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Constraints and stakes in enhancing archaeological landscapes in the digital age

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Abstract: From the early 1980s, UNESCO has designated some of the world's immovable masterpieces of archaeological interest as a World Heritage of Humanity. Some sites, here described as "archaeological landscapes", are inseparably natural and cultural in nature, being deeply connected both to their ecological and geological environment, and to their cultural background both ancient and modern, including their economic and tourist potential. This multifaceted nature comes with specific natural and anthropogenic threats, as well as specific constraints on their preservation and enhancement. This celebrated but fragile heritage has recently benefited from the advances of the digital revolution, in the context of an "open society" approach to cultural assets. Through digital "copies" of archaeological sites and their environment, both online and as 3D replicas, such properties are today being preserved, examined, and circulated to the public on a global scale. Simultaneously, current trends in several disciplines dealing with heritage have started to question patrimonialization processes by addressing major anthropological and ethical issues. Within this transitional context, we here examine the case of archaeological landscapes, from the combined viewpoints of integrated management of heritage promotion, preservation, awareness-building and local economical development, in the perspective of present-day trends in museum science and patrimonial anthropology.

Keywords: Archaeological landscape; mixed heritage; global patrimonialization; local enhancing; Geopark; 3D reconstruction

Introduction

*"Every time a piece of world heritage is obliterated, public opinion feels disgusted."*²

Since 1972 when UNESCO started to register and enhance the treasures of world heritage, mankind's adventure on this planet has taken on an unprecedented depth and significance. Simultaneously, those properties, spaces and knowledge that pertain to the collective identity, laden as they are with important social, symbolic or sentimental values, have gradually been brought to the core of political, economic and community values. Today there is such a thing

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² Quoting Yves Uberlmann, interviewed by with Siegfried Forster for RFI, 16.12.2016

as a common heritage of mankind, which we need to bequeath to future generations, “either in their original state, or transformed, or recreated” (Cormier-Salem & Guillaud, 2016:257). Be it as a political instrument, as a source of identity or as an economic asset, enhancing heritage has become a major means of self-assertion, recognition and even development for societies. Its translation into words or ideas is therefore today a crucial problem for which there is no universal solution, both because “heritage” can have quite different meanings, and because it is grounded in immensely diverse identity but also geographical and ecological contexts. Indeed, since heritage can be tangible as well as intangible, natural as well as cultural, movable as well as immovable, many scientific disciplines have put the isolation, valuation and long-term preservation of various types of heritage at the heart of their approach.

Here we will discuss a particularly fragile type of heritage: immovable archaeological heritage, i.e. heritage from a distant past (sometimes dating from long before recorded history) of which no part can be removed without disrupting its semantic integrity. Both because they are directly connected to the history and evolution of a society, and because they are set in its present-day territory, such archaeological remains, take on a variety of values in current community and political contexts which may expose it even more to deterioration or even deliberate destruction.

Except when viewed uniquely as architecture, irrespectively of its local environment, immovable archaeological heritage is indissolubly natural and cultural, inasmuch as it tends to merge with its support and its surroundings, i.e. to become “mixed” in UNESCO terms; moreover, such landscape bound sites are to be approached as “archaeological landscapes”. The combined result with which the archaeologist or spectator are confronted today is the unique testimony of a specific moment in the evolution of mankind, both as a cultural and social being, but also in physical and symbolic interaction with the global or local history of the planet and the environment. Moreover, archaeological landscapes are significant to both archaeologists and ethnoarchaeologists, who investigate them in a horizontal perspective of relations between artefacts (anthropic phenomena), and to geologists, palaeoclimatologists and geophysicists, whose vertical, chronological approach centres on ecofacts (of animal, vegetal or mineral origin).

Recent transdisciplinary trends attempt to bring together the activity of those two main sections of archaeology in order to investigate the landscape-bound relationship between cultural or symbolic artefacts and their natural environment, and hence to work out a complete understanding of ancient human occupation. This applies, amongst numerous fields and ancient traces, to the abundant instances of artistic expressions on rock (Clottes, 2002), here

on in referred to in short as “rock art”. Today, the valuation and preservation of this type of heritage concerns not only those disciplines that pertain to archaeology and history, but also museologists since, as the symbolic legacy of ancient cultures occurring in the territory of present-day populations, this archaeological heritage elicits a strong sentimental, historical and intellectual appeal to various audiences. Nor are scientists the only ones concerned: in addition to the public, who may turn it into a full-scale economic asset, various preservation, cultural and educational institutions, along with neighbouring populations, also play key roles.

