

# Dating rock art paintings in Serra de Capivara National Park

Combined archaeometric techniques

## Abstract

*Dating the rock art paintings in Serra da Capivara National Park precisely and reliably, is still not possible, however, different techniques used on samples from the sites have provided numerous results. Multiple dating and sampling techniques have demonstrated how important it is to adapt the process to the circumstances and specific conditions of each site. Dating rock art by a method constructed by a combination of several archaeometric processes is here exemplified by Toca do Serrote da Bastiana.*

## Historical approach

Situated in north eastern Brazil and south-eastern Piauí, the Serra da Capivara National Park occupies 130000 hectares land on a geological border, where a “cuesta” front separates two great formations: the peripheral plain of São Francisco river and the sedimentary basin of Piauí-Maranhão.

The semi-arid climate alternates between a dry and a rainy season. The park is situated in the “caatingas”, open formations of the plain. or dry forests making up, ecological links between fauna and vegetation. The main part of the “cuesta” is made of sandstone, modelled by erosion into rock-shelters in the valleys and on the plateaus. The rocks of these shelters have been painted by people living in this region in prehistoric time. Despite the erosive action of natural agents, a considerable number of the shelters are still decorated with rock art panels.

The great number and value of the decorated archaeological sites have determined the creation of Serra da Capivara National Park. Since the end of the 1980's, two institutions in particular have actively co-operated to preserve it: the *Fundação Museu do Homem*

*Americano* (FUMDHAM), a scientific and philanthropic group, and the Brazilian Institute of Environment and renewable natural resources (IBAMA).

## Dating

The rock art in the national park region has been dated thanks to discoveries made during archaeological excavations. Even though the morphology isn't always identifiable there is reason to believe that the painted sandstone blocks, discovered in sediment layers, may be more than 20000 years old.<sup>1</sup>

Exactly when the rock paintings were produced is difficult to state. Damage has occurred with the action of natural agents on the rock formations, on the walls and on the paintings. The damage affected several components of the paintings in various ways and these alterations change the entire painting phenomenon. Direct observation does not permit us to understand these alterations which take place on an imperceptible level, exposed to regular taphonomic processes. It is therefore necessary to take into account all possible intervention

agents, independently of any sensible perception we may have of them.

The analytic procedure adopted for the rock art painting sites of the national park favours data obtained by archeometric techniques.

The aim is chronological dating of rock art paintings, the means are a detailed matrix and a reliable measure of approximation.

## Description of Toca da Bastiana site

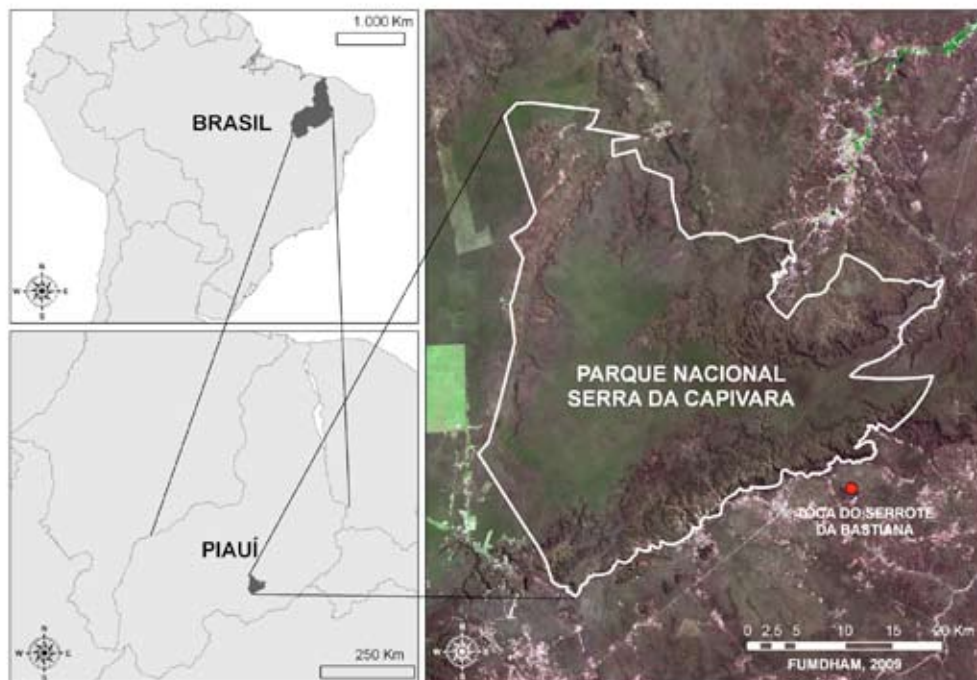
Opposite the “cuesta” front marking the border of the two great geological formations of the national park, the plain and the sedimentary basin, there are several limestone boulders underneath which are a great number of caves with entries forming rock shelters. The caves don’t protect the rock art with the exception of entrance areas occasionally exposed to sunlight.

