




Holocene capuchin-monkey stone tool deposits shed doubts on the human origin of archeological sites from the Pleistocene of Brazil

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Abstract

New World capuchin monkeys are well-known by their ability to solve problems using stone tools that have the characteristics and morphology of some human-made stone tools. The aim of the present contribution is to carry out brief comparisons between the Pleistocene archeological sites from Brazil (e.g. Pedra Furada, Sitio do Meio, Vale da Pedra Furada, Toca da Tira Peia) and capuchin-made stone tool deposits. Pleistocene sites from Brazil are characterized by the exclusive use of immediately available raw material, the predominance of unifacial flaking, and abundance of cortical flakes, together with the absence of blades and bifacial thinning techniques. In all these aspects, the sites resemble capuchin-made lithic deposits and lack a number of human attributes. In sum, based on positive and negative evidence we are confident that the early archeological sites from Brazil may not be human-derived but may belong to capuchin monkeys.

Keywords

Brazil, capuchin monkey, early peopling of America, Pedra Furada

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Introduction

The origin of Pleistocene archeological sites from Brazil constitute a hotly debated topic on the archeology of the early peopling of the Americas (Araujo, 2014; Bahn, 1993; Boëda et al., 2021a, 2021b, 2022; Borrero, 1995, 2015, 2016; Clemente-Conte et al., 2017; Dennell and Hurcombe, 1995; Dillehay, 2000; Fiedel, 2017; Gomez-Coutouly, 2022; Guidon, 1997; Guidon et al., 1996; Lourdeau, 2019; Meltzer et al., 1994; Parenti, 2001; Parenti et al., 2018; Politis, 1999; Prous, 1997; Prous and Fogaça, 1999; Vialou et al., 2017). These sites include the most robust and coherent evidence sustaining an early human population (prior to the Late Glacial Maximum) of the South American continent, and constitute an important supporting evidence for other less well-known Pleistocene sites distributed along South America (e.g. Arribas et al., 2001; Boëda et al., 2014a, 2021a; Dillehay, 2000; Dillehay et al., 2015, 2019; Fariña and Castilla, 2007; Fariña et al., 2014; Guidon, 2008; Navarro-Harris et al., 2019). Among the most representative sites are “Pedra Furada,” “Sitio do Meio,” “Vale da Pedra Furada,” and “Santa Elina.” The best known site, “Pedra Furada” has a Pleistocene cultural component dated 32,000–50,000 ¹⁴C year BP (Guidon and Arnaud, 1991; Parenti et al., 1990), as well as evidence of Holocene human occupation (see Parenti et al., 1990). The Pleistocene components are characterized by the exclusive use of simple stone tools made of locally occurring quartzite and quartz cobbles (Delibrias et al., 1988; Guidon and Delibrias, 1986; Guidon et al., 1994).

Unexpectedly, recent findings in Northeastern Brazil (Haslam et al., 2016; Proffitt et al., 2016) show that capuchin-monkeys (*Sapajus* spp.) are capable of making and using a large number of stone tools. Capuchins of Serra da Capivara National Park (SCNP)

in Brazil (Figure 1a and b) produce human-looking lithic deposits. It is well known to primatologists that capuchin-monkeys are able to use diverse stone and plant tools (see Falótico and Ottoni, 2014), in more varied activities than any other known non-human primate, including chimpanzees (Falótico and Ottoni, 2016; Ottoni and Izar, 2008).

In light of new evidence, Fiedel (2017) proposed, just as a possibility, that the supposed Pleistocene human deposits of “Pedra Furada” were made by capuchin-monkeys. He considered this together with the possibility that these stone tools were geofacts produced by the actions of gravity and waterfalls or that were made by a conservative *Homo sapiens* population. Parenti et al. (2018); see also Boëda et al., 2021a, 2021b, 2022), criticized Fiedel suggestion and proposed that “Pedra Furada” materials are mostly of human origin. More recent contributions also sustain this view (Boëda et al., 2021a, 2021b, 2022; Gruhn, 2018; Lourdeau, 2019).

