

**USE OF WOOD RESOURCES BY HOLOCENE HUNTER-GATHERERS OF CIDADE DE
PEDRA, MATO GROSSO, BRAZIL**
USO DE RECURSOS LENHOSOS POR CAÇADORES-COLETORES HOLOCÊNICOS DA
CIDADE DE PEDRA, MATO GROSSO, BRASIL

Caroline Bachelet

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Use of wood resources by Holocene hunter-gatherers of Cidade de Pedra, Mato Grosso, Brazil

Caroline Bachelet¹

Abstract: Anthracology is a discipline based on the study and interpretation of dispersed or concentrated charcoals discovered in archaeological sediments. Concentrated charcoal usually come from hearths used for food preparation or specialized activities. The study provides information on the use of wood as fuel, and the environment in which it was collected. This paper presents the results of anthracological analyzes of four shelters (Ferraz Egreja, Morro Solteiro, Antiqueira, Pacifico) dating from middle to recent Holocene, located in southwestern of Mato Grosso state. Analyses were performed on macro-remains carbonized sampled in hearths, firebrands and concentrations. From taxonomic identifications of charcoals, the objectives are to determine different uses of plant resources by hunter-gatherers and reconstruct the vegetation near to the sites in the past. The results indicate that the groups were collecting firewood randomly, depending on the availability of dry wood around the habitat. Vegetation was characterized by typical formation of the Cerrado, as currently observed in the Cidade de Pedra, indicating some stability in the ligneous cover in the region over the last 5.000 years.

Keywords: Anthracology, Paleoethnobotany, Prehistory, Brazil.

Resumo: Antracologia é uma disciplina baseada no estudo e interpretação de carvões encontrados dispersos ou concentrados nos sedimentos arqueológicos. Os carvões concentrados vêm geralmente de fogueiras utilizadas para a preparação de alimentos ou atividades especializadas. O estudo fornece informações sobre o uso da madeira como combustível e o meio ambiente em que estes foram coletados. Neste trabalho apresentamos os resultados das análises antracológicas de quatro abrigos (Ferraz Egreja, Antiqueira, Morro Solteiro, Pacifico) datados do Holoceno médio até o Holoceno recente, localizados no sudoeste do Mato Grosso. As análises foram feitas sobre macrorrestos carbonizados amostrados em fogueiras, tições e concentrações. A partir das identificações taxonômicas dos carvões, os objetivos foram determinar as diversas utilizações dos recursos vegetais por grupos caçadores-coletores e reconstruir a vegetação existente próximo aos sítios no passado. Os resultados indicam que os grupos coletavam o combustível lenhoso de maneira aleatória, dependendo da disponibilidade de madeira seca em torno do habitat. A vegetação foi caracterizada por formações vegetais típicas do Cerrado, como observado atualmente na Cidade de Pedra, o que indica certa estabilidade da cobertura lenhosa na região nos últimos 5.000 anos.

Palavras-chave: Antracologia, Paleoetnobotânica, Pré-História, Brasil.

¹ Pós-doutoranda. Museu Nacional, Universidade Federal do Rio de Janeiro (UFRJ), Brasil; Programa de Pós-Graduação em Arqueologia, Departamento de Antropologia - Laboratório de Arqueobotânica e Paisagem, Brasil. bachelet@mnhn.fr

INTRODUCTION

Located in the southwest of the Mato Grosso state, about twenty kilometers from Rondonópolis (Figure 1), the vast territory of 'Cidade de Pedra' (300km²) was continuously occupied since the mid-Holocene by several groups of hunter-gatherers (VILHENA VIALOU 2006). Rock art, lithic industries, ceramics, combustion remains (etc.) reflect their passages in the numerous archaeological sites discovered since 1984 during prospections. These have led to the discovery and inventory of 167 rock art sites (shelters, walls) and open sites reflecting a significant use of the territory (VILHENA DE TOLEDO 2013). In 1997, IBAMA recognized archaeological and environmental richness of this area and an ecological reserve named 'RPPN Parque Ecológico João Basso' was created to protect and to preserve the fauna and flora typical of the cerrado biome, and archaeological heritage of the Cidade de Pedra (VILHENA VIALOU and FIGUTI 2013).