Toca da Bastiana is such a small limestone shelter decorated with paintings and engravings (Figures 1, 2A and 2B. Picture 2B shows the wall after the calcite sampling). In comparison with other paintings in this limestone region, the paintings are original, rather special. They are made in ochre or black. Two of them show figures with an unusual graphic profile, manifested in scenographic, thematic and technical aspects (figures 3, 4 and 5). The diversity, as well as the graphic regularities, suggests that the paintings were created by different authors, members of different communities sharing graphic codes that could be identified by the establishment of graphic profiles.

## Historic dating of Toca da Bastiana site

The main part of the painted figures is partially covered with thin calcite plates of a variable thickness. The presence of those limestone deposits made dating by new methods possible,

Fig. 1. The Serra de Capivara National Park and Toca do Serrote da Bastiana site.





*Fig. 2A. The site at the beginning of the excavations.*

*Fig. 2B. The site after excavation and sampling of parts of the calcite covers.*





Fig. 3. Isolated anthropomorphic figure painted red, a common figure at several sites in the National Park.

Fig. 4. Animal figures painted black, unique figures in all the region.



methods which are just about to be applied in archaeology.

Figures 6A and 6B show two anthropomorphic figures covered with a 0.2 cm thick calcite plate and the state of these figures just after the first sampling made possible by EPR in 1991 by Oswaldo BAFFA (*Instituto de Física, Universidade de São Paulo, Ribeirão Preto*).<sup>2</sup> The sampled part of the calcite was dated to be 17000 years old.

In 2001, S. Watanabe and his team (Universidade de São Paulo) sampled a new piece of calcite on the same figures and used it in a new X-Ray diffraction analysis in order to identify the composition of the calcite - required for TL and for EPR<sup>3</sup> dating. Uranium, thorium and potassium measurements of the wall and the calcite deposits are used as reference. The sampled calcite corresponds with the interior sector of the figures. The calcite sample was crushed to a size between 0.08 and 0.18 mm. Without any other transformation, the grains were dated with EPR. The results in both cases were between 33.000 and 35.900 years.



*Fig. 5. Engraved handprints.*

*Fig. 6B. Detail of 6A*



*Fig. 6A. Two red-painted anthropomorphic figures after removal of the thin calcite cover. Small figure.*

In 2002, a great human figure was discovered under a thick calcite cover (figures 7A, 7B and 7C). The left half was cleansed while the right side remained covered by calcite. Samples from the calcite cover were dated by the TL and EPR techniques. The samples were crushed as at former datings. The results were 48.286 and 39.442 years, respectively. These calcite crystal results suggest an even older dating for the figure.

In order to verify these results with the results of other dating techniques, M. ROWE<sup>4</sup> used a red painting sample of a human figure and the calcite on top of it. Figure 8 shows the figures after sampling by surface scratching. The left human figure vanished completely. Even though Rowe recognized that the calcium oxalate deposited on the wall also contains other contemporary elements such as carbon, he dated the samples by radiocarbon techniques. The result of these datings is 2.490 +/- 30.