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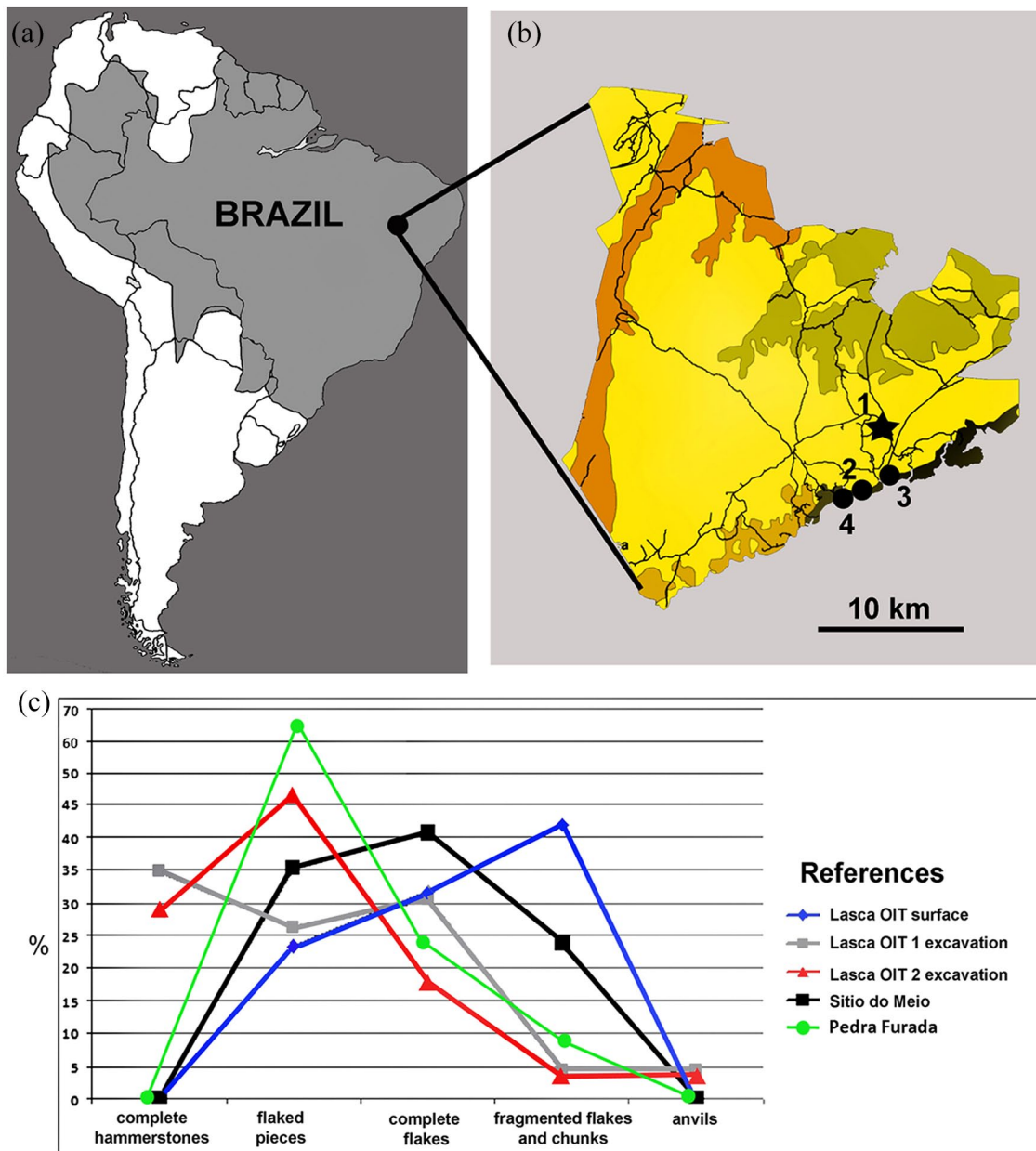


Figure 1. (a) Map showing the location of Serra do Capivara National Park in South America; shaded in gray the distribution of the genus *Sapajus* in South America; (b) distribution of early archeological sites near to Serra do Capivara, including those of capuchin-monkey (*Sapajus* spp.), 1, Serra do Capivara (capuchin-monkey archeological and recent sites); 2, Boqueirao da Pedra Furada; 3, Toca de Tira Peia; 4, Vale da Pedra Furada; Star indicates monkey sites and circles indicate human-derived archeological sites; (c) graphic showing the frequencies of stone tool types in Pleistocene levels in sector 2 of Sítio do Meio, Pleistocene levels of Pedra Furada and capuchin monkey sites. The left column indicates the percentage of stone tool type within the site, and the horizontal row indicates the stone tool type. Distribution of *Sapajus* in A, modified from Alfaro et al. (2012); map in B, modified from Astete (2008).