In today’s amply documented context of accelerated, worldwide destruction of this heritage, in areas that are sometimes remote and sparsely populated, and often at the centre of symbolic, territorial or identity issues (Girault, 2017). The digital revolution offers long term solutions, 3D model-making technology is increasingly being used for displaying, circulating and safeguarding such sites through digital copying. The sites can thus be represented in the form of physical or virtual reconstructions. Thanks to rapid progress in image capturing, model-making and internet access technologies, such archaeological heritage, which by its very nature remained hitherto confined to its support and its setting, now can be replicated, decontextualized and displayed. In this way, it can be made accessible to all those interested, along with its scientific description, thus removing the need to travel physically to the original site.

However, the very antiquity of such archaeological heritage, as pointed out by André Leroi-Gourhan (1964, 1990:18), makes it accessible to us only as a “truncated message”. Because of this constraint, and also because of its dual nature, both symbolic and territorial, working with it involves significant ethical, museological and educational issues which it is necessary to identify and set in perspective before embarking on the making of a digital copy.

In order to address this issue, we shall begin with a review of what is threatening rock art sites today, thus stressing the urgent need to implement new pathways for their long-term preservation, one of which is 3D digital copying.

Next, we shall investigate a few cases of digital replicas, pointing out their undeniable advances toward making available and opening up archaeological heritage to researchers and to society generally, but also some their limitations, either educational, cognitive, or ethical. Finally, and in the light of such considerations, we shall examine solutions aimed at local tourist management of archaeological landscapes in their environment and on their original and present situation. We shall examine instances of integrated management of heritage promotion, preservation and awareness-building, in the perspective of present-day trends in museum science and heritage anthropology.

1. Current threats on archaeological landscapes

1.1. Assessing the current situation of threats on rock art

The dangers affecting ancient rock art, whatever its nature and in whatever location, may be seen to fall into two categories. The first category includes various hazards linked to the natural environment of the sites, whether they be climatic, climato-edaphic or biological; from deep fractures in the rock as a result of alternating dry and wet weather conditions; to superficial abrasion and alteration by aeolian erosion, or localized interference from fauna or flora. Any of these agents are liable, at any point in the geological history of a site, to affect the interpretation of a group of figures, or to make them illegible, or even to make their very presence altogether invisible through the dissolution or fragmentation of the supporting rock face. For example, the colour Neolithic stone paintings at Laas Geel in Somaliland are today in a vastly variable state of preservation (Gutherz & Jallot, 2011) because the site, located at the meeting point of two rivers and which has been left unenclosed. The site has remained a grazing ground and is a natural habitat for baboons, as well as a regular nesting spot for many birds, causing massive deterioration to the painted rock walls. This is probably the case ever since the paintings were made.

Another group of external interference affecting rock art involves human actions through the course of history. These alterations are manifold and result from widely different motives, some more complex, or indirect, than others.

Some are the result of a variety of human-generated pollution throughout history. For instance, acid rains originating from industrial pollution in the mid-20th century have destroyed a major proportion of the open-air rock art of Scandinavia (Clottes, 2002). Even today, the continued expansion of agricultural, urban, and industrial activities, such as mining, as well as the increased infrastructure, is a growing threat to some major rock art groups. This is the case of Australia's Burrup Peninsula (a.k.a. Murujuga), where the world's largest concentration of rock art is presently facing total annihilation through the building of natural gas, fertilizer and even explosives factories and the associated roadworks. As of the beginning of this century, 25% of the 300 000 known petroglyphs in this complex have already been obliterated for the sake of such industrial developments (Bednarik, 2002).

It must be remembered that, in addition to direct destruction of rock art in the course of levelling the terrain prior to development industrial activity also has a remote impact on painted rocks in its neighbourhood, up to a distance of several tens of kilometres. The Egyptian site of Wadi Abu Subeira, an extensive group of carvings, some dating back to the Middle Palaeolithic, suffers not only from the extension of chalk and iron mining on the sides of the valley, but also because the constant traffic of lorries, carrying the minerals, causes vibrations that are dangerously detrimental to the integrity of the engraved surface of the rock (Storemyr, 2012).