Multidisciplinary researches from 1984 to 2013 allowed to highlight prehistoric settlements in their cultural, paleoclimatic and chronological contexts. Many painted, engraved, drawn representations (geometric signs, anthropomorphic and animal figures) on the rock walls of the shelters were recorded and analyzed (PAILLET 2006; VIALOU 2013, 2006). The excavations of several shelters have revealed archaeological sites occupied in the long time (Ferraz Egreja, Abrigos Vermelhos), temporary camps (Arqueiros, Morro Solteiro, Pacifico, Antiqueira) and a burial site (Cipó) (VILHENA VIALOU 2009). Many lithic and ceramic vestiges, colorants, ornamental elements were uncovered. Remains of hearths, embers (large branches burnt) and charcoal concentrations (hearths cleaning, simple combustion area without stones construction) were discovered in quantity more or less abundant in all sites. The presence of these combustion remains indicates that human groups were collecting wood and bringing it in their shelters to make fire and respond to their daily needs (light, cooking, protection, etc.). These carbonized macro-remains (charcoal, seeds, fruits), result of anthropic activities, are the subject of the present work. Indeed, through anthracology (study of charcoal found in archaeological context), it's possible to obtain information both paleoethnobotanical (use of woody vegetation by human groups in the past) as palaeoecological (characterization of the natural environment, landscape and paleoclimate, where prehistoric people have lived and developed) (CHABAL 1999; SCHEEL-YBERT 2004).

In this work, we present the results of anthracological analyzes of fireplaces, charcoal concentrations and embers from four shelters in 'Cidade de Pedra'. From the taxonomic identifications of archaeological charcoals, we try to know: What were the firewood collection practices, the collected woody species, the selection criteria, the firewood supply areas? How was the landscape, the environment in which the hunter-gatherers lived at the beginning of the Holocene?