The aim of the present contribution is to compare capuchin-made lithic deposits from modern and Holocene sites with Pleistocene archeological records from Northeastern Brazil in order to discuss the possibility of a non-human origin of these deposits.

Materials and methods

We have carried out a comparison between stone tool frequencies on monkey and purported human sites from the Pleistocene of Brazil based on published sources. We selected the data sources published by Aimola et al. (2014) for Sítio do Meio and the average data from the three Pleistocene levels at Pedra Furada reported by Parenti (2001) because they are the most completely known assemblages. These sites were compared with published capuchin sites reported by Proffitt et al. (2016),

Haslam et al. (2016) and Falótico et al. (2019) come from the Serra da Capivara National Park, nearby the here discussed archeological sites of “Pedra Furada,” “Sítio do Meio,” “Tira Peia,” and “Vale da Pedra Furada.”

Because the classificatory method employed by different authors differed, we employed a comprehensive categorization method. In this way, our category “flaked pieces” includes the categories of broken hammers and flaked pieces of Proffitt et al. (2016) and choppers, cores and retouched pieces of Aimola et al. (2014). In “flaked pieces” we encompass lithic pieces that show evidence of conchoidal extraction by means of percussion, beyond its inferred intentionality. Aimola et al. (2014) do not distinguish between flakes and small debris, and because of the low number of the latter in the sample, we do not include this category in this review (Figure 1c).

Capuchin-made stone tools and their record

The use of stone tools in chimpanzees has drawn the attention of primatologists (Haslam et al., 2009; Köhl et al., 2016). Because parallels between chimpanzee tool use and the archeological record have been drawn, the need for distinction between the two data sources has been widely recognized (Haslam et al., 2009; Parenti et al., 2018). This resulted in that purported early hominin deposits may in fact correspond to old ape sites (Mercader et al., 2007).

In the last decades, stone tool use was reported for the New World capuchin monkeys (*Sapajus* spp.). Capuchins have activity areas that result in lithic deposits, the remains of which may last for millennia (Falótico et al., 2019; Haslam et al., 2016). In this way, Haslam et al. (2016) described two capuchin stone tool sites, of about 600–700 BP and 3000 BP. These sites are open air or low cliffs associated with narrow conglomerate ridges and much larger conglomeratic outcrops (Falótico et al., 2019; Proffitt et al., 2016).

The stone-tool activity of capuchin monkeys is mainly restricted to stone on stone percussion that typically involves an individual using a rounded quartzite cobble as a hammer to strike another rock or a nut, and in some cases used for digging (Falótico et al., 2017; Ottoni and Izar, 2008). In the first case, the cobble is used to strike repeatedly on quartzite cobbles detached or embedded in the conglomerate (Haslam et al., 2016; Proffitt et al., 2016). Artifacts used by monkeys include hammer-stones, complete and fragmented flakes, anvils, and flaked artifacts (Haslam et al., 2016). Furthermore, monkeys re-use broken hammer-stone parts as fresh hammers (Proffitt et al., 2016).

Hammers are smooth, rounded quartzite cobbles with percussive damage on their surfaces, including small impact points (Haslam et al., 2016). Evidence suggests that capuchins are selective of the stones they use, since they are at least four times heavier than natural cobbles in the same environment (Haslam et al., 2016). The hammers show great variability and their size depends on the availability of local rocks and the kind of resources that must be processed (Luncz et al., 2016; Mendes et al., 2015). The manipulation of the hammer-stones during use produces numerous small, non-invasive, conchoidal or wedge flake scars along the edge of the striking platform, perpendicular to the flaking surface. The flaked surface exhibits one to numerous unidirectional overlapping flakes, including clear platforms, bulbs and hinge terminations resembling human-made “unifacial choppers” (Haslam et al., 2016; Proffitt et al., 2016). The flakes have features typically occurring in early and late stages of reduction, being represented by both cortical and non-cortical pieces (Parenti et al., 2018; Proffitt et al., 2016). Some of these appear to be “retouched” flakes, because of the presence of flaked margins, resembling human-made stone tools (Proffitt et al., 2016 extended data fig 6b).

On the other hand, monkeys frequently use tabular sandstones for anvils (Proffitt et al., 2016). These are usually over four times heavier than hammers (Proffitt et al., 2016). These have a localized area of percussive damage located on a prominent surface (Proffitt et al., 2016).

Capuchin-monkey not only select material for stone tools, but also transport it. Haslam et al. (2016) reported that the stone source of monkey archeological sites was about 30 m. away, and transporting of stones is frequent in capuchins (Ottoni and Izar, 2008).