In addition to expanding economical activity and its wake of pollution and potential destruction, military conflicts, such as occur frequently in certain parts of the world (Karamti & Girault 2017) -not to mention the increased destructive power of modern weaponry-, pose a growing threat to cultural heritage sites, whose preservation in wartime becomes secondary (Croissard, 2007).

Beside these various anthropic sources of deterioration of rock art, which may be described as side-effects of totally unrelated human activities, the patrimonial, symbolic or cultural dimension of rock art is, in itself, the reason for numerous attacks, some even considered wilful (Girault, 2017). In this context, military conflicts should be mentioned once again since, in a growing number of cases, the opponent's heritage has become a legitimate target, which one feels justified in wilfully defacing, destroying or even denying. In other cases, the very nature of the rock art (i.e. its iconic content) may invite its own destruction. For instance, throughout the Sahara region, where Islam is the prevailing religion, some sites, despite their being recognized as world heritage treasures under UNESCO, have already been vandalized or even obliterated, either because they testify to pre-Islamic times, a part of history which some would seek to deny altogether³, or because certain subjects, particularly the human figure, are considered to be contrary to the rules of Islam. In the case of the rock art site of the "Enclos des Fiancés", on Morocco's Yagour Plateau, it is the depiction of sexual intercourse that led to its destruction.

Paradoxically, while such archaeological art can be described as "fossile art" (Clottes, 2002:4), meaning it is no longer carried on by the present-day descendants of the communities which created them, other local communities have incorporated the carvings into their mythological storytelling and ritual activity (Graff, et al 2014). In turn, this may induce

³ As stated by the local expert, Abdelkhalek Lemjidi in a report to the Moroccan government. Quoted orally by Maxence Baill

occasional surface destructions through new, superimposed engravings, or even more drastic destruction of the site through digging below the rock face for perceived hidden treasures.

Finally, one must also mention deteriorations originating in the “patrimonialization”⁴ of archaeological sites and their subsequent operation and management. In the case of the upper Paleolithic rock paintings in the famous Altamira cave, which were the very first to be recognized as prehistoric art by late 19th century scientists. Deterioration was found, shortly after the opening of the cave to visitors in the 1960s. The fragile microclimate, essential to the preservation of the paintings in their original location, was already beginning to alter as a result of the flow of visitors and a CO₂-laden atmosphere. Subsequently, the curators of many painted caves across the south of Europe have felt it necessary to reduce the threats connected with human presence. In France, several approaches are presently being enforced. Certain sites, such as Font de Gaume and Les Combarelles (both in the Dordogne) are still open to the public, through certain adjustments and appropriate tourist management procedures. Others, including the Niaux cave (Ardèche) remain open only in part while certain galleries are closed to the public; furthermore caves such as Lascaux and the Chauvet cave have been placed under severe quarantine, with access totally denied to both tourists and researchers.

1.2. Accessibility: difficulties and restrictions

However, restricting access to rock art in order to preserve it, as curators have had to do in the latter cases, highlights a new category of constraints potentially affecting the future of rock art. As is the case with all monuments, archaeological rock art remains a non-entity until it is in actual contact with visitors and researchers.

As far back as the 1830s, following a *Note for the Preservation of the Monuments of Egypt* addressed by Jean-François Champollion to the Viceroy of Egypt, in which the author complained of “barbaric devastations” (Volait, 2010), a new ruling was introduced for the management of the archaeological heritage, not just as a scientific treasure but also as a vital future asset for the country (ibid). Indeed, archaeological tourism, which was for the first time sought out as an argument to support preservation, has subsequently become the largest single source of income of the country (Carabelli & Verdelli, 2007)⁵. However, not all rock art sites

⁴ By patrimonialization, as expressed in French, we mean the series of institutional processes by which a material or immaterial object becomes a heritage property, on any scale.

⁵ That was true until the 2011 events that caused tourism revenue to plummet

are able to elicit the full valuation and visibility which they deserve, and thus realize this economic potential for those countries and areas⁶.

