside, where sambaquis are found, for example. The microarqueobotánica, at the same time, facilitates the reconstruction of paleoenvironments and the diverse practices involved in the management of vegetation, the micromorphology of soil allows the recognition of human activities, the complicated processes of occupation, together with postdepositional transformations through the detailed microscopic analysis of sediments. Ultimately, it is established that the integration of these diverse methodological methods notably drives regional archaeological studies, especially in investigations of hunter-gatherers, lithic technologies, as well as cultural landscapes. The previous one, consolidates microarchaeology as an absolutely essential approach for the generation of more certain, contextualized, and, of course, multiscale interpretations of the past.

Keywords: *Microarchaeology, archaeological methods, microscopic analysis, paleoenvironments, archaeological record*

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INTRODUCTION

Contemporary archaeology has undergone profound transformations in the field of theory, method, and its respective practice, changes that accompany technological developments, aiming each time more to take advantage of the intrinsic interdisciplinarity of the discipline and of the synergy among schools, premises, and research problems that deal with the archaeological record. In this context, the application of microscopic methods increasingly forms part of the interpretations and enrich both the qualitative and the quantitative analysis, managing to connect different

scales of analysis with the objective of promoting inferences on the sociocultural, environmental, and symbolic dynamics of the past.

The critiques of the rigid positivism of processual archaeology, together with the arrival of Postprocessual approaches, have led to a profound revision of how archaeological knowledge is generated (1). This movement, which had already been anticipated by the idea of the “loss of innocence” of Clarke (2), underlined the necessity of a more reflexive and contextual archaeology, disposed to integrate diverse lines of evidence. Microarchaeology is key in this debate, insofar as it postulates that for the archaeological record the meticulous analysis of microscopic remains is not a subfield, a technique, or an auxiliary. Interdisciplinarity has become a characteristic seal of archaeological practice, from large international projects such as that of Çatalhöyük, under the charge of Hodder (3), even up to more regional and smaller-scale investigations that are carried out in South America.

In the Brazilian context, several archaeological projects have made manifest the importance of combining traditional field methods with high-resolution laboratory analyses, such as those that have been realized in the southeast and center-west of the country (4; 5; 6), as well as in Amazonian areas (7; 8; 9). These studies evidence that, in order to understand human occupations, technological systems, and their relation with the landscape, it is necessary to adopt approaches that can address diverse temporal, spatial, and material scales.

It is in this context that traditional materialist archaeology encounters the loss of innocence (2), and the basic classifications, seriations, and typologies encounter the interpretative universe in the functional, symbolic, and sociocultural fields of the relation between human beings and material culture.

Even with the advanced state of our techniques, applying microarchaeological methods in a constant form continues being difficult, especially under warm climates. Under those conditions, natural deterioration affects greatly the organic remains, vegetal, and terrestrial deposits. It is known that factors such as acid soil, air charged with vapor, and active microbial life make it difficult to preserve useful samples for fine analyses, such as the molecular or isotopic. In any case, new investigations evidence that, once their ambits are appropriately understood, the microscopic information reveals important indications about ancestral diet, human migrations, past environments, the administration of the territory, and the development of diverse archaeological sites. Under this approach, four principal directions stand out today: the study of molecules, the measurement of isotopes, the exploration of diminutive vegetal particles, and the meticulous observation of the strata of the soil.

In contemporary archaeology, depending on the characteristics of the context and its capacity to preserve the material remainders, especially the molecular analyses that permit characterizing ancient DNA, making it possible to extrapolate basic materialist archaeology toward fields of human relations, resulting in inferences on ancestry, peoplings, and displacements among different regions; especially this discussion makes itself present in the dynamics of American Archaeology, a theme until today discussed and problematized by the different fronts of investigations in research centers of the continent.

In complement, the data associated with isotopes permit corroborating data on paleo-alimentation, migratory movements, and seasonality, especially when we take into consideration coastal environments and of the nomadic hunter-gatherer societies and their complex archaeological context.

In Brazil, a relevant area of study is microarchaeobotany; by means of the analysis of microscopic residues—seeds, charcoal, pollen, phytoliths—that help to decipher past environments and patterns of utilization of vegetals.

