Article

Monuments, paintings and lakes: areal study in central Sahara and in Borkou during the Holocene

Des monuments, des peintures et des lacs : étude aréologique au Sahara central et au Borkou à l’Holocène

Yves Gauthier

Abstract

It is agreed that an appreciation of rock art is essential for an understanding of the peoples of the Sahara. However, what we lack is precise dating. Then, it is difficult to use rock art to plot population history and group interactions. In the absence of dating, we put forward another approach that foregrounds the study of the geographical distribution of archaeological facts. A rock art phase can be dated indirectly if it is viewed in relation to a type of monument which has been dated, as in the case, for instance, of the Corbeilles and the engravings in the Messak style. The full potential of this approach is revealed when the archaeological data is considered in relation to climatic factors. In Borkou, recovering the Holocene paleolakes enables us to explain the uneven distribution of the kraals and to establish the periodisation of the parietal images.

Keywords: central Sahara, Borkou, rock art, chronology, palaeolakes, settlement/kraals.

Résumé

L’Art rupestre souffre d’un déficit général de datation. Il est, donc, difficile de l’exploiter pour restituer l’histoire du peuplement et mettre en évidence les interactions entre groupes. À défaut de datations directes, nous proposons une approche alternative, qui s’appuie sur l’étude des aires de distribution de faits archéologiques. Une phase rupestre peut être datée indirectement si elle est mise en relation avec un type de monument déjà daté, à l’instar des Monuments en Trou de Serrure et des peintures du style d’Iheren ou des corbeilles et des gravures du style du Messak. L’approche adoptée montre tout son potentiel si on couple les données archéologiques avec les facteurs climatiques. Pour le Borkou, la restitution des paléolacs holocènes permet d’expliquer la distribution très hétérogène des enclos et d’établir la périodisation des images pariétales.

Mots-clés : Sahara central, Borkou, art rupestre, chronologie, paléolacs, enclos/kraals.

1 Chercheur indépendant.
E-mail address: yves.gauthier8@wanadoo.fr

© Institut national des sciences de l’archéologie et du patrimoine/2022/ISSN : 0068-4015/e-ISSN : 2820-6908.
1. Introduction

Since the middle of the last century, the chronological calibration and periodization of rock images has been the subject of many studies, but it must be admitted that we are still far from a general consensus covering all the periods of the Holocene and all the Saharan provinces. In addition to the differences of opinion on identical data, we are far from fully knowing the rock art of the Sahara, vast areas remaining almost entirely untouched. Moreover, the weak point of the field of study remains the dating: apart from some cases of burial by archaeological or geological datable strata, one does not really know how to date the paintings or the engravings. Attempts made by various methods have, generally, been unsuccessful and, to date, only indirect information has been obtained for a chronological calibration of the rock images: this data is based mostly on superimpositions, on the presence / absence of animal species or that of weapons (ax of a particular type, bow or lance, throwing knife...). It should also be emphasized that the dating of an image or a scene is insufficient if one hopes to accurately figure out rock art with its multiple phases because it does not provide information regarding how long each lasted. Neither does such dating take account of the interactions between the cultural groups who produced the paintings and engravings.

In the absence of substantial progress being made in the dating of these works, it is imperative to find alternative methods to advance in the analysis of parietal images. For a few years now\(^2\), we have approached the question differently from traditional approaches by focusing on the location and distribution of rock art phases, by examining specific themes, and by investigating different geographical scales (local, regional or pan-Saharan). Engravings and paintings are not the only anthropic traces testifying to the history of the Saharan populations. Among the most obvious and easy to detect are the remains of habitations and monuments, funerary or not, which, by tens of thousands, dot the desert. Like the rock images, their distribution provides us with information about the Saharan populations.

It is easy to imagine that a single cultural group has left more than one footprint (images, monuments, decorated ceramics, polished, or carved objects...) and, if so, this must be reflected in the respective distributions. Similarly, through various factors (water, pasture, game, dangerous animals or disease carriers, building materials...), the climate has inevitably played a crucial role in the distribution of archaeological facts. Restoring the Saharan cultural panorama, necessarily, involves the taking into account of these different anthropogenic traces and of paleo-environmental data. In a first approach\(^3\), we have shown how the restitution of the precise layout of some lakes illuminates the archaeological context and makes it possible to better locate the rock images in time at the local scale.

The present work aims to show the interest of an areal approach coupled or not with studies on the layout of the lakes and considering the evolution of their level of filling under

\(^2\) Gauthier Y. 2011a, p. 47-86 et 2011b, p. 91-118.
\(^3\) Gauthier Y. 2011a, p. 47-86.
the effect of the climatic pejoration, which began 5-6000 years ago. One of the objectives is the periodisation of a few sets of parietal images of two regions while emphasizing the drastic changes in lifestyles imposed by the climate.

2. Material and methods

The studies presented here draw on different sources. Thus, for our analysis of rock art, we rely on geolocated photos, mostly collected during our field visits. An essential part of this work is the analysis of high-resolution satellite images in the visible wavelength domain, made available by various vendors (Bing, Google Earth, Yahoo, Here) since 2006. When they are of reasonable quality, these images can detect and recognize the nature of objects of a size greater than or equal to 2-3 m with a fairly good reliability. This is sufficient to identify most dry-stone constructions (funerary monuments or not, habitats, trapping systems) that dot the Sahara, the detection being facilitated by the general absence of vegetation. It is important to add however that the fine details of the structures are not always visible because they have suffered from the depredations of both man and nature. There is the additional problem of the sometimes-mediocre quality of the images and their bi-dimensional character (top view only), which sometimes causes doubts or confusion about the type of constructions and / or variants. The inventory of anthropic structures, visible on these satellite images, has allowed us to establish distribution maps, at the level of the Sahara, for dozens of types of constructions.

At the same time, our analysis is based on the use of paleoclimatic data with a particular focus on the location but also and especially on the contour of the paleolakes during the Holocene. To restore the paleoshores, in a manual mode, we relied at first on the satellite images (Google Earth). The first tests proved very positive⁴, we then imported radar images (SRTM90 and SRTM30) with the help of QGIS software, for much faster results, more reliable and covering multiple wetlands in the southern half of the Sahara.