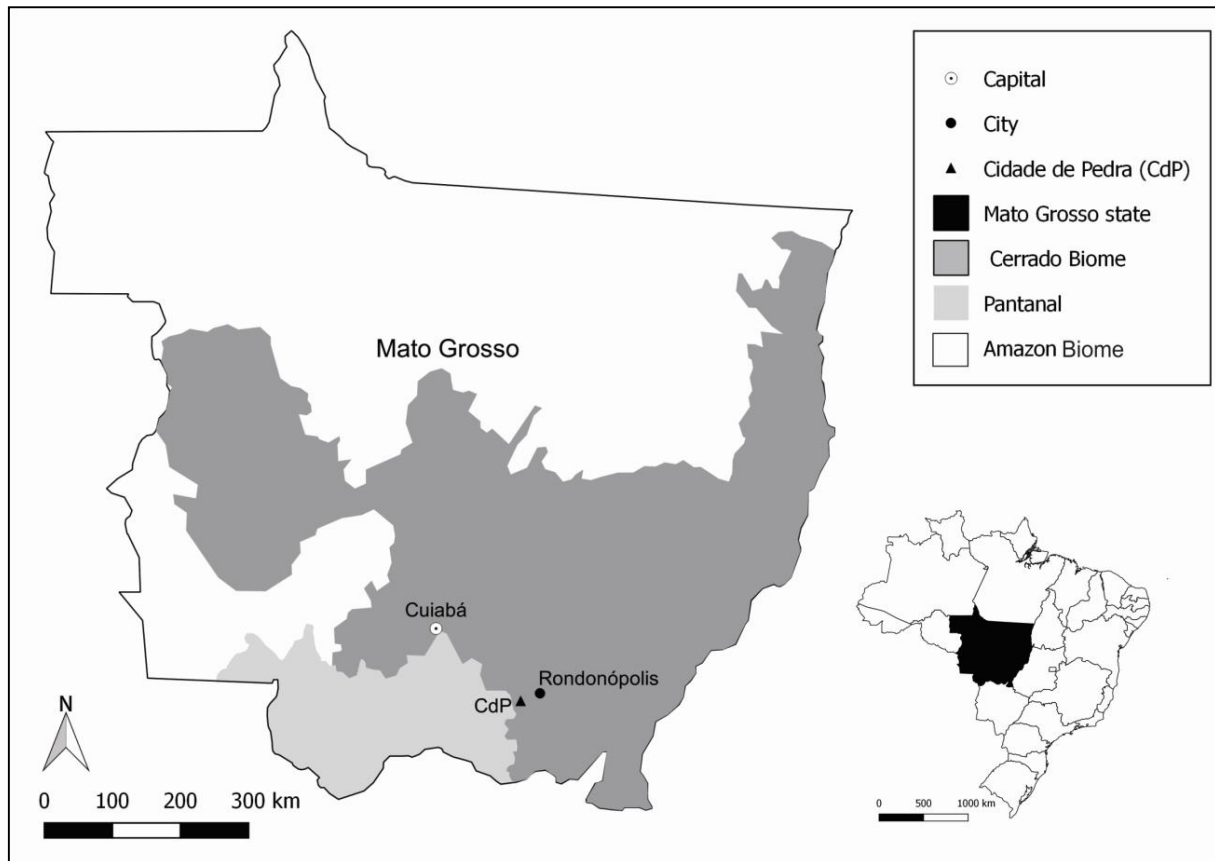


Figure 1: Location of the “Cidade de Pedra” and the different biomes represented in the Mato Grosso state (fonte IBGE, modif. C. Bachelet).

Archaeological context

Anthracological analyzes were performed from macro-remains carbonized from archaeological sites Ferraz Egreja, Morro Solteiro, Antiqueira and Pacifico (Figure 2). These are four rock shelters occupied several times since the middle Holocene by various human groups. In the present state of researches, Ferraz Egreja is the only one presenting continuous occupation, of 6.000 years BP to 100 years BP. The three other shelters were occupied more occasionally since 1.000 years BP (FONTUGNE 2013).

The first human groups that have settled in ‘Cidade de Pedra’, and more particularly in Ferraz Egreja, did not produce ceramics. The lithics associated with them is abundant, and characterized by a variety of rock fragments such as flint, silicified arenite, quartz and small flakes debited on site. No hearths were discovered. However, some small charcoal concentrations associated with the archaeological material were highlighted (BACHELET 2013).

In the following occupations, ceramics with varied shapes and decors, lithic industries (ax blades, hammers, chips), ornament elements (beads, pendants), and a large quantity of colorants (hematite) have been found. Currently, the oldest evidence of the use of ceramics is attested on Ferraz Egreja around 3.000 years BP (VILHENA VIALOU 2006). Embers, hearths, concentrated and dispersed charcoals in sediments are present in all sites and in all archaeological layers in varying quantities.