Another valuable resource, emerging with precision from the micromorphology of the soil, employs this technique to decipher, through minimal samples, the presence of fire, human activity, burials, or the subsequent transformations in an archaeological site. Moreover, this approach, separating itself from broad approaches, centers us on how microarchaeology, effectively, increments significantly the reach and the solidity of the conclusions obtained in archaeology.

The interesting comes when one looks at how it unites distinct levels of analysis with what the past leaves under the ground. Paths are opened by showing small but profound methods used today in ancient findings. Uniting distant examples, from Latin America to Anglophone regions, strengths emerge together with weak zones. It surprises to see how these approaches could be woven among themselves in local works. Behind each layer there are social histories, changes of the environment, or technical advances already forgotten. Upon addressing these themes, this article seeks to enrich the methodological and epistemological debate in the field of archaeology, highlighting microarchaeology as a strategic area for constructing more solid, contextualized, and multiscalar interpretations of the archaeological record.

MATERIALS AND METHODS

The approach that we are utilizing in this study combines different fields and looks at things both at small and large scales, with the objective of mixing the details at small scale with the larger image in order to understand better the ancient sites. The work rests on the premise that the sociocultural and environmental processes of the past manifest themselves in a differential manner in the archaeological record, requiring analytical tools capable of operating at distinct scales of observation and resolution.

In a general manner, this interdisciplinary research project is based on a critical review of specialized literature combined with a comparative systematization of case studies coming from Latin American and Anglo-American archaeological contexts, which is considered an efficacious strategy for evaluating the potential of microarchaeological methods under different conditions of taphonomic, ecological, and cultural type, especially in what is found situated in tropical and subtropical environments (of difficult preservation of the micro remains), permitting connecting common problematics to the different cultural areas of America, as is the case of the shell mounds (Sambaquis) Brazilian and of the most ancient human remainders in the context of the cenotes, as is the case of the finding of Naia in Quintana Roo, Mexico, contexts these that classically have their interpretation limited to what the macro can present and from microarchaeology transform themselves into particular histories of indigenous America.

The methodological analysis is grouped into four principal axes of modern microarchaeology: molecular analyses, studies of stable isotopes, microarchaeobotany, and micromorphology of soils. Each one of these axes addresses the methods of obtaining and analysis of data, but from the integrating point of view of dialoguing those technical protocols of obtaining and analysis of data with archaeological problematics of greater scale. The investigation with stable isotopes is considered a crucial technique for ascertaining what people ate, where they moved, and in what epochs they lived.

The molecular analyses are considered principally from the study of ancient DNA, making emphasis on their applications for the reconstruction of processes of occupation, dispersion, and even biological affinity of human populations.

On the methodological plane, criteria of selection of samples, conditions of preservation, as well as limits derived from taphonomic processes are discussed, especially in contexts of acid soils.

It is not the fact of only analyzing molecular data, but of crossing these informations with indications of the archaeological environment, avoiding little scientific conclusions or outside of the context.

Stable isotopes result crucial upon attempting to understand the ancestral diet, the migrations, and the chronologies of settlements. Specialized techniques are applied, detecting subtle chemical signals, let us say of carbon, together with traces of nitrogen or oxygen, all from osseous remains, whether human, of animals, even in residues preserved within ancient vessels.

Interpreting those data in isolation would be misleading; they result much more significant if they are integrated with data of the paleoenvironment, of the archaeological context, and of the post-mortem interaction of the remains with the subsoil. Vegetal vestiges, although minimal, also contribute value; their imperceptible footprints, such as the ancient pollen, or microcrystals within seeds, offer a glimpse of the pretérite vegetal landscape. The protocols of sampling, preparation, and analysis, in conjunction with collections of reference and graphic representations are very fundamental.

Thanks to this, one can help to imagine how the ancient environments were, what people ate, how they managed the plants, and how they organized their spaces by effect of their activities. In fourth place, enters the micromorphology of lands, centered on reviewing thin sections obtained by means of ordered extractions during open-air works. Looking at the sediments with a lens gives clues about how the strata found in ancient sites formed, separating what was done by humans from phenomena such as floods, coverings of mud, or accidental burnings. Each observation made at the microscope goes united to information of layers, forms of the terrain, and material findings that deepen the sense of each context found. The methodology exposed is based on the articulation of a set of lines of evidences in which the contextualization of the data and the integrated reading of the social and environmental processes is prioritized, which will permit amplifying the analytical resolution of archaeology and contributing to elucidate more precise and complex reconstructions of the human dynamics in the past.