By comparing their areas of distribution, we then tried to see if two archaeological phenomena, partially or fully contemporary, can be attributed to the same cultural group. In addition to the eventual linkage of these phenomena, which is already an interesting contribution, the objective was to chronologically fix one of them by using the knowledge of the time slot occupied by the other. In some of the cases that concern us here, we tried to date the origination of rock images produced by a group on the basis of funerary monuments, which have already been dated. Areal studies also help explain the boundaries of several archaeological events, i.e., those of cultural groups, which are limited in their expansion by the presence of another. At the same time, the outline of the paleolakes is essential, both for interpreting the very complex distributions of some lithic structures and their evolution over time, and for estimating the age of the rock paintings located on the very edge of the Megatchad⁵.

⁴ Gauthier Y. 2011a, p. 47-86.
⁵ Gauthier Y. 2020.
2.1. About the distribution of archaeological phenomena

Although the rock arts are found in all the great massifs and in the main Saharan reliefs (Fig. 1.), this is not the case for all archaeological phenomena. Some, such as crescent-shaped monuments, cover an area of more than two million square kilometers, from the western edge of the Ténéré to the Atlantic and about 12° in latitude, while rectangular tumuli (ibidem: 1064) are clustered on only 30,000 square kilometers and corbeille monuments on approximately 60,000 square kilometers.

Archaeological phenomena of large geographical size are often more difficult to apprehend, and it is more difficult to explain their evolution and their interactions with others because, most of the time, they cover several cultural entities. This can be seen in the Libyco-Berber inscriptions that we have been able to relate to the figurations of chariots. These are found in many massifs without there being any homogeneity in the rock arts irrespective of the period.

It is usually at smaller scales, that of a massif or a small province, that the correspondences are the most frequent and the easiest to find. Rock art falls perfectly within this category. Indeed, the cultural groups that emerge from all the Saharan images rarely go beyond the frame of a massif: Ennedi, Tibesti and Borkou for Chad, Aïr and Kawar for Niger, Tassi-

---

7 Gauthier Y. 2004, p. 45-62.
8 Gauthier Y. 2011b, p. 91-118.
li-n-Ajjer, Ahaggar or Immidir for Algeria, Tagant, Adrar and Bir Moghréïn region in Mauritania to name but a few. And many lithic structures are distributed over areas of the same dimensions as we will see. It is important to note that until now we have not found, covering the same geographical area, two types of lithic structures or equivalent density spectra.

3. Monuments and Rock Art of the Central Sahara

3.1. Keyhole Monuments and Iheren style paintings

Keyhole Monuments (KHM below) are funerary constructions emblematic of the central Sahara. For a detailed description of their architecture, their orientation, the possible affiliation with other monuments and their relative chronology, we refer to previous works.

Remarkable by their shape (Fig. 2, 3) as well as by their size (more than 100 m sometimes), these constructions are among the oldest in the region as evidenced by the hundreds of examples of overlays by/repurpose for other types of monuments (various tumuli, platforms, «V» shaped monuments, «crescents»).

Fig. 2: keyhole monument of the Immidir (Algeria) (© Y. Gauthier).

Fig. 3: keyhole monument of the Amadror region (Algeria). L= 52 m (© Google Earth).

---

The age of the KHM has been well established by ten dates obtained on monuments of Emi Lulu (Northern Ténéré, Niger) and the Fadnoun Plateau\textsuperscript{10} (Ajjer, Algeria). The oldest of these dates back to 3341-3030 BCE and the most recent to 2907-2697 BCE, a fairly narrow range of only a few centuries. Nevertheless, it is not excluded that these funerary structures existed before or after. The dated monuments are in fact only a sample of the 5554 KHM indexed to date and are located in two small extension areas with regard to the distribution area (Fig. 4). With the exception of a few dozen of them, these monuments are confined to the central-Saharan massifs – Ajjer plateau, Immidir, Akukas and Ahaggar – and to the plains they frame\textsuperscript{11}.

![Fig. 4: distribution of Keyhole monuments (red) and sites with corbeille monuments (blue) CAD: Y. Gauthier (© Google Earth).](image)

Since a very large majority of KHM are located in the Ajjer or its surroundings, correlations, if any, are to be found among rock art ensembles having their barycenter on this massif. For obvious reasons of chronology, one can discard the Caballine and Cameline images that

\textsuperscript{10} Berkani H. \textit{et al.} 2015, p. 59-70.

\textsuperscript{11} Gauthier Y. 2019.
follow them, all much more recent than the KHM. The time difference is much greater than a millennium for the former: in the Sahara, the horses, one of the recurring themes of this group of figuration with the chariots to which they are coupled, are at best contemporaries of – but more likely later than – the Second Intermediate Period (1650-1549 BCE), period during which domestic horses appear in Egypt\textsuperscript{12}.

Among the earlier regional ensembles, in the current state of knowledge, two have extensions too limited to answer the question: paintings in Ozan Eharé style, those in Ti-n-Abanher style\textsuperscript{13}. The situation is different for those, probably the oldest ones, in the Round Heads style (RH below). A group of images and only one, that of Iheren style figurations (Fig 5-7), seems to be related to the KHM: the 303 related sites share the same geographical area with occupations in terms of relative density of the same order of magnitude\textsuperscript{14}. We note indeed a presence of engravings or paintings in Iheren style on the same four massifs. The absence of Iheren style rock images in the lowlands - where there are more than 1300 KHM - is easily explained by the lack of shelters that can preserve paintings. This absence of Iheren style images echoes that found more generally for rock art across all eras and styles (less than ten sites in total).

It is on the Ajjer plateau that the majority of Iheren style paintings and engravings are concentrated, with two high density sectors in the NNE of Djanet and in the region around the eponymous site of Iheren. It is not surprising, because these two sectors are the most popular and those that have been the subject of the most intense research. Elsewhere, low densities reflect a lack of exploration more than a real absence, as evidenced by the general distribution of rock sites (Fig. 1). To summarize, it is likely that the distribution of Iheren style figurations is much more homogeneous than it seems and that these are certainly present almost everywhere on the Ajjer plateau, reflecting the distribution of KHM.

We thus find ourselves with two archaeological events whose distributions are surprisingly similar in terms of relative extension and density. On this basis we may easily conclude that both are the work of one and the same cultural group. However, two other scenarios could be proposed: 1 / a simultaneous occupation of the same territory by two independent groups, one having built the KHM, the other having made the paintings and engravings in Iheren style; 2/ the occupation of the same territory by two groups without any temporal overlay. It seems difficult to imagine the peaceful coexistence of two culturally diverse groups in such a vast area. On the other hand, it seems highly unlikely that two culturally distinct groups, with different lifestyles and livelihoods due to climate change over centuries, have colonized exactly the same geographical space.