One reason for this can be the difficulty of visiting a site. The rock art groups in Morocco's Atlas Mountains, including the Yagour Plateau, a spectacular geological area harbouring some 3,000 Bronze Age engravings, are a prime example of the various hindrances, both geographical, topographical, as well as cultural difficulties, that can work against a site. Not only do the high altitude (above 6,000 feet) and the harsh climate with alternating heavy snowfall and periods of severe heat, make the area practicable for only 5 or 6 months of the year, according to one organization promoting treks to the High Atlas⁷. These sites are in a sparsely populated area, 80kms from Marrakech, the nearest urban and cultural centre for mass cultural tourism and the starting point of treks, are poorly indicated by road signs and on maps, and lack the amenities essential to tourism. Nor, of course, are archaeologists, art historians and other researchers spared such difficulties. Further south in Morocco's Atlas Mountains, the Azrou Klane site, with over 400 engravings, is now the centre of a major interdisciplinary project, Geopark H2020 RISE⁸, aimed at cataloguing and documenting the archaeological heritage, and at educating the community on the importance of preservation. However, this remote area, where herding is still the main activity, suffers from the same environmental and climatic constraints along with a lack of accommodation and other facilities (Graff, 2014).

All too often, this is not the biggest problem facing tourism and field researchers. Political tensions of one kind or another can actually entail physical dangers. For example, access to the rock art complex at Laghchiwat, in southern Morocco (25kms from the Mauritanian border) with engraved scenes of undisputed interest and richness (Ewague *et al.*, 2016), has for long remained quite dangerous for local researchers, and out of bounds for all foreigners, due to armed conflicts between Morocco and Frente Polisario over control of Western Sahara and its resources (Rodrigue, 2011). Even today, travelling to most parts of the Sahara region is "strongly advised against" for French nationals⁹; the unsafe zone includes not only Mauretania and Mali, but also Algeria, where Tassili n'Ajjer, one of the world's largest

⁶ From International Charter on Cultural Tourism, adopted in 1999, 5.1, pp. 22

⁷ See the website www.CyberBerbere.com (in french)

⁸ The European GEOPARK project (2014/2018), led by Yves Girault, aims to study in a comparative way (North/South) the "patrimonialization" processes (for natural and cultural heritage), in a context of international labeling by UNESCO. The objective is to question the notion of "geological heritage" according to the World Network of Geoparks, using empirical methodologies on heritage data and socio-economic development dynamics of territories through geo-tourism.

⁹ From the French Ministry of Foreign Affairs website, "<https://www.diplomatie.gouv.fr/en/>" (21.03.2018)

collections of prehistoric rock art once developed as a natural park, is now forbidden to tourists and researchers both foreign and local¹⁰.

1.3. A new consideration: isolation and neglect

In addition to the various risks pertaining to the natural environment and anthropic development around rock art sites, there is a new type of danger: that of isolation and neglect. All parties concerned with the archaeological heritage are caught in a vicious circle in which local touristic and heritage issues, circulation of information on international scale, *in situ* preservation and “patrimonialization” are closely linked.

In some countries, the “patrimonialization” process just does not work and those sites are jeopardized by the refusal of international organizations to extend the protection and value that come with such recognition. To return to Somaliland’s Laas Geel rock art complex, which is currently facing potential destruction (Gutherz & Jallot, 2011), a “patrimonialization” project was submitted to UNESCO as far back as 2010, but to no avail since only countries partnered with the World Heritage Convention are eligible, which Somalia (whose sovereignty over Somaliland is only formal anyway) has failed to do, whilst Somaliland is not recognized as an independent country. This is one case where a site of obvious archaeological and natural interest is faced with neglect through improper stratification of “patrimonialization” procedures.

Yet even “patrimonialization” cannot always avert the risk of neglect. One example of this is the Drakensberg rock art complex, on the border between South Africa and Lesotho. Despite having been granted World Heritage status by UNESCO, and sourcing revenue through responsible foreign tourism to finance management, operation and preservation activities (Smith & Duval, 2013), and although tourist accommodation is available (albeit still under way in part), the site, which at present attracts only one in ten tourists visiting this region (ibid), is in dire need of visibility, both locally and in tourist information centres etc., as well as through dedicated travel websites. Since tourism revenue is the main, or even sole, source of income for this site, this is detrimental to both the local communities involved in the responsible tourism scheme and for preservation activities, which require sizeable funding given its extent and its natural and cultural importance, which can only lead to further isolation.