RESULTS

For the proposed discussion, 4 (four) important contexts of the micro and macro archaeology will be presented and discussed, of which we have the molecular analyses, the stable isotopes, the microarchaeobotany, and the micromorphology of soils, their respective contexts of application and their theoretical and methodological problematic adapted to the context of the archaeology of the American continent and its alterity.

Molecular Analyses

As first practical case, we will present perspectives on the molecular analysis in archaeology. In the microscopic analyses, the analytical method that encompasses the smallest objects of the microarchaeological investigation is, without doubt, the molecular analysis, which works with units of measure that go from millimeters (mm), micrometers (μm), nanometers (nm) up to ångströms ($\text{\AA}$). In the field of archaeology, its principal area is the study of ancient DNA.

The study of ancient DNA is present in the investigation that involves ancient contexts with presence of fossil remains; in the case of archaeology, in contexts with human biological remains, which implies the revision and discussion of the occupation, the displacement, the technology, and the human antiquity.

In the ancient contexts of the American continent, the discussions and critiques are constant, with a recurrent turn from the Clovis and Pre-Clovis paradigms, perspective adopted by the principal centers of study of the United States (10; 11; 12; 13) as the first groups that entered the continent through the Bering Strait, and then dispersed following a north-south axis, toward paradigms linked to other ancient sites dispersed throughout the continent and possible other routes of occupation and distinct periods, especially those located in South America.

Outside of the Clovis and Pre-Clovis axis, the findings in Quintana Roo, Mexico, in the decade of 2010, oblige to revise old paradigms, upon evidencing osseous remains in a geological formation called doline or cenote, that is to say, depressions caused by diverse geomorphological events located in karstic zones. In this case, the Mexican region forms extensive interconnected subterranean systems that store the aquiferous reserves of the entire zone, which presents deficiencies in superficial reserves.

In this sense, Naia was identified by means of submarine prospecting and presents herself as a female hominid, dated between 13,000 and 12,000 years before the present. Her remains presented a quality and quantity of material adequate for molecular analyses, especially mitochondrial, that revealed an origin very similar to that found in the American contexts of pre-Clovis cultures, of originating peoples of Asia, and an antiquity that coincides temporally with interglacial periods (14; 15).

Owing to the acidity of the soils present in the tropical contexts (16; 17; 18), few human biological remains, whether remains of soft or hard tissues, or even coprolites (with the possibility of extracting DNA data according to their conservation), resist the natural and anthropogenic weathering. In the Brazilian context, there exist few contexts in which the taphonomic processes permit the adequate preservation of biological remains for the extraction of ancient DNA, highlighting the studies realized by the Laboratory of Human Evolutionary Studies of the Institute of Biosciences of the University of São

Paulo, under the coordination of Professor Dr. Walter Neves, who realizes an extensive interdisciplinary investigation in archaeological contexts of Lagoa Santa, MG (19; 20).

As Neves (2016) justifies, the studies in this area are scarce in Brazil owing to the difficulty of preservation and extraction of the remains, as well as of their analysis, since we do not count with specialized laboratories on the theme, and we depend principally on the collaboration with international institutions such as the Max Planck Institute in Germany and the University of Copenhagen in Denmark, referents in investigation.

Analysis of Stable Isotopes

The analysis of stable isotopes is characterized by the chemical identification of elements and can be applied in diverse fields, such as ecology, agronomy, geology, and archaeology. In archaeology, it is possible to establish the seasonality, the mobility, and the diet in relation with the human and material remains.

In studies realized in Brazilian contexts, the investigations realized in Sambaquis stand out, whose objective is to identify the sociocultural dynamics among the groups of hunter-gatherers, characterizing the use of the malacological fauna as diet, the seasonality of the availability of this resource, and, finally, the operative chain in relation with the obtaining, management, use, and final disposition of this resource (21).