The most likely hypothesis therefore remains that Iheren style and KHM were produced by one and the same cultural group. The immediate and most notable consequence is that these figurations are indirectly dated: they were made during the same time slot as the KHM (for a more detailed discussion see Gauthier 2019, 2020).

\textsuperscript{13} Distribution maps in Muzzolini A. 1995, chronological table in Le Quellec J.-L. 2013, p. 34.
\textsuperscript{14} Gauthier Y. 2006, p. 79-110 and 2019.
Fig. 5: distribution of rock images in Iheren style (red 303 sites) and Messak style (blue). Data: F. Duquesnoy, Y. Gauthier & J.-L. Le Quellec. CAD: Y. Gauthier (© Google Earth).

Fig. 6: fish in Iheren style. Wadi Allôn (Libya) (© Y. Gauthier).
3. 2. Corbeille Monuments and Messak Style engravings (Libya)

In terms of indirect dating, a similar approach can be applied to the neighboring region that straddles Algeria and Libya, and which mainly includes Messak, Akukas and its extension to the south, Tadrart (Fig. 4-5). We have identified a type of structure unknown elsewhere in the Sahara, corbeille monuments (Fig. 8). This name derives from the shape drawn by the peripheral plates, planted diagonally in the ground, which delimit a stony circular space. These structures frequently have circular appendages too and can form complex sets\(^{15}\). They are distinguished from other lithic constructions by their location, mainly at the edge of the plateau, at the top of the cliffs dug by the wadis. In a large number of cases, they are situated directly above the rock art sites with Messak style engravings.

\(^{15}\) Gauthier Y. 2004, p. 45-62.
These corbeille monuments are also distinguished by their function. While the KHM are human burials, the searches of the corbeille monuments have never revealed anything but the remains of domestic animals\textsuperscript{16}. In total we have listed 374 distributed over 200 sites, the majority (92\%) on the Messak with a fairly homogeneous distribution from north to south (Fig. 4). The seventeen other corbeille monument sites are located in the Akukas (1 site), in the Algerian Tadrart (7), in the north of Niger (1), in the Gebel Ben Ghnêma East of the Messak (2) and finally in the sector of Oued Aramat, on the Libyan side of the Ajjer plateau. As we will see below, another important feature to be noted is that many of the central stelae of these corbeille, and sometimes their peripheral plates, bear engravings with very specific themes and a known style.

The Messak is famous especially for its extraordinary engravings which can be counted in tens of thousands and many of which are among the most beautiful Saharan achievements. The subgroup that interests us here is that of engravings in the style of Messak\textsuperscript{17}. These (Fig. 9-10) are characterized by an incised V-line, cut deep, or by a polished groove, internal or external hammering / polishing, with a double line of outline, the tear in the eye of the an-

\textsuperscript{16} Di Lernia S. and Gallinaro M. 2010.
\textsuperscript{17} In the sense defined by Le Quellec J.-L. 1996.
Monuments, paintings and lakes: areal study in central Sahara and in Borkou during the Holocene

animals, ribs in relief, a stereotypical grimace outlined two or three times on the faces of large fauna or therianthropes or a «water droplet lip»18. In addition to these defining characteristics, which are not all always present simultaneously, we very often encounter an outstanding artistic quality (Fig. 10). These engravings are of a size, equal to, and sometimes greater than the reality they represent with, for example, a 5.90 m long elephant, giraffes around 8 m, or a hippopotamus of 3.60 m in length. Among the remarkable subjects in this group of figurations are strange animals - four-legged or bovid-headed ostriches, a hippopotamus with predatory jaws, monkeys with insect paws)19 - or a recurring geometric pattern, «ovaloid» forms20 (Fig. 9).

Fig. 10: aurochs in the Messak style, with double line and internal polishing (Messak, Libya) (© Y. Gauthier).

These ovaloids, of which several hundred examples have been listed, are sometimes represented in isolation, but often in the presence of other animals that seem to traverse them or contain within them anthropomorphic figures. More remarkable still, we find dozens of double ovaloid shapes sometimes in close proximity and sometimes touching one another21. These motifs, which lack a definable meaning, are in a sense a fossil indicator, especially when

21 Gauthier Y. 2008, p. 89-104.
they are double. Among the themes specific to this group, it is necessary to point out again
the poles which, as among today’s Saharan nomads, are used to hang up cooking utensils such
as the milk containers22 and characters wearing animal masks in a back to front position23.

The presence of large African fauna and more particularly that of aquatic animals such
as crocodiles or hippopotamuses, much more abundant in this group of figurations than in
any other in the Sahara, suggests work produced during a humid climate phase. Conversely,
the absence of horses or dromedaries seems to rule out their having been produced during
more recent periods. However, it is difficult to be more precise if we rely only on indirect
arguments and, to date, no engraving of this style has been dated directly.

The areal approach gives us the means to go a little further in the chronological dating
of these works. One argument in favour of attributing the two archaeological facts to the
same cultural group lies in the images engraved on the corbeille monuments (Fig. 9). There
are indeed anthropomorphs with animal, masks worn back to front, poles used to hang uten-
sils, various animals (cattle, sheep, giraffes, rhinoceroses) and, mostly, ovaloids sometimes
associated with animals. Moreover, in some cases we find the use of the double contour line
and / or internal polishing. Thematically and stylistically, the engravings on the corbeille
monuments are similar to those defined above as being in the Messak style24.

Moreover, as in the previous case (MTS and figurations in Iheren style), there is a re-
markable similarity between the distribution area of the corbeille monuments (Fig. 4) and
that of the Messak style engravings (283 sites; Fig. 5), including in the finer details. In both
instances most of the elements are to be found on the Messak plateau with further examples
in the sector of Wadi Aramat, Akukas and Tadrart. Only two or three corbeille monuments
and an engraved site are located outside the common area. There is nothing surprising if some
small differences exist in terms of local density: on the one hand, engraving and building a
lithic structure are not equivalent operations and, on the other hand, local conditions (avai-
lability of slabs for the corbeille monuments, and the presence of rock surfaces suitable for
engraving) can influence the presence / absence of one or the other of the two phenomena.
For this reason, even if in theory other hypotheses can be put forward, the most plausible
remains that the same cultural group produced the corbeille monuments and the engravings
in Messak style. This leads us to conclude that the engravings were produced within the same
temporal span as the monuments, between 4550-4370 and 4220-3960 BCE25.