In 2007-2008 F. BOUSTA and S. TOURON<sup>5</sup> identified alterations of microbiological or mineral origin and specified the agents responsible for the visible imbalance on the sites. In Toca da Bastania, seven samples of the wall were gathered, four of which included red and black pigments.

The microbiological results show that the biological agents covering the site are mainly black lichens of small size. These lichens belong to *Verrucaria sp.*, a gender very common on limestone and siliceous rocks. Seaweed samples which almost didn't survive in the laboratory belong to the *Chlorophyceae* family. Lichens, seaweeds and bacteria living on the rock shelter walls, die out during the very dry periods, but reappear with the first rains. Thus, organic material accumulates constantly on the wall and vanishes with older deposits, leading to inaccurate dating with 14 degrees Celcius.

Fig. 7A. Piece of the shelter wall with a thick calcite cover.

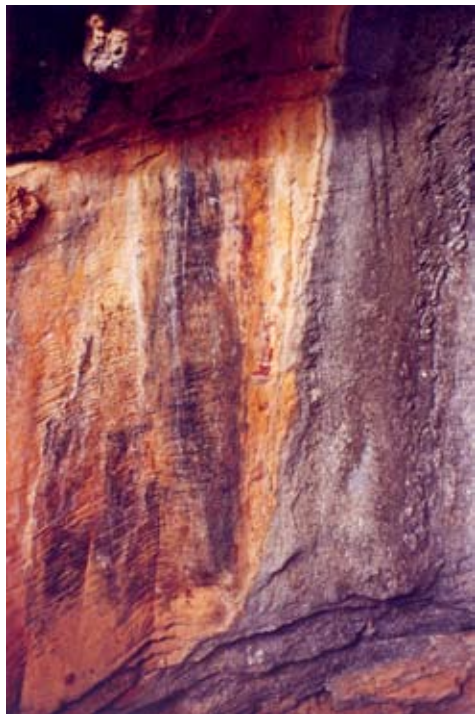


Fig. 7B. Same wall as on fig. 7A, at the initial removal of the calcite cover.



## Conclusions

The wall and the paintings covered with biological agents lead one to imagine error factors, not controllable, at attempting radiocarbon dating, a constant phenomenon at all archaeological sites.

With EPR dating, crystals of oxalate of calcium are dated constituting a problem concerning the sampling of calcite plates covering the paintings. The first samples are obtained by scratching the surface, and the product is the result of the melting of all levels of deposits. Therefore, the result is the average age of the crystals. It is of course possible that older crystals, even rock crystals, can slip into the sample. It is also possible that in the dilution process, of the plates of calcite and the poste-

rior crystallization, older crystals may slip and twist the sample. An adjustment of the process used in the sampling is therefore required. F. BOUSTA and S. TOURON, *Laboratoire de Recherche des Monuments Historiques* in France, have sampled with a tool. It seems necessary to proceed to sampling with a micro-tool of a reduced diameter to avoid damaging the figures and to be able to remove the entire sample with its stratigraphy of limestone deposit. The segregation of the different levels of deposit could make it possible to choose crystals at each level for separate dating. Crystal dating could open for reliable results regarding indirect dating of paintings covered with limestone plate. The researchers at *Fundação Museu do Homem Americano* are currently seeking a definitive way to define the age of the paintings in the National Park of Serra da Capivara region.

Fig. 7C. View after the calcite cover on the left side of the human figure has been cleansed.



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Fig. 8. One of the two anthropomorphic figures shown in figures 6A and 6B was scraped to obtain the sample dated by M. Rowe.



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## Notes and references

1. Guidon, N., Arnaud, B, 1991, *The Chronology of the New World: Two Faces of One Reality*, World Archaeology, Vol. 23, N0 2, Chronologies, pp. 167-178.

2. Electronic spin resonance of carbonates: dating method of quartz and carbonates, which does not undermine the sample and is very useful in archaeology. It is frequently used together with other dating methods.

3. WATANABE, S. et al, *Some Evidence of a Date of First Humans to Arrive in Brazil*. Journal of Archaeological Science (2003) 30, 351-354.