¹⁰ As stated by Malika Rachid, 2015, orally quoted by Gwenola Graff

The marginalization of such sites in the scientific world is no less worrying. The complete closure of certain areas of archaeological interest to scientists either local or foreign (as in the case of Algeria), and to the newest techniques and methods of research, is both a major hindrance to the advancement of science on a global scale and a threat for their preservation, whether they be known or as yet undiscovered. In the latter case, those areas will not benefit from the latest advances in archaeological exploration work through state-of-the-art technologies and up-to-date scientific expertise; if even duly discovered, operated and even “patrimonialized” rock art sites are still exposed to environmental and anthropic hazards, as we have learnt is indeed the case, prospects are even more dire for the undiscovered wealth of rock art of such restricted areas. As for those sites that are already known to science, the impossibility to acquire and publish fresh, up-to-date data is a significant blow dealt to the advancement of research, since technological and methodological progress constantly makes it possible to obtain ever better data and knowledge on parietal sites in their original surroundings. Moreover, those data are essential to model-making on a global scale; when such inaccessible sites are thus excluded from this process, this is not only a source of biases in scientific work, but will also push those sites out of the scope of science, which in the long-term can only lead to their neglect.

2. Heritage and educational value of replicas VS. actual sites

2.1. 3D replication to the rescue of threatened sites

Ever since its advent, photography has proved a valuable aid to document art in general and archaeology in particular, enabling one to carry the work “into situations where the original can never be found” (Benjamin, [1939] 2000:255) and thus convey it to audiences. In the context of today’s digital revolution, new technologies take on a major role in capturing, recording, analysing and reconstructing archaeological sites (as well as in everyone’s practical life) and digital capture has asserted itself as a key documentary tool and means of exchange for researchers, and also a means of mediating it to the public. In addition to procuring a new type of scientific and patrimonial archive, it allows us to see and make seen, but also to share successive interpretations and thus provide a constantly up-to-date reality (Pinçon & Geneste, 2010).

In the case of rock art in its own natural and geological surroundings, digital copies and 3D replication (provided the technology can include both the work itself and its environment) may in some cases make it possible not only to preserve them from various natural and anthropic interferences, which “patrimonialization” is not always enough to avert, it also allows us to “sanctuarize” them by restricting access (both for caves and in open-air situations), while still allowing us to freely circulate its scientific content and public appeal, and maintaining the essential semantic connection with its environment.

Improvements in the capture and retrieval of data through a choice of topographical survey techniques now allows this process to be carried out in the minutest detail to the full extent of a rock art site and its immediate environment, without the sensory and cognitive biases of the human observer. This is particularly the case with the Google Street View project, which aims at capturing the work and its surroundings in their full extent and complexity. Several major heritage monuments and their natural setting are already accessible worldwide via the internet as complete or partial reconstructions, including such prominent names as the Inca citadel at Machu Picchu in Peru and the the main temple of the Angkor-Vat complex in Cambodia.

2.2. From communication tool to awareness and educational aid

The value of dematerialized 3D replicas of a mixed site has opened a wide field of research and innovation for their appraisal and accessibility, mostly on a global scale intended for mass tourism. With regard to museums and other mediation institutions, technological progress and its gradual appropriation, 3D makes it possible to interpret and present heritage items in a multitude of ways. In accordance with the multiple aims of museums and exhibitions, including the educational, one may integrate into the presentation a variety of approaches of growing complexity in order for any specific audience to fully comprehend the subject.

France’s Lascaux cave, with its celebrated upper-Palaeolithic colour paintings, has become a full-scale creative laboratory for digital and physical replication in museums and other institutions, including tourist facilities, ever since the closure of the original site in 1980.