3.3 A regional vision of population evolution

At this point, we need to return to the KHM and develop a broader vision of the
distribution of the groups present in the central Sahara. In fact, we note that the corbeille
monuments and the KHM are mutually exclusive (in the geographical sense), the two dis-

tributions «abutting» against each other with a small overlapping band (Fig. 4). The case is strictly identical, of course, for the distributions of Iheren style figurations in the West and for Messak style engravings in the East (Fig. 5). Evidently the time slots for the two groups have no overlap and the oldest KHM was built more than half a millennium after the realization of the most recent corbeille monument (only those which have been dated).

Neither of these two groups could therefore have restricted the other in its extension and conquest of territory. On the other hand, it is clear that the western territory (plateau of Ajjer, Akukas, Tadrart...) was populated prior to the arrival of the creators of the figurations in the Iheren style. In most cases, the overlays show that the RH style paintings (example in Fig. 11) are still underlying those in the Iheren style. At least one example exists of an engraving similar to those in the Messak style overlaying RH figurations.²⁶


Fig. 11 (a et b): paintings in the Round Heads style: anthropomorphs, antelope, geometric motifs over a fantastic animal (warthog?) Wadi Aher (Aramat area, Libya) (© Y. Gauthier).
In other words, when the first corbeille monuments and engravings in the Messak style appear, the group at the origin of the RH paintings is already in place in the west and it precedes the group at the origin of the Iheren style paintings. The dates obtained for an underlying deposit discovered on the floor trodden by the RH artists in Séfar show that the RH paintings were made during the Holocene, at the earliest 10,000 or 9000 years ago\textsuperscript{27}, but they do not specify an end date. Nevertheless, the analogies between the distribution of the RH paintings and those in the Iheren style, lead to the very highly likely hypothesis, that there is a relationship between the two sets\textsuperscript{28}, which gives a terminus \textit{ad quem} for RH images.

On the one hand this means that we can date the realization of the RH paintings as well as understanding their relation to the other rock art figurations and, on the other hand, we are in a position to understand why the engravers of the Messak were slowed in their expansion towards the west: the region was already occupied. The regional chronology reproduced in part, in Fig. 12 modifies and completes the more general scheme presented by Le Quellec (2013: fig. 18).

This preliminary study, of course, needs to be confirmed, as the situation is certainly more complex than it appears on this diagram: 1 / other groups of smaller extension or of later date have left their mark on the rocks and 2 / a part of the territory studied here is untouched by research and discoveries. With the notable exception of Wadi Djerat, this last remark applies to all the northern Ajjer; likewise, the entire border strip with Libya, on the Algerian side, which constitutes a large fraction of the transition zone between the two sets of monuments (corbeille monuments and KHM) suffers from being underexplored as suggested by Fig. 1. We can therefore expect that our conclusions will be modified and / or improved in the future.

\textsuperscript{27} Mercier \textit{et al.} 2012, p. 367-373.
\textsuperscript{28} Gauthier Y. 2020.
4. Periodization of the Borkou Rock Art (Chad)

4.1. Climate and wetlands

In order to describe the history of Saharan settlement, especially given its geographical position straddling the Tropic of Cancer, it is essential to consider the climate as a major parameter of evolution and distribution of humans. In this context, rainfall and water availability are the most important factors. At the beginning of the Holocene, the monsoons returned to the north so that the northern half of the Sahara benefited from an average annual rainfall ranging from 250 mm over southern Tibesti to 1000 mm per year over the boundary of the current Sahel. This (relative) abundance of rains favoured the development of the lake Megatchad which had previously dried up, and that of the Inner Niger Delta and thousands of lakes and wetlands (Fig. 13). The extension and the density of the wet surfaces could even constitute here and there barriers that restricted both animal and human expansion. And such a multitude of lakes necessarily had a decisive influence on human settlement until the end of the wet Holocene episodes. The Borkou is one of the regions most affected by this phenomenon, with a constellation of small lakes and marshes (not shown) and dozens of large lakes, some of which cover several hundred square kilometers (Fig. 14), which together with Lake Megatchad constitutes a considerable total surface in fresh water.

Fig. 13: isohyets (mm) and vegetation during the first half of Holocene (4000-8000 BCE). Savannah with variable tree cover:<10% (yellow); 10-40% (orange); 40-80% (brown); tropical forest> 80% (green); desert (white); Mediterranean climate (violet). Adapted from Larrasoana et al. (2013). Lakes shown with QGIS and according to the literature (Niger interior delta). Blue dots: BCE dates of the certified oldest domesticated bovines in the regions around Borkou (CAD Y. Gauthier) (© Google Earth).
4. 2. Diversity of Rock Art and Lifestyles

Between this mid-Holocene wet environment and the present hyper-arid atmosphere, it is readily admitted that people have had to profoundly change their way of life and subsistence. Unsurprisingly, Borkou’s parietal images reflect these drastic changes (Figs 15-19). Aquatic activities (fishing and navigation) and water-dependent animals such as hippopotamuses, crocodiles or fish indicate favourable climatic conditions\(^{29}\) (Fig. 15-16); at the other end of the time scale, the images show camels that testify to an arid environment (Fig. 19). Between the two, the overlaid images, which include thousands of figurations of domestic cattle of varying styles and/or techniques (Fig. 17-18), give expression to pastoralism.

The Borkou is undoubtedly one of the regions neglected by rock art research. In an area covering more than 200 000 square kilometers, we know little more than 250 rock art sites of which many are as yet unstudied.

The scientific literature (see for example, Negro et al. 1996 and references cited) is indeed not very extensive and does not do justice to the historical and artistic interest of the region. In addition, many older publications offer only descriptions or freehand drawings containing numerous significant errors.

\(^{29}\) Gauthier Y. 2018, p. 265-292; 2019 and 2020
In parallel with the temporal evolution mentioned above, the data currently available shows a diversity of styles, techniques, and themes, indicating a complex pattern of settlement of the region and this phenomenon occurring probably at all periods. Since the mid-Holocene, the Borkou was probably populated by a mosaic of related cultural groups, like what is known for the neighbouring Ennedi and as is the case, of our days with the Toubou populating northern Chad. We cannot as yet provide a full description of the Borkou region since our current knowledge is still too fragmentary. However, this does not preclude us from drawing some conclusions from the rock art and archaeology of the area.