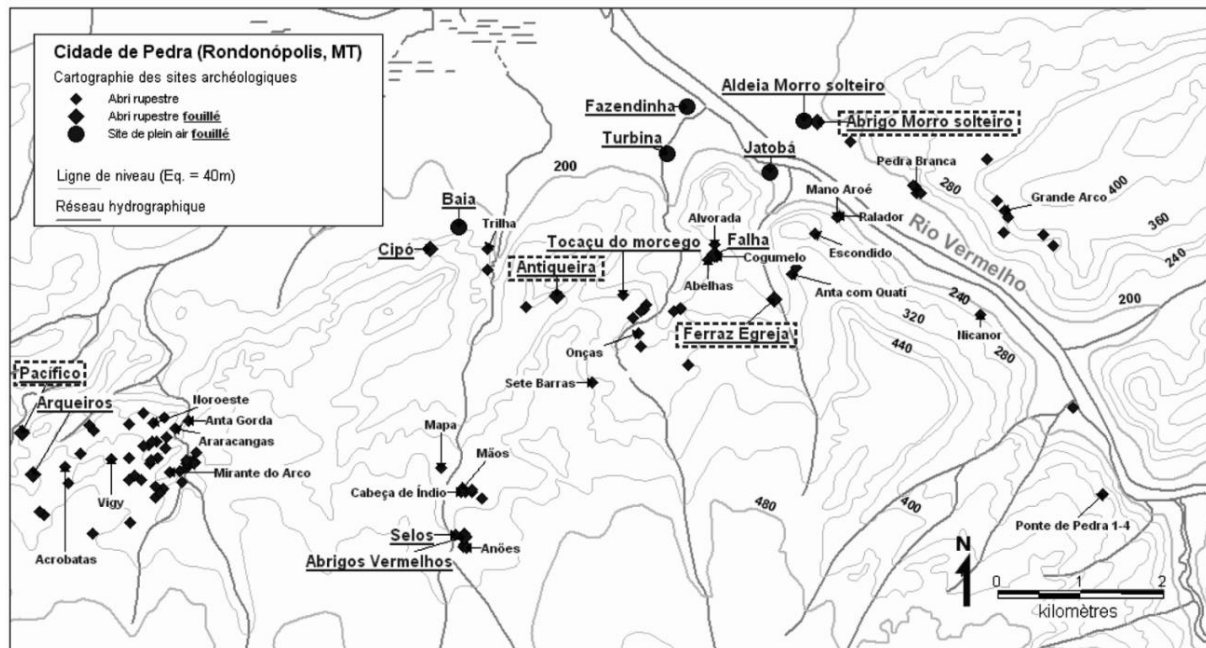


Figure 2: Map of archaeological sites discovered in the “Cidade de Pedra”. In dashed lines, the sites studied in this article (VILHENA VIALOU and FIGUTI 2013).

Materials and methods

Three types of archaeological deposits have been identified and studied: hearths (built by stones); charcoal concentrations; embers. All these carbonized deposits were uncovered in well-dated occupation layers (Table 1). At Ferraz Egreja, 18 carbonized deposits (seven hearths, 11 charcoal concentrations) and six embers, dated to 5.460 ± 40 years BP to 200 ± 70 years BP, were analyzed. In Morro Solteiro, the three concentrations studied were sampled from the 3rd archaeological level (C1) dated to 320 years BP and the 5th and 6th archaeological levels (C2, C3) dated around 1.000 years BP. At Antiqueira, combustion remains are few. No constructed hearth was found. Four concentrations (C1 to C4) dated between 1.300 years BP and 500 years BP were analyzed. Finally, at Pacifico, one charcoal concentration dated at around 1.000 years BP and one hearth dated 1.620 ± 30 years BP were studied.

All the material was water- or dry-sieved, sorted and studied. For this, each charcoal was manually broken according to three wood anatomical sections (transverse, longitudinal tangential, longitudinal radial) and observed under a reflected light microscope with bright and dark field (CHABAL 1992, 1997; PEARSALL 2000). All charcoal fragments over 4mm were analyzed. Taxonomic determination was performed from multiple repositories: reference collection, literature, database.

Table 1: Dating of carbonized deposits studied in the four archaeological sites in the 'Cidade de Pedra' (dating conducted by the Gif-sur-Yvette Laboratory).

Site	Deposits	N° laboratory	Dating (yrs. BP)	Dating (yrs. cal.BP)
Antiqueira	C2	Gif-11732	830±30	667-744
	C4	Gif-12212	1305±30	1082-1271
Ferraz igreja	F1	Gif-10046	200±70	-3-315
	F2	Gif-10047	205±40	1-302
	F3	Gif-9698	1110±50	915-1059
	F4	Gif-11441	1585±35	1344-1521
	F5	Gif-12344	1670±30	1409-1593
	F6	Gif-9697	1900±40	1634-1882
	T1	Gif-9044	460±40	329-534
	T2	Gif-9044	460±40	329-534
	T4	Gif-12431	1535±30	1301-1478
	T5	Gif-12215	1840±50	1562-1860
	T6	Gif-12339	2820±30	2779-2949
	C1	Gif-10044	420±40	324-505
	C2	Gif-10048	780±20	656-721
	C4	Gif-10049	1060±40	801-1045
	C5	Gif-10050	1240±40	979-1239
	C8	Gif-12000	2120±50	1893-2287
	C10	Gif-12429	5120±35	5667-5913
C11	Gif-12428	5460±40	6017-6296	
Morro solteiro	C1	Gif-12433	320±60	152-491
	C2 – C3	Gif-12341	1005±30	797-927
Pacífico	F1	Gif-12432	1620±30	1382-1531