As noted by Haslam et al. (2016) capuchin percussion is an example of intentional stone breakage by a non-human primate that generates lithic accumulations; however, these sites lack a large number of human attributes. These include hearths, blades, bifacially thinned stone tools and flakes, cut-marked bones, exotic raw materials, or traces of symbolic behavior.

Pleistocene archeological sites from Northeastern Brazil: A brief overview

As indicated above, Pleistocene archeological sites from Piauí area, at Brazil are among the most debated pieces of evidence concerning the early peopling of the Americas (Boëda et al., 2013, 2021a, 2021b, 2022; Lourdeau, 2019; Parenti et al., 2018). Among the most representative sites are Pedra Furada (see Parenti, 2001), Sitio do Meio (Aimola et al., 2014; Boëda et al., 2016), Vale da Pedra Furada (Boëda et al., 2014a, 2021b), and Toca da Tira Peia (Lahaye et al., 2013).

“Pedra Furada” is probably the most well-known and debated site, having a number of features that have been attributed to anthropogenic origin and genesis for Pleistocene levels (32,000–50,000 ¹⁴C yr BP). The site is located in the semiarid Caatinga of northeast Brazil, in the Serra da Capivara National Park. It is a sandstone rock-shelter, 70 m wide, and 18 m in depth (Guidon and Arnaud, 1991; Parenti, 2001). The archeological assemblage is composed of quartzite cobbles which occur in a conglomerate layer approximately 100 m above the shelter floor (Meltzer et al., 1994).

The Sitio do Meio and Toca da Tira Peia sites are rock shelters that were dated as 25,170 ¹⁴C yr BP and 20,000 BP OSL, respectively (Aimola et al., 2014; Lahaye et al., 2013). The Pleistocene levels at Vale da Pedra Furada (12,600 ¹⁴C yr BP –24,500 OSL) site consists on an open air site at the boundary of a sandstone cliff (Boëda et al., 2014a, 2014b, 2021b). This site is near a natural deposit of quartz and quartzite cobbles, as well as sandstone blocks (Boëda et al., 2014a, 2014b).

Several of these Pleistocene sites show traces of purported hearths but the uncertain origin of the charcoal sheds doubts on its human origin (Boëda et al., 2014a, 2014b, 2016; Borrero, 1995; Meltzer et al., 1994).

The stone tools from these Pleistocene sites are characterized by their low morphological diversity, including hammers, anvils, flakes, and retouched flakes (see Aimola et al., 2014; Guidon and Delibrias, 1986; Parenti, 2001; Parenti et al., 2018; Figure 1c). A notable trait of the lithic assemblage is the non-predetermined character of the product (Guidon et al., 1994), being characterized by unifacial shaping and the absence of prepared cores, blades, and bifacial thinning techniques. Further, the artifacts are made using cobbles and cortical flakes as blanks with short reduction sequences (Boëda et al., 2014a, 2014b, 2021b; Guidon and Delibrias, 1986), employing the hard-hammer unifacial flaking technique (Delibrias et al., 1988). The cores show a low number of extractions (Delibrias et al., 1988). It is worth to mention that these Pleistocene technologies are strikingly different from those of the Holocene that unambiguously belong to humans. The later include stone tools made on exotic raw materials and manufactured according to complex reduction sequences (Parenti, 2001).

Discussion

“Pedra Furada” has been in the center of the debate about the Pleistocene peopling of northeastern Brazil for several decades. Some authors doubted on the human character of the sites, focusing criticisms on two main aspects: on one hand, the methodology employed during the excavation of the site, and the other, the human origin of the deposits (Borrero, 1995, 2015, 2016; Fiedel, 2017; Meltzer et al., 1994; Prous, 1997). The critics to the methodological approaches were contested and rejected by Guidon et al. (1996) and Parenti (2001).

On the other hand, Prous (1997) suggested that at least part of the assemblage was the result of monkey throwing stones from the top of the rock shelter, a proposal criticized by Guidon (1997). Subsequently, and in light of discoveries by Haslam et al. (2016),

Fiedel (2017) highlighted that some stone tools from Pedra Furada were similar to those flaked by monkeys. However, this author did not rule out that these tools may simply be geofacts created by water and gravity or artifacts made by humans. Recently, Parenti et al. (2018) performed a taphonomic analysis on the site, convincingly refuting the fluvial origin of the lithic artifacts. Further, based on a comparison with some selected materials, Parenti et al. (2018) conclude that the stone artifacts are larger and show greater sophistication than those generated by monkeys. They concede that a minor part (if any) of the stone tools may have been the result of monkey activities. In any case, they sustain that most (if not all) the artifacts were created by humans, a proposal supported by more recent contributions (Boëda et al., 2021a, 2021b, 2022; Lourdeau, 2019).