Fig. 15: Artchana II (Borkou). Fishermen carrying harpoons, a pronged harpoon and/or a net and surrounding a possible dam to catch fish. See Gauthier 2018 (© Gauthier).

Fig. 16: cat-net fishing, a canoe and a hippopotamus. Artchana II (© Y. Gauthier).
Fig. 17: Derdia (?), 30 km NW of Faya. Bovines next to a camp (© Y. Gauthier).

Fig. 18: Ounianga Sérir. Forward-facing horned domesticated bovine with a criss-cross motif collar (© Y. Gauthier).
Monuments, paintings and lakes: areal study in central Sahara and in Borkou during the Holocene

4. 3. The enclosures and lakes of Borkou

4. 3. 1. Architecture and function

Of all the populations that have occupied the Borkou, only one is at the origin of the simplest subcircular lithic constructions (Fig. 20-21). These structures (described below as enclosures) comprise a peripheral wall of variable width and height (Hmax ~ 1 m) consisting of erected plates or a pile of blocks depending on the availability of materials. Their size is 30-40 m in diameter on average but can exceed 200 m. Often the largest enclosures are also the most complex with multiple compartments of different sizes and shapes (Fig. 21).

Their architecture and size led J. Hansen (1993) to assimilate them to South African kraals. The Kraals contain, as here, large spaces reserved for domestic animals, sometimes with subdivisions defined by species or by the age of the animals and others, of smaller size, reserved for housing the various family members. Since there is no evidence of agriculture towards the mid-Holocene, apart from the confinement of herds, it is difficult to imagine that such large spaces would be reserved simply for human habitation. An indirect confirma-
tion of this dual function of the Borkou enclosures is provided by rock images that, unambiguously, depict domestic cattle in pens (Fig. 22).

For the reasons explained previously, we are not able to present images from the Borkou and the examples are taken from the rock art of the neighbouring Ennedi. In one of them, we see a space occupied by cattle and, next to it, another space occupied by two anthropomorphs (Fig. 22), as in the case of the kraals of South Africa.

Fig. 21: east of Faya. Satellite view of two complex enclosures with double walls and multiple compartments. D. - 120m for the enclosure on the left (©Google Earth)

Fig. 22: enclosure with a living area occupied by two individuals and an area set aside for bovines. Herté Saouni (?), Ennedi (© Y. Gauthier).
4. 3. 2. Distribution

Of the 20,025 enclosures listed in the Sahara (see distribution map Gauthier 2019), about 13,430 are in northern Chad, including 3140 in Borkou (Fig. 14). Their distribution is very heterogeneous with a density close to zero over a large part of the territory. There are areas of very high density and several areas of medium/low density: among the latter we find, the region of the village of Gouro, the cliff edges between Gouro and the lakes of Ounianga, the area a little further north and the area to the east and southeast of the Aorounga crater. However, two huge concentrations of enclosures clearly predominate: one near the village of Kaortchi and the other, the largest, west of Faya.

As it stands, such a distribution makes no sense. We need also to take account of the outlines of the paleolakes that dot the Borkou, especially the Kaortchi Lake and the Megatchad (Fig. 14, 23-24). Approximately 95% of the enclosures are located on the edge of these paleolakes, in close proximity to them (one to two kilometers), or in the surrounding area.

In reality the proportion is certainly higher than this because we have not (yet) reconstructed the form of some of the lakes, especially the smallest ones and those that border the cliffs in the Gouro-Ounianga region. In Borkou, lakes and enclosures are therefore undeniably linked. An identical correlation is found for wetland enclosures in northern Air (Niger), as well as for other types of lithic construction, in Mauritania. In Tibesti, the location of the largest number of enclosures in the Sahara, we face a different situation. In the absence of lakes, we must use geological and tectonic factors to find an analogy that explains a highly heterogeneous distribution. (work in progress).

4. 3. 2. An aniconic group?

Thanks to areal studies, we can develop other ideas concerning the population groups that erected these enclosures. It appears from the distribution maps that there is a total divergence between their locations and those of the rock art sites (all periods considered): where there are enclosures, there are no parietal images and vice versa (Fig. 14). Both phenomena have a close relationship with the lakes, but not necessarily an identical one and not in the same places. In broad terms, the distance separating rock sites and enclosures far exceeds that which could be attributed to sites with different purposes within a cultural group (habitation, necropolis, sacred places, rock art sites...). And besides, it is extremely rare to find enclosures and rock art in the same location. It follows that the group of cattle breeders occupying the enclosures was aniconic, this being therefore a concrete example of anti-correlation and a demonstration of the variety of possibilities offered by the areal approach.

This may turn out to be of primary importance because, given the relative age of the enclosures (and thus of the animals that were confined within them), it is quite possible that no image of the most ancient cattle in the Borkou is available.

30 Gauthier Y. 2020.
31 Gauthier Y. 2019.
4.3.3. Ancient enclosures?

Fig. 23: Kaortchi (a, b, c et d), detail of the distribution of about 750 enclosures and shrinking of the lake due to climatic pejoration (filling level: 322 m, 318 m, 314 m, et 310 m (© Y. Gauthier).
The undeniable relationship between flooded areas and enclosures is a decisive factor in indirectly determining the age of these enclosures. Indeed, their distribution around Lake Kaortchi and in the basin of Faya, the northern area of Lake Megatchad, contains information helpful to the dating process. Settlers arrived around those lakes that were well fed by heavy rainfall during wet periods at the turn of the mid-Holocene. With the gradual degradation of the climate, the lakes grew smaller, and the inhabitants moved down towards the lake basins, following a retreating shoreline, as near the village of Bedo (Fig. 23).

The particular situation of the enclosures of the Faya basin allows us to go further in our chronological analysis. As a matter of fact, with the exception of a dozen of them, the enclosures are all located at an altitude lower than that of the highest average level of the Megatchad in the Holocene (Fig. 24). The immediate consequence is that these constructions are more recent than the last high stand of the lake, which already determines a terminus a quo. This is also consistent with the distribution of the enclosures around Lake Kaortchi: these are proportionally much more numerous around the high levels (322 and 318 m on Fig. 25) and were thus erected mainly at the end of the mid-Holocene wet episode and / or at the beginning of the degradation that takes place about 6000 years ago. Another remarkable fact for the Faya basin is that there are only a few enclosures below 250 m, below which the basin becomes independent of that of the Bodélé (Fig. 24). If we assume that the shrinking of the lake was a monotonous process, the moment the lake descended below this level would be a terminus ad quem.