4. ROWE, M. et al, *Accelerator Mass Spectrometry Radiocarbon Ages of an Oxalate Accretion and Rock Paintings at Toca do Serrote da Bastiana, Brazil*, American Chemical Society, 2002, 22-33.

5. F. BOUSTA et S. TOURON, *Rapport de mission*, 2009, Laboratoire de Recherche des Monuments Historiques de France.

## Appendix

While dating of rock art paintings is the theme of our paper, this appendix offers a broader presentation of the pictorial heritage of Brazil.

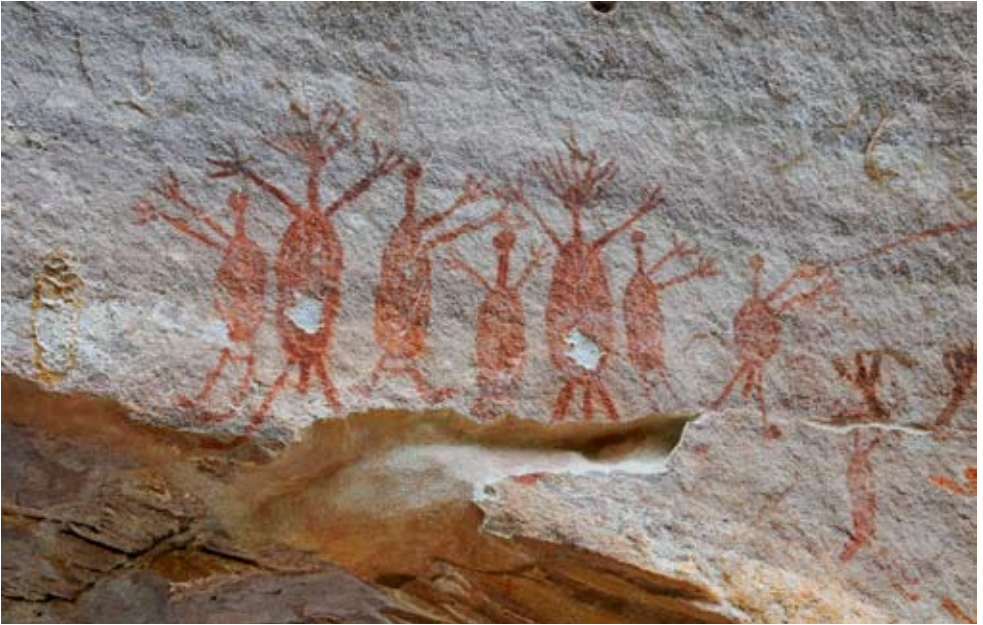


*Site: Toca do Morcego: Rock shelter paintings of human figures, two of them 1 metre tall, and beside them four small figures; all males and with their arms raised.*

*Site: Toca do Perna IV: Male and female human figures in a sexual scenario, their arms raised and three other figures, one with raised arms, two with one arm pointing to the left. Above them, animals and geometric figures. (There are many rock art shelters like this one in Perna Valley).*







Site: Toca da Passagem: Human figures with raised arms, two with ornamented heads, three of them males. (From rock shelter in Serra Branca Valley).

Site: Riacho Santana: The rocks at the bank of this river are covered with engravings of geometrical figures and a few human figures, hands and feet.





*Site: Toca do Pajau: A deer, a bird, an 'ema' and some human figures. Two anthropomorphic figures are carrying a tree. To their left, two figures point at another tree. Between the 'tree scenarios' four of a total of five human figures appear to be engaged in acrobatics. Below the deer two human figures in yet another 'tree scene' and to figures more at the top of the tree. (From Rock shelter in Desfiladeiro da Capivara, a very deep and narrow valley).*

*Site: Toca do Estevo III: Paintings partially destroyed by land clearing fires. This and 172 other rock art sites are ready to receive visitors. (From the beautiful Veredão Valley in Serra da Capivara National Park).*





Site: Toca do Salitre: A male figure with raised arms and at his left a woman, apparently pregnant – a rather common rock shelter motif in Serra da Capivara National Park.



Site: Toca da Extrema II: An animal and geometric figures. (From a rock shelter in Serra Branca Valley).