RESULTS AND DISCUSSION

From about 3.136 charcoal fragments analyzed, 2.541 were determined. A total of 81 *taxa* were identified: 68 at Ferraz Igreja, 19 at Antiqueira, 9 at Morro Solteiro and 12 at Pacífico. The number of *taxa* varies from one to 17 by structure (Table 2). The deposits of the four shelters have relatively heterogeneous composition. These results indicate the practice of diversified and opportunistic gathering of firewood, rather than specialized on a botanical species in particular. Dry fallen wood, often abundant in vegetation and easily accessible, probably provided most of the firewood. This type of wood is very common in the cerrado *sensu stricto* and cerrado. Natural tree pruning generates a great quantity of dead wood easy to pick up. By taxonomic determinations, we know that the wood used for human groups was mainly collected from these two types of plant formations, during all occupation phases. Currently, species characteristic of these plant formations are found from about 500m around the shelters. Therefore human groups were probably supplying fuel in the nearest vegetation from their camp and mainly where the dry wood was most

abundant. At Ferraz Egreja, the results cover a long chronological sequence. It's possible to compare firewood gathering behaviors of the groups that have occupied the shelter. Taxonomic identifications show that the wood was collected in forests and wooded savannas characteristics of the study area. However, it appears that the cerrado *sensu stricto* was privileged throughout the occupancy period of the site. These data show that the firewood collection practices were relatively similar over the time.

Of the 78 *taxa* identified, only two were recognized in four sites: *Curatella americana* (lixreira) and *Aspidosperma* sp. (peroba) (Figure 3). The first is typical of the cerrado *sensu stricto* vegetation. The wood has a medium density, difficult to work and rarely used. Presently, it's mainly exploited for charcoal production. Honey flowers are used in traditional medicine against inflammation of the throat, cough, etc. (LORENZI 2008). The second is characteristic of semi-deciduous forest, cerrado and transitional areas with cerrado (LORENZI 2002, 2008). The wood is considered of good quality, medium to high density, and often used in civil construction and fuel.

Other wood of good quality were also identified: *Hymenaea* sp. (jatobá), *Anadenanthera* sp. (angico), *Pterodon* sp. (sucupira), *Hirtella* sp. (vermelhão), *Terminalia* sp. (capitão) etc. (Figure 3). On the other hand, many species of Anacardiaceae, Annonaceae, Myrtaceae and Leguminosae families produce edible fruits (LORENZI et al. 2006). Other species are also known and commonly used in traditional medicine: *Byrsonima* sp. (murici), *Brosimum* sp. (algodãozinho), *Virola* sp. (sucuuba) etc. (LORENZI and ABREU, 2008). It's interesting to note the presence of *Anadenanthera* sp. (angico) in various carbonized deposits of Antiqueira, Morro Solteiro and Ferraz Egreja. It's a dense wood, of good quality, and frequently used by local population as fuel. Bark and flowers are used in the bronchitis treatment, throat inflammation, or breathing problems. Tannin content in the bark is also used in crafts and leather work (LORENZI 2002, 2008; LORENZI and ABREU 2008). Seeds of the *A. colubrina* species have hallucinogens and hypnotic properties (LORENZI 2008). Some studies indicate that these seeds were used in the past, and still are today, by indigenous groups in Latin America during ritual ceremonies in powder inhalant called "yopo" (RODD 2002; CAROD-ARTAL and VÁZQUEZ CABRERA 2007; PAGÁN-JIMÉNEZ and CARLSON 2014).

Analysis of embers, discovered only in Ferraz Egreja, allowed the identification of wood from Leguminosae: *Sweetia* sp. (canjica), *Dipteryx* sp. (baru), *Peltogyne* sp. (pau roxo), *Tachigali* sp. (carvoeiro) and Anacardiaceae families: *Astronium* sp. (aroeira) (BACHELET 2013; BACHELET et al. 2011). Except *Tachigali* sp., all embers are high density wood (QUIRINO et al. 2004, 2005) widely used as firewood by local communities. They could be used as fuel to feed and maintain the fire burning. They could also be used for other reasons. For example, the smoke from *Peltogyne* sp. wood acts as a repellent and is often used to repel mosquitoes. Aroeira wood is employed for the construction of habitats and tools. Leaves, seeds, roots are used in crafts (ornaments, dyeing) and traditional medicine (ointment, tea, etc.).

Table 2: Presence/Absence of the determined *taxa* in all carbonized deposits studied in the four rock shelters and total number of *taxa* identified in each deposit (C: charcoal concentration; F: hearth).