Fig. 24: distribution of about 1150 enclosures in the Faya basin and extension of Megatchad lake at its maximum average level (329 m) and at the level of the threshold of outflow (250 m) into the Bodélé basin (© Y. Gauthier).
The level of filling of lake Megatchad during the Holocene has been the subject of many studies, the most recent proposing a model for its evolution. According to this model, the lake would have fluctuated around its mean maximum level (329 m) for several thousand years during the first half of the Holocene and would have dried up very rapidly during the 5th millennium (Fig. 31). These authors hypothesize a transgression following a temporary improvement in climatic conditions approximately 3 ka ago. If the water level of the Megatchad rose to nearly 300 m this would be incompatible with the state of preservation of the enclosures situated between 250 and 300 m altitude in the Faya basin. Such a transgression would inevitably be associated with a length of the Megatchad of nearly 1000 kilometers. The shores of the lake would have been subjected to the devastating waves that are produced in stormy conditions and the enclosures would not have resisted... whereas in fact they are well preserved.

Fig. 25: evolution of the level of the northern part (Bodélé) of lake Megatchad since the inception of the Holocene (black). Adapted from Armitage et al. 2015. red: levels 329 and 250 m (Fig. 24); blue: age of the crescent monuments of Niger; green/yellow: probable time slot of enclosures (see text); violet: proposed evolution of the Megatchad level by Armitage et al.

In addition, the suggested highstand (violet dotted line in Fig. 25) is based on an assumption concerning the height of the sill of the Bahr el Ghazal which conditions the discharge of the southern basin of the Megalake into the northern basin (the Bodélé) and therefore, as an indirect consequence, filling the Faya basin. Armitage et al. (2015) implicitly admit that this still has not changed for more than 3000 years and that it was therefore at the current level of 287 m. There is a high probability that the sill was actually about 15 m higher (analysis in progress), which would have prevented water flowing from the southern

---

basin and filling the Bodelé. The level of the southern basin never reached 300 m altitude during the second half of the Holocene.

It is more reasonable as far as the Bodelé and the Faya basin are concerned, to envisage a monotonous reduction of the filling level. As a result, the 329 and 250 m levels roughly determine the enclosure construction period, that is to say a period of a little over two centuries at the end of the 6th millennium (in green in Fig. 25). It should be remembered, however, that rare enclosures are to be found on the plateau at altitudes higher than the maximum level of the lake and that a few others are at altitudes below 250 m: they may correspond to the appearance or disappearance phases which expands the time frame. In addition, we must consider uncertainties concerning the dating which restrict the level of the lake as well as possible errors relating to altitude measurement: in our view it is more sensible to assume a range of half a millennium (yellow).

4. 4. Some pointers for a regional chronology

4. 4. 1. crescent-shaped monuments overlaying enclosures

We find a confirmation of the date of completion of these structures if we bear in mind the context in which similar enclosures appear in the region straddling the Algeria-Niger border, in the NNE of Aïr. Like the Borkou, this region was dotted with lakes and marshes and crossed by a large watercourse: here too, the enclosures were mainly concentrated around the bodies of water whose contours they follow. We know at least twenty cases where crescent-shaped monuments (definition and distribution) are superimposed on enclosures in this region and/or were built by reusing their materials. We never encounter the opposite situation where an enclosure is built with or on a crescent. From this we conclude that crescents are generally more recent than the enclosures. Luckily, many funerary monuments in the same region have been studied and dated by Paris (1996) and among them are six crescents. The ages of five of them are indeed grouped between 4000 and 4600 years (Fig. 25). Dating by hydroxy-apatite was not perfectly mastered at the time of the study and since, radiocarbon dating has improved with the emergence of AMS (Accelerator mass spectroscopy) and with new treatments to remove secondary calcites. Applied to a same series of KHM, this results in a narrowing of the time slot of existence of the monuments. Such a narrowing is expected for the crescents and consequently we reject the sixth (too) early date.

The architectural and contextual similarities (their situation close to lakes, their increased density at higher levels) allow us to make the connection between these two sets of enclosures in Niger and Borkou and to argue in favour of an identical or similar period on account of their relation to the same climatic episodes. The dates obtained for the cres-
cent-shaped monuments of Niger thus provide (another) terminus ad quem for the enclosures which globally are older than 4600 BCE, in perfect agreement with the deduction drawn from the altitude of the enclosures and the evolution of the Megatchad.

4. 4. 2. Domestication of cattle in Chad and neighbouring countries

Chad is certainly one of the Saharan countries where the date of introduction and the evolution of livestock farming are the least well known. In published work some supposedly domestic animals exhumed in Tibesti have been given very early dates. However, these have been refuted: we do not take them into account. The only marker available at this stage is a very low date, 630 BCE, for a domestic cattle jaw in Ennedi.

Such a late introduction of domestication in northern Chad seems implausible given the distribution of remains of the oldest domestic cattle in the peripheral regions (Fig. 13). In Niger, Sudan and southern Ahaggar, cattle breeding is attested as early as the end of the 5th millennium BCE and even older dates, late 6th millennium-early 5th century, are known for domestic cattle in the Messak (Libya), Akukas (Libya) and Adrar Bous (Niger). Between Jebel Rahib in Sudan where domestication appears at the latest around 4200 BCE, and the Ennedi site that provided this date of 630 BCE, there is little more than 400 km without a geographical barrier. The notion that more than three millennia separate the introduction of cattle breeding between these two areas seems to us to be implausible and the absence, in Chad, of a date in the 5th millennium seems to us reveal a lack of research.

The massive presence of enclosures built during the 5th millennium around the lakes and the representations of herds of cattle, largely preceding those of dromedaries throughout northern Chad, are essential indicators that this practice was probably adopted simultaneously in Borkou and across neighbouring regions.