Initially, one very fragmentary facsimile was briefly shown at Paris’ Grand Palais. Then a second reconstruction was made in 1983, and is known to this day as Lascaux II¹¹. Again, this

¹¹ Opened in 1983 near the original site, the facsimile - Lascaux 2 - has become the most visited site in the Dordogne. Built on this success, the production of a movable facsimile - Lascaux 3 - was launched in 2010, at

reconstruction concentrates on the two most acclaimed panels, of which surveys and images were already widely circulated, and, albeit on a small scale, replicates both the paintings and their rock support, if not the actual environment of the subterranean system. Suited and arranged to welcome all types of visitors in whatever number, the exhibition also includes an extensive illustrated introduction area to the history of both the cave and its replica, whose setup and mediation is designed to highlight and contextualize those features of the original which are deemed most relevant to any specific audience, as well as to address the partial nature of the reconstruction. Visitors, far from shunning Lascaux II as a mere substitute, flocked to what was acclaimed as both a major piece of world heritage and a scientific and technical masterpiece, establishing it, with more than 250 000 visitors in 2015¹², as the most widely visited tourist site in the Dordogne.

In a natural progression away from the constraints of the original, Lascaux III (2012) was conceived as an exhibition travelling across four continents. In addition to a museum presentation that, like Lascaux II, brings an essentially thought-provoking experience, it includes highly interactive displays and mobile digital guides.

Finally, the International Centre of Parietal Art, established in 2017 in the immediate vicinity of the original site, offers a complete facsimile and walks visitors through an immersed experience, emulating as faithfully as possible the cave just as it was prior to its closure, utilizing interactive tablets.

One limitation, however, remains unchallenged; the approach is essentially visual, just as in the caves themselves, where some sections lie out of reach and the fragility of the rock support renders them untouchable. Yet, the life-size copy of the Roc-aux-Sorciers rock shelter, obtained from digital 3D data, includes the possibility for visitors (especially the visually impaired) to actually touch the carved surface, making for an immersed experience that takes them right into the upper Palaeolithic era. Indeed, it often happens with European parietal art that the figures play upon the undulation of the rock-face to create an effect of movement, shadow or perspective. Here, tactile contact, in its full sensory intensity, provides a fuller grasp of the work and highlights its nature as a ‘mixed’ heritage; 3D reconstruction allows a

the initiative of the Dordogne General Council. Lascaux 3 was exhibited for the first time in 2012 in Bordeaux, before being exhibited abroad. In addition, a new facsimile of the entire cave, the Centre international d'art pariétal - Lascaux 4 - opened its doors in Montignac in December 2016, on the outskirts of the cave.

¹² According to the statistics from the *Comité Départemental du Tourisme de la Dordogne*, and from the *Observatoire de suivi de l'économie touristique*, 2016 edition

much more befitting experience and understanding than with the fenced-in, untouchable original.

2.3. Limits of 3D copying regarding preservation and valuation of archaeological landscapes

Copying and/or reconstructing an immovable, “mixed” (i.e. landscape-bound) piece of heritage involves specific constraints deriving from the equipment required (photographic, digital or other). Photogrammetric coverage of a rock art site by ‘image archaeologists’, e.g. as part of creating a Geopark, involves a GPS survey of the surrounding area with the aid of a tachometer. Such equipment is not only heavy and cumbersome, some Saharan countries including Morocco, Algeria and Egypt have made it illegal to import drones and forbid their operation for leisure or professional purposes alike. Such restrictions will also apply in several Middle-eastern countries, along with other areas harbouring prominent archaeological sites, such as the ancient Mayan cities¹³. Such biases in the technical feasibility of 3D copying could lead to certain archaeological sites being marginalized or overlooked within the web-based panorama of scientific communications, leading to cultural cherry-picking under the pretence of global access (Ory-Lavollée *et al.*, 2002).

Another significant limitation to be pointed out in connection with archaeological landscapes is the importance of an actual physical confrontation between site and visitor. While the Lascaux II 3D-reconstruction may have obtained some of its success thanks to its novelty and technological prowess, Lascaux III was viewed as a relative failure in some venues. Manager Olivier Retout explains: “Both informed and general audiences expected to see a global reconstruction”¹⁴; indeed, the home page of the official website advertised: “Lascaux thoroughly revealed for the first time”, and went on to promote the total immersion aspect of the facsimile, inviting visitors to “admire and share the authentic emotion of discovering the cave [...] and reflect [on its] environmental and cultural context.”¹⁵. Interestingly, the public, once it has sated its curiosity with the technical appeal of the project, will still want to experience the archaeological site in its full semantic and symbolic integrity, i.e. against its geological and geographic setting. Indeed, the International Centre of Parietal Art has chosen to locate itself in the immediate vicinity of the original cave, and favours an open architectural style offering a close connection with the landscape. This is a complete

¹³ See the website “<https://droneregulations.info>”

¹⁴ In an interview for the *Sud-Ouest* online Journal, 01/09/2015

¹⁵ See the website “www.lascaux.fr/en”

about-turn; after replicating, modelling and touring Lascaux around the globe, the most complete reconstruction ends up sitting right at the base of the original hill and making the landscape part of the experience again.