The analyses can be realized from the extraction of collagen of human osseous remains (22) in order to determine the diet and the displacements in search of food, as well as to determine the use of plants by the ceramic populations by means of the extraction of carbonized residues conserved in the bottom of the vessels (23). The stable isotopes permit verifying the presence of chemical elements in diverse types of materials and substrates. They facilitate the diagnosis of their origin, nutrition, and movement from the perspective of a systematic analysis of the biological and taphonomic characteristics.

The collection of materials for analysis at micro and macro scale implies processes of laboratory strictly regulated and general standards (27; 28), as well as specific, as in our case of archaeology (29; 30). In equal manner, several guides of reference have been created that will serve as base for comparing the materials collected (31), as well as specific guides for Brazilian biomes, such as the Cerrado, the first great systematic guide on palynology developed by (32), and the Amazonia, with the work of Colinvaux, De Oliveira, and Moreno Patiño (33).

The interdisciplinary archaeological work that utilizes archaeobotanical data offers the possibility of integrating data that go from data of the landscape (macro), such as the paleoenvironmental characterization of a context or region, up to the identification of seeds or grains that served as food (micro), which can reconstruct the diet and therefore the organization and sociocultural relations of groups or populations throughout time, within a characteristic specific landscape (space), which can be chosen owing to alimentary deficiencies or cultural phenomena (34; 35; 36; 37; 38).

Micromorphology of the Soil

In the field of archaeology, the microscopic analyses that utilize samples of soil as principal material of study generally are framed in the area of geoarchaeology.

In archaeology, the micromorphology of the soil is characterized by the analysis centered on the solution of preestablished problems related with the soil and its occupation, as well as its subsequent abandonment, etc.

In this sense, it is possible to characterize the layers of occupation and the respective social activities that interfered in them, identifying exogenous actions to the human activities, such as burials, inundations, fires, and others that alter the natural composition of the layers and that become taphonomically recognizable through changes visible only at the microscope, activities related with the domestication of plants, among others (39; 40; 41; 42).

The micromorphology of the soil is also present in studies that characterize paleoenvironments and chronological studies, with the identification and interpretation of the records that model soils and sediments in relation with the context of the different processes involved in the dynamics of the soil at anthropogenic and natural level (43).

The analyses are configured from the systematic collection of field samples, with the objective of a better identification and characterization of the contexts to analyze, and their subsequent treatment and laboratory analysis, which consists of the preparation of thin sections. Its microscopic analysis seeks the interpretation in the ambit of the chemical, physical, and mineralogical analyses.

In the south of Brazil, micromorphological analyses are realized in order to characterize the sociocultural dynamics in relation with the “Sambaquis” (shell mounds), verifying and validating their natural or anthropogenic formation, their human use as social space for the cultural relations and their function in relation with the landscape.

Another example is the characterization of combustion structures realized in controversial contexts, such as the sites located in Serra da Capivara in Piauí and in Lagoa Santa, Minas Gerais, which involve important contexts with respect to the occupation, displacement, and interaction with the first human groups that interacted on the American continent, aiming at the identification and verification of the contexts of combustion as of anthropogenic or natural origin, as well as the movements in the contexts marked by possible continuities and structural and organizational changes registered in the archaeological contexts.

DISCUSSION

The theories, methods, and tools presented offer numerous foundations for the characterization of archaeological contexts, validating or refuting previous hypothetical premises, which permits a greater refinement of the sociocultural and environmental reconstructions for the analysis of the material culture and their respective places of activity and interaction.

In the context of American archaeology, we believe that many of the techniques and methods presented could be applied in any archaeological investigation realized by professionals with the due formation, especially in the contexts that have materiality that permits realizing these types of analyses, presenting themselves as an important complement to the studies of technology, of the operative chain, and the technological

system employed by the groups of hunter-gatherers or those associated to the contexts occupied by agricultural ceramic groups.

In the case of the lithic materials, it would be susceptible of microscopic analyses with emphasis on the traceology (44), and in addition to presenting the technological and utilitarian characteristics of the materials, it could in exceptional cases present botanical evidence related with its daily use. For the ceramic material culture, it could reveal the technological and cultural data related to the processes of pottery production, taking into consideration that the elections with respect to raw materials and manufactures are resulting from a cultural tradition (6). This type of interpretation is strategic for an archaeology that surpasses the basic interpretations of the material culture, transforming objects into active agents of the human activities and relations. Taking into consideration its technicity and the capacity to generate both quantitative and qualitative data, microarchaeology together with the material culture permits elevating the basic discourses toward the scientific and objective inference.