4. 4. 3. Kazer: camels, wells, and hippopotamuses

The Kazer site with its engravings is undoubtedly one of the largest, quantitatively, in the Yarda region (Borkou). Over a distance of about a hundred meters, the base of a cliff is covered with hundreds of engravings attributable to recent phases of rock art if we judge by the color of the lines and the themes expressed. In the vast majority of cases, we only note very subtle differences in patina: without necessarily being contemporary, these engravings cannot be very

---

38 Le Quellec J.-L. 2013, p. 2-46.
distant in time. With regard to this group of engravings, three aspects are central to any
discussion of the evolution of lifestyles and subsistence under the influence of climate degra-
dation: 1 / a multitude of camels; 2 / representations of wells and garden irrigation (Fig. 26);
3 / two illustrations of hippos (Fig. 19).

If the dromedary appears as early as the second millennium BCE in Nubia, it does not
really spread until the first millennium\textsuperscript{41} and it probably did not reach northern Chad before
this date. This animal is therefore part of an already arid climatic context, which we have
confirmed by the (almost) contemporary images of wells and camels at Kazer. The presence
of wells in a rock art layer is indeed a fairly clear indication of a climatic deterioration which
implies the need to fetch water from where it subsists (underground) whereas earlier it was
available on the surface in a region, the Borkou, characterised by its lakes. Indeed, we never
find a representation of wells on the old layers whether in Chad or elsewhere in the Sahara.

On the other hand, it is very surprising to see these dromedaries and wells alongside
a mother hippopotamus and baby, engraved at about the same time as evidenced by the
patinas. The persistence of lakes in the Faya / Yarda region is the only way to explain the
survival of these pachyderms. Nowadays, there are still a few small ponds, lakes and residual
marshes at the location of the paleolacs (Bedo, Tohil, Kaortchi...). They are fed by springs
that counterbalance evaporation. These areas of water have greatly decreased in volume since
the maximum level reached during the previous humid period but, thanks to the springs,
probably at a slower rate than in the case of Lake Megatchad. The extinction of the hippopo-
tamus population can probably be explained by the cumulative effect of hunting and by the
lack of vegetation (occasioned by the absence of rainfall) rather than by the disappearance of
areas of water.

4. 4. 4. Navigation and fishing on Lake Chad and in Borkou

Northern Chad stands out from other Saharan provinces in many aspects (rock art,
monuments, languages, habitat). But it stands out in particular on account of its aquatic
activities, fishing and navigation, which is not surprising given the number of paleolakes it
contains. The Borkou is the region that has provided the largest number of images of aquatic
activity: pirogues, fishing scenes and / or fishermen’s implements\textsuperscript{42} (Fig. 15-16, 27-28). These
reveal a resolutely water-based way of life, probably more than elsewhere. Harpoons and bone
hooks, found in the Faya basin, Ounianga and other places\textsuperscript{43} support the hypothesis that fi-
shing, and navigation played an important role for the populations having occupied Borkou
during wet periods. At the same time, in regional rock art, angling (Fig. 28), harpooning (Fig.
15) and cat-net fishing (Fig. 16) bear witness to the variety of methods used, often from of a
boat.

\textsuperscript{42} Gauthier Y. 2018.
\textsuperscript{43} Huard P. and Massip J.-M. 1964, p. 105-123; Courtin J. 1965, p. 70-75.
Fig. 27: Taïtroa. Canoes and monochrome people. Two of them bearing long appendages similar to those found in Artchana II (Fig. 18) (© Y. Gauthier).

Fig. 28: Tohil. Line fishing from a canoe. Two fish are caught. 1'T 28 cm (© Y. Gauthier).

A major discovery contributes to the timing of navigation in the Sahel and, as far as we
are concerned, in Borkou. In 1987, a perfectly preserved monoxyl canoe was found in fluvial sediments at Dufuna, on the Komadugu Gana (Nigeria), a river several kilometers wide at this location. In the Holocene, it fed the Megatchad, a hundred kilometers downstream. Independent dating of two different fragments of the boat place it at more than 6000 BCE, at the time when Lake Megatchad was at its highest level. In Breunig’s opinion the degree of technical skill shown in the construction of the canoe indicates that it was far from being a primitive model, proof that navigation had already been practised there for some time (1996), be it in Chad or elsewhere.

Fig. 29: Cultural and climatic data in Borkou (Chad) during the Holocene: evolution of lake Megatchad (black); shrinking of Kaortchi paleolake (blue); probable periods of navigation and fishing (green), enclosures (orange), cattle herding (red), dromedaries and wells (yellow), hippopotamuses (violet). The period of the probable production of the paintings of canoes in Artchana II (Gauthier 2020) is indicated in green. Chronological data from neighbouring regions (vertical lines): Niger crescents (blue), ancient, domesticated bovines (red) and the Dufuna canoe (green) (© Y. Gauthier).

Given the geographical and environmental context of the time, it is reasonable to expect that a fairly rapid diffusion of the concept of navigation took place, from the south to the north of the Megatchad, in a few centuries at most, during the high-water phase (Fig. 25 and 13). For the moment – until and unless an even older boat is discovered – we can consider that navigation and fishing probably appeared in the Faya basin and on the big lakes of Borkou about 8000 years ago. In any case, an intermediate step is provided by the paintings of the shelter of Artchana II which clearly illustrate these two activities⁴⁵: the location of the site, on a peak which dominated lake Megatchad, leads to the hypothesis that these paintings were most likely made during the high-water phase (*ibid.*) 5500 years ago or more (Fig. 25).

5. Discussion and conclusion

The areal approach has led us to attribute the construction of the keyhole monuments (KHM) on the one hand and the production of Iheren style paintings and engravings on the other hand to the same cultural group present in the main massifs of the central Sahara (Immidir, Ajjer plateau, Ahaggar, Tadrart and Akukas). The most notable consequence of linking these elements together is that we can date indirectly the subset of images whose temporal boundaries were previously unclear. At the same time, a similar analysis likewise concludes that the Messak style engravings were made by the builders of the corbeille monuments whose range extends from the Messak to the Aramat region (NE end of the Ajjers plateau) and includes Tadrart and Akukas. Here again, the linking of the two phenomena makes it possible to date more precisely the Messak style engravings whose period of production is defined indirectly by the ten or so dates obtained on the corbeille monuments.

The territories occupied by these two distinct groups are mutually exclusive with a transition zone of a few tens of kilometers. However, there is a gap of more than five centuries between the oldest KHM and the most recent corbeille. It was therefore not the painters of the Iheren style images who limited the Messak engravers in their quest for territory to the East and center of the Ajjer Plateau, but their predecessors. The analysis of distribution areas shows that the latter are most likely to be the creators of the paintings in the RH style. There is a high probability of there being a connection between these two groups (RH>Iheren).