Archaeological Sites		Antiqueira				Morro Solteiro			Pacífico		Ferraz Egreja																		
Family	Genus/species	C 1	C 2	C 3	C 4	C 1	C 2	C 3	C 1	F 1	F 1	F 2	F 3	F 4	F 5	F 6	F 7	C 1	C 2	C 3	C 4	C 5	C 6	C 7	C 8	C 9	C 10	C 11	
Anacardiaceae	<i>Anacardium</i> sp.										x														x				
	<i>Astronium</i> sp.1																												
	<i>Astronium</i> sp.2																												
	<i>Astronium</i> sp.3						x	x																					
	cf. <i>Astronium</i>																												x
	<i>Spondias</i> sp.																		x										
	<i>Spondias</i> /Tapirira																												
Annonaceae	cf. <i>Xylopia</i>																							x		x			
	<i>Rollinia</i> sp.									x																			
Apocynaceae	<i>Aspidosperma</i> sp.	x		x		x		x		x								x						x					
	<i>Aspidosperma</i> sp. 2										x			x															
	cf. <i>Aspidosperma</i>																							x					
	<i>Himathantus</i> sp.																x												
	<i>Peschiera</i> sp.	x																											
Arecaceae	-												x					x					x			x		x	
Asteraceae	<i>Dasyphyllum</i> sp.																												x
Bambusoideae	-				x																								
Bixaceae	<i>Cochlospermum</i> sp.																												x
Chrysobalanaceae	<i>Hirtella</i> sp.		x								x		x	x	x														
Combretaceae	<i>Terminalia</i> sp.												x	x			x												x
Dilleniaceae	-																												
Dilleniaceae	<i>Curatella americana</i>			x				x		x	x		x																
	<i>Doliocarpus</i> sp.													x															
Euphorbiaceae	<i>Mabea</i> sp.																												
Goupiaceae	<i>Goupia glabra</i>		x								x																		
Humiriaceae	<i>Humiria balsamifera</i>																												
Lauraceae	cf. <i>Siparuna</i>																												
	<i>Nectandra</i> /Ocotea				x								x																
Lecythidiaceae	<i>Eschweilera</i> sp.																												
Leguminosae-	<i>Copaifera</i> sp.	x		x																									