When we speak of microarchaeobotany, it calls attention how the study of the pollen helps to imagine ancient landscapes. Although it depends on the type of site, what is found under the ground many times recounts details about the climate when those persons lived. The interesting appears upon noting changes among layers: some voids are not accidents, but clues guarded for centuries. From there arises a distinct form of understanding past cultures, not only by their objects, but by the environment that surrounded them. Unfortunately, taking into consideration the contexts with neotropical soils so common to the archaeological findings on the American continent, where it becomes difficult, if not impossible, the preservation of organic materials or ecofacts, surely the contexts will occur in which any analysis directed to the identification and interpretation of said materials is discarded.

Finally, the geomorphology is present in the characterization of sites at the level of their archaeological landscape (De Barros, 45) and their use in the human manufacture, whether as carved objects or even as the elements utilized as temper for the ceramic pastes.

In the approach of the study, we speak of how to choose samples, maintain them secure, and establish limits based on how they decompose with time. This method prefers to look at the molecular findings in conversation with other archaeological clues in order to maintain itself distant from unilateral or independent conclusions.

The investigation with stable isotopes is considered a crucial technique for ascertaining what people ate, where they moved, and in what epochs they lived.

Highlighting the standardized protocols for the sampling, treatment, and analysis, throughout the use of collections of reference and the method of atlas. This helps us to assemble ancient environments, how people utilized foods, administered vegetal resources, and organized spaces based on their activities.

The micromorphology of the soil is the fourth method of which we speak, and it treats of studying these thin layers that we obtain from the careful collection of samples from the field.

In its context of application, a great part of the archaeological studies are realized under the dynamics of the universities or of the contract archaeology, making necessary the search for space where the equipment and consecutively experienced professionals can offer the services or the investigative collaboration. It is necessary to highlight the importance of the interdisciplinary work, so valued by the Processual and Postprocessual archaeology. The case studies presented in this article could go beyond the interpretation of contexts previously present in the archaeological record and surely ignored owing to the lack of precision or even of knowledge of said methods and tools.

CONCLUSIONS

In the first place, this work makes manifest the role of microarchaeology as one of the strategic fields from which contemporary archaeology can operate in the effective integration between micro and macro scales in the interpretation of the archaeological record. The continuous introduction of molecular, isotopic, botanical, and sedimentary microscopic records opens in a significant form the analytical possibilities of the discipline, and offers more faithful reconstructions in the field of the sociocultural, technological, and environmental dynamics of the past. From this perspective, microarchaeology is not to be considered as a set of auxiliary techniques, but as a methodical and epistemological strategy that in a direct form contributes to the process of construction of the archaeological knowledge.

In the second place, the distinct approximations of microarchaeological character evidence both the high interpretative potential of the same and their limitations in neotropical contexts, characterized by intense taphonomic processes, in which the adverse environmental conditions, the acidity of the substrate, elevated humidity, limit the preservation of organic remains and for this reason the applicability of certain analyses. However, the cases that are studied give account that, when these analyses are contextualized and integrated to the other types of archaeological evidences, they are capable of partially overcoming the limitations and generating key information on diet, mobility, paleoenvironments, practices of management of resources, and the processes of formation of the archaeological sites.

Finally, we can conclude that the strengthening of microarchaeology is directly related with the consolidation of interdisciplinary approaches and with the necessary interrelation between the academic investigation, the laboratory infrastructure, and the specialized formation of the persons who dedicate themselves to the study of problematics of archaeological type. The joint application of the microscopic analyses applied to the regional studies—linked both to the academic archaeology and to the contract archaeology—potentiates a more nuanced reading of the technological systems and of the operative chains, all of this in interrelation with the human societies and the landscapes. Within this framework microarchaeology profiles itself as a tool that shall be key in the construction of multiscalar, contextualized, and critical interpretations that are capable of giving response to the theoretical-methodological exigencies that the archaeology of the 21st century poses itself.

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