An important consequence of this analysis is that we now have a terminus *ad quem* for RH style paintings, the end of which probably coincides with the beginning of the Iheren style paintings (Fig. 12). In this we think we have fulfilled (partially) one of the wishes of Le Quellec (2013: 34), which was to «refine the stylistic classifications by using the documentation already available ».

In a completely different context, the introduction of the climatic factor into the study of cultural data leads to the establishment of a chronological table and a periodization of rock art of Borkou (Fig. 29), a region rarely studied in academic publications, of which the

⁴⁵ Gauthier Y. 2018 and 2020.
majority appeared in the 1960s and which contained unreliable recorded data\textsuperscript{46}. The new documents shed new light on Borkou’s complex history and reveal relatively clearly the radical changes in the lifestyles and livelihoods of the groups that occupied it.

Navigation and fishing, the origins of which possibly lie in the Sahelian provinces and the present-day Lake Chad region, probably appear at the turn of the 6\textsuperscript{th} millennium BCE and have been widespread for millennia in the Faya basin and on the string of lakes located between Faya, the Ounianga lakes and southern Tibesti. Their relative rarity in rock art, the absence of remains of boats and the lack of studies on the paleolakes and the basin of Mega-Thad prevent us from following the evolution of these activities. Neither can we correctly determine the moment of their disappearance. The only clues in our possession are some superposed layers – always the same, cattle over boats – and the fact that fishing and navigation never coexist with cattle breeding in the same scene.

Pastoralism seems to appear later, possibly at the beginning of the 5\textsuperscript{th} millennium, if one refers to the situation in neighbouring countries, perhaps a little later. It was fully developed when the regression of Megatchad Lake began around 5,500 years ago, marking the appearance of enclosures in which domestic cattle are confined. Was cattle-rearing introduced into northern Chad at the same time as the enclosures were built? We cannot formally prove it, but the hypothesis is worth taking seriously. We do not have any clues regarding the age of the (older?) enclosures located in the NE of the spread, at a shorter distance (~ 900 km) from the Egyptian sites which contained the oldest remains dating to about 8000 years old (Fig. 13): Cattle breeding moved from Egypt to the Sahara and to northern Tibesti\textsuperscript{47}, and was perhaps accompanied by this form of habitat and animal husbandry.

Rock art attests to a decrease in the importance of this activity over time: it is indeed hardly present at all in the most recent layers, but it has not completely disappeared from northern Chad. We have occasionally met small herds near the great gueltas of the neighboring Ennedi and we do not know if there are any left in the Borkou. However, a subtle change has taken place: rock art shows cattle without humps while those observed in the field or on some recent paintings have humps.

At the period when camels first arrived, despite the drastic changes in climate, some hippopotamuses may well still have been alive thanks to the persistence of small lakes north of Faya. A lack of fodder and the practice of hunting over a long period – as illustrated in the paintings at Archana – were responsible for the animals’ extinction.

As the last hippos disappeared, the people had to dig wells in order to find the water they could no longer find on the surface. Rock art illustrates a change in lifestyle, rarely expressed elsewhere in the Sahara. Several irrigation scenes - most likely set in the nascent oases - bear witness to the timid beginnings of agriculture and foreshadow the current panorama.

\textsuperscript{46} Gauthier Y. 2018.
\textsuperscript{47} Jousse H. 2004.
The contrast is therefore striking between the humid atmosphere of the mid-Holocene, with an area covered with lakes and marshes, crisscrossed by fishermen on their boats and the current situation, a mineral universe where only a few oases survive.

Further studies and fuller listings will be required in order to refine our knowledge. The present analysis has highlighted the gaps in our knowledge when it comes to the dating of habitations and funerary monuments. There are indeed numerous types of habitation and monuments that defy dating and others for which we have only rare dates, or which are restricted to a single geographical area. This means that we are unable either to date more precisely their time frame or plot the extent of their spread especially when it comes to those examples, which cover the greatest area. A second area to be studied concerns the evolving morphology of the lakes, which in turn determines the pattern of population settlement.

The areal approach can successfully be applied in other fields of enquiry and to other geographical areas.

Photos, drawings & CAD: Christine & Yves Gauthier

Acknowledgements

The inventory of painting sites in the Round Heads style and Iheren style is a collective work done with Jean-Loïc Le Quellec and Frédérique Duquesnoy: I would like to thank them for their precious help. And I am indebted to Monique and Ceri Crossley who did the translation.

Bibliography


Monuments, paintings and lakes: areal study in central Sahara and in Borkou during the Holocene


Huard P. and Massip J.-M. 1964, Harpons en os et céramique à décor en vague (wavy line) au Sahara tchadien, BSPF 61, p. 105-123.


ملخص

الصور الجدارية التي لا شك أنها تساهم بشكل كبير في معرفة تاريخ سكان الصحراء، تفتقر إلى التأريخ. نتيجة لذلك، فأنه من الصعب استخدامها في عملية استعادة تاريخ الاستيطان وإبراز التفاعلات الممكنة بين المجموعات البشرية. في حالة عدم توفر تأريخ مباشر، نقترح نهجًا بديلاً يعتمد على دراسة مناطق توزيع الظواهر الأثرية المختلفة. يمكن تأريخ مرحلة معينة من الفن الصخري بشكل غير مباشر إذا كانت مرتبطة بنوع من المعالم الأثرية المؤرخة، كما هو الحال مثلاً بالنسبة للمعالم المسمى «ثقب المفتاح» ورسومات أسلوب «إهرن». وهذا المعالم ذات شكل السلة والتفصيل بنمط «الماسك». تظهر هذه المقاربة إمكاناتها الكاملة إذا قمنا بربط البيانات الأثرية بالعوامل المناخية. بالنسبة إلى «بوريكو»، فإن استعادة مسار ومستوي البيئات القديمة (الباليولاك) خلال الهولوسين يجعل من الممكن شرح التوزيع غير المتجانس للحظائر «كرال» وبالتالي التمكن من تحقيب الرسوم الصخرية.

الكلمات المفتاحية: الصحراء الوسطى، بوريكو، الفن الصخري، الكرونولوجيا، الباليولاك، الحظائر (كرال).