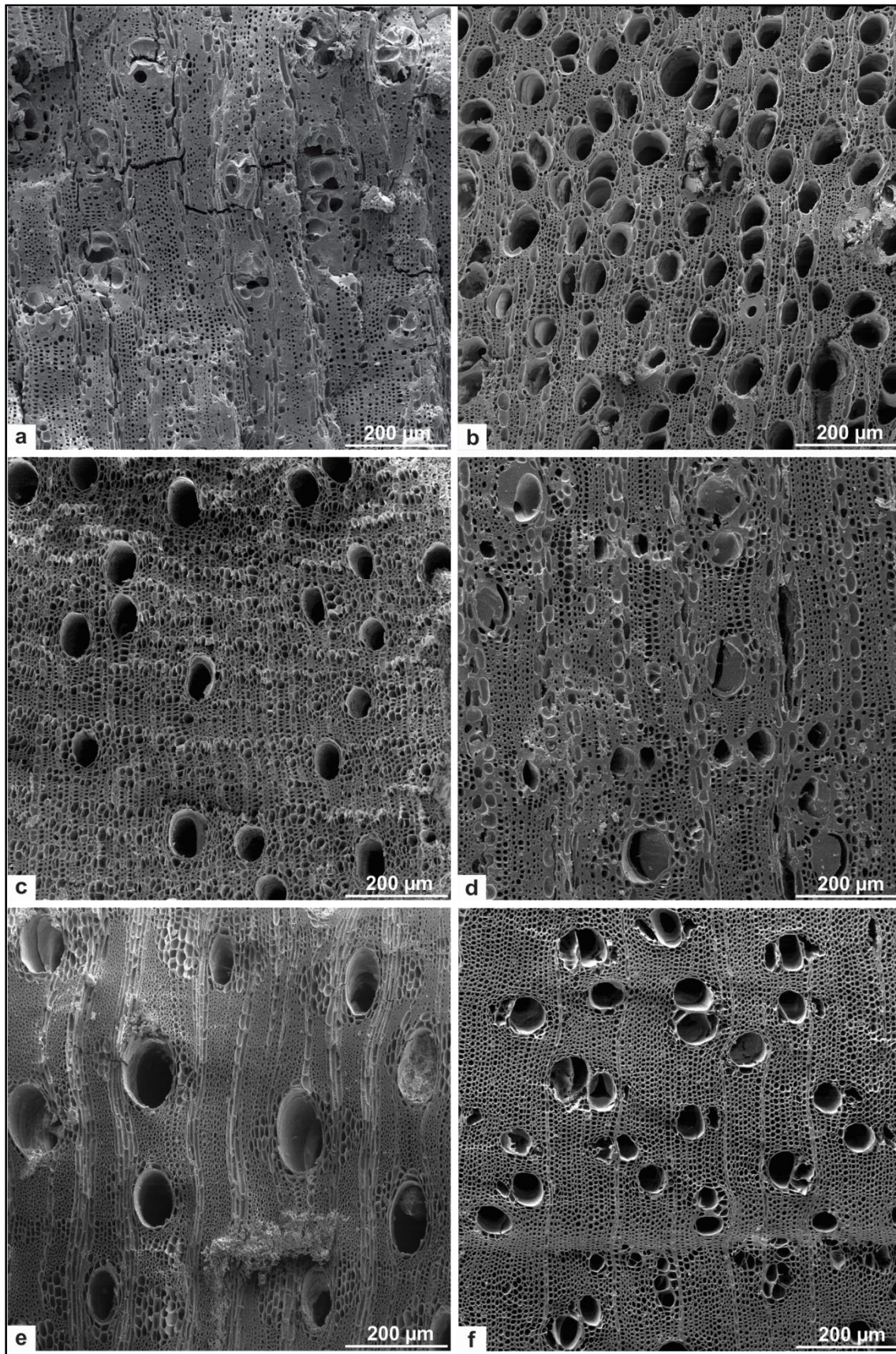


Figure 3: Photographs of transverse sections of charcoal fragments from Ferraz Egreja (Scanning Electron Microscope): (a) *Astronium* sp.; (b) *Aspidosperma* sp.; (c) *Hirtella* sp.; (d) *Copaifera* sp.; (e) *Hymenaea* sp.; (f) *Allophylus* sp.

The wood diversity identified in these sites suggests that there was no selection based on taxonomic criteria, but maybe according to others parameters. Several species have specific ecological properties and have been collected for various reasons (firewood, cooking, protection, light, crafts, medicine, etc.). Criteria such as the condition and the size of wood (wet, dry, green, death, diameter) could be considered. Some authors have indeed shown that according to these criteria, the wood has a different behavior when put in the fire (THÉRY-PARISOT 2001). It can produce more flames, more smoke, or a particular odor. However, ethnographic studies have shown that despite a great knowledge of the vegetation, dead wood and wood availability near the habitat often determine the collection of firewood (RAMOS et al. 2008). At Antiqueira, Morro Solteiro, Pacifico and Ferraz Egreja, the results suggest that fallen dry wood was selected for the fire.

Anthracological analysis was conducted from concentrated deposits covering the last 5.000 years. These charcoals are generally not considered the most appropriate for paleoenvironmental reconstitutions (CHABAL et al. 1999). Nevertheless, they can to give a partial and punctual image of the paleovegetation and paleolandscape. Taxonomic identifications has allowed highlighting taxa markers of various vegetation formations (cerrado, cerradão, gallery forest, vereda) currently well represented in the study area. All the results indicate that for nearly 5.000 years, human groups have collected and used characteristic species of Cerrado biome for daily activities (BACHELET 2014). Therefore, the landscape and environment of Cidade de Pedra was already very similar to what we see today, and current climatic conditions were already well established in the region. These results are consistent with paleoclimatic data known from other parts of Central Brazil that suggest that, after a dry period at the beginning of the Holocene, the current climatic conditions are installed from 5.000 or 4.000 years BP (LEDRU et al. 1998, 2006).

FINAL CONSIDERATIONS

Analysis of combustion remains of four shelters has revealed firewood collection practices and the privileged catchment areas by the occupants of Cidade de Pedra over the time. Hunter-gatherers were collecting firewood for their daily activities in the vegetation around the shelter. They were probably opportunistically collecting dry wood, the more easily accessible, and mainly in the cerrado and cerradão. Firewood was not selected according to taxonomic criteria. Other parameters related to the activities and the daily needs of hunter-gatherers probably played an important role in collecting firewood.

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