In the case of these early archeological Brazilian sites the main part of the “industry” is made of quartz and quartzite cobbles and flakes that show unidirectional flaking, with scarce examples of bipolar percussion. On the other hand, there are sandstone boulders used as anvils. These stone tools are made of immediately available raw material that was not transported from far away, and was largely sourced from less than 20 m away. All these features are characteristics shared with monkey sites as described by previous authors (Proffitt et al., 2016), as well as with capuchin behavioral data that shows that capuchins can carry stone cobbles over 30 m stretches (Ottoni and Izar, 2008; Visalberghi et al., 2009).

The study of frequencies of stone tools and stone tool types in supposed early human archeological sites, as for example, Sitio do Meio and Pedra Furada, fall well within the variation recovered for Capuchin-monkey sites (Figure 1c; Proffitt et al., 2016). Although these frequencies may be also found in human-derived sites, they are congruent with the hypothesis of monkey genesis of those sites.

Furthermore, from a technical perspective, the exclusive presence of unifacial flaking and predominance of cortical flakes are features uncommon in most human sites, but abundant in capuchin-monkey sites (Haslam et al., 2016; Proffitt et al., 2016), a trait shared with the Pleistocene archeological sites from northeastern Brazil. Regarding the complexity of the lithic technology, Parenti et al. (2018) argue that the artifacts from Pedra Furada show a much more complex technique than those of current monkeys. However, the images published by these authors show stone tools similar to those documented for the capuchin monkey sites (e.g. compare Parenti et al., 2018 figure 15 with Haslam et al., 2016, figure 1C and 1H). Further, in both samples, there are no bifacially thinned blanks (sensu Andrefsky, 2005; Aschero and Hocsman, 2004), blades, or even artifacts lacking cortex, which are remarkable elements in Holocene sites from the area (Parenti, 2001).

More recently, Boëda et al. (2021b) describe a purported human-made artifact from the Pleistocene site Vale da Pedra Furada. The artifact was found associated with diverse cobbles and pebbles that are very similar to those reported for other northeastern Brazilian sites mentioned above. The artifact consists of a fragmented and heavily weathered slab of silty sandstone that Boëda et al. (2021b) considered an unusual tool that is unknown in other Pleistocene contexts from South America. However, this artifact is not very different from those previously reported from nearby sites, showing a pattern of simple flaked margins with few crude and rough retouches. This element shares with remaining pieces coming from the same site (and other sites from northeastern Brazil) a very simple manufacture process and may not be as unusual as originally stated by Boëda et al. (2021b).

An additional aspect that has recently been used as a proof of the human origin of Pedra Furada lithic artifacts is the volume of the pieces, which is supposedly bigger than that used by primates (Parenti et al., 2018). However, the range and average of the

weights of the Pedra Furada artifacts are within the variability registered for the assemblages used by primates (Falótico et al., 2019; Mendes et al., 2015, see Parenti, 2001). Likewise, it is known that the monkeys use different sizes of rocks for different processing activities (Luncz et al., 2016), resulting in assemblages with weight averages even higher than those recorded for Pedra Furada (Mendes et al., 2015).

Borrero (1995, 2015, 2016) noted no important changes in the technological characteristics of these occupations for more than 50,000 years, an unusual feature for any human group. Boëda et al. (2021a), argued that there existed some chronostratigraphic changes at Vale da Pedra Furada. However, these changes were not adequately reported and based on unquantified estimations, which makes not able to evaluate at the moment. In any case, Falótico et al. (2019), noted also that capuchin industries also show some variations along time.

In addition to the positive evidence presented above, it must be pointed out that Pleistocene sites from Piauí share with capuchin sites the absence of unambiguous human attributes as hearths, cut-marked bones, exotic raw materials, traces of symbolic behavior or stone tools as blades, bifacially thinned artifacts and flakes. In sum, based on negative and positive evidence we are confident in that the early archeological sites from Brazil (e.g. Pedra Furada, Vale de Pedra Furada, Toca da Tira Peia, Sitio do Meio) may not be human-derived but may belong to capuchin monkeys.

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