The same trend toward ever more faithful rendering of the original is even more obvious in other reconstructions: the Pont d'Arc project, a faithful replica of the Chauvet Cave, the world's oldest painted cave known, aims at mimicking, down to the smallest detail, the temperature, half-light, acoustics and every last crevice of the rock-face, as well as its moist sheen and various eco-facts relating to the biological and geological history¹⁶. Once inside the reconstruction, only the floor signage and pathway would remind one that this is not the real thing. This tallies with the remark often heard from museum visitors, that they desire the authenticity of the original, or with Walter Benjamin's observation that "the most perfect reproduction will always miss the *hic et nunc* of the work." (Benjamin, [1939] 2000:258)

Indeed, in the case of such 'mixed' heritage as rock art sites, only a physical approach will help one to fully appreciate the natural environment, which in turn is essential for grasping its cultural significance. Studying parietal art in the Sahara has even been described as "landscape archaeology", since the meaning of the engravings depends in part on their dialectic relationship with the surroundings (Graff & Kelany, 2013; Graff *et al.*, 2014). Experiencing the landscape in its dual nature, both as a natural system and as a cultural construction, is therefore crucial also for its full appreciation, and is just not possible with a 3D replica, meaning a distinct educational and cognitive shortcoming.

Finally, 3D reconstruction also poses an ethical challenge, as with any archaeological heritage. Nearly two thirds (63%) of all properties in UNESCO's mixed heritage index¹⁷ are located in the less developed countries, while the funds to finance such projects, as well as the technical expertise, are available only in the developed world. Indeed, to the knowledge of this author, there are no instances of replicated sites exhibited in less developed countries, either in museums or in other cultural facilities, and even the long-term continuance and accessibility to the public of those would be in question. Preserving heritage properties, as 3D replicas as well as in their original location, requires extensive funding, which is provided by international bodies, who cannot help having their own set of cultural values and criteria. "Patrimonialization" could therefore be perceived, in the historical perspective of the cultural pillage in the colonial era, as a new instance of developed countries usurping the material

¹⁶ First-hand assessment and confirmed on "www.hominides.com/index.php/en"

¹⁷ See the list on the UNESCO website "<https://en.unesco.org/>"

heritage of former colonies; could not this, too, run the risk of encouraging destructive reactions or neglect?

Developing cultural value needs to take into account the political underbelly that has become unshakable about heritage, as well as the modern drive toward decolonizing heritage properties and cultural facilities, along with sustainable development.

The digital reconstruction of archaeological landscapes being thus impaired by several major educational and ethical limits, the situation calls for a serious reevaluation of the alternative option of *in situ* enhancing within a protected area, in keeping with the complex heritage, territorial and scientific aspects with which such properties are endowed. The process of “patrimonialization” needs to be anchored in a fully interdisciplinary approach, and in the active collaboration of a variety of partners on a several levels, so as not to bias their educational potential. Amongst all options currently available, UNESCO's Global Geopark program, with its focus set on three main objectives – “protection and conservation; tourism-related infrastructural development; and socio-economic development” (Azman, 2010:505) – would appear most appropriate for the enhancing of archaeological landscapes.

3. The need for *in situ* assessment of archaeological landscapes

3.1. Archaeological landscapes in the context of protected areas today

Beginning with the Yellowstone National Park (1872), the U.S.A. pioneered the appraisal of natural heritage monuments. Almost exactly one century after this vanguard move by the US Government to take into its custody this and other areas of geological interest “for the benefit and enjoyment of the people”¹⁸, UNESCO was inspired to launch its own “Man and Biosphere” program (1971) as a new tool for environmental preservation and management on an international scale (Batisse, 1982), setting forth the basic concept of nature preservation and the protection of cultural property within a combined heritage site (Gonzalez-Tejada *et al.*, 2017). The following year, the discussion of the Convention concerning the Protection of the World Cultural and Natural Heritage within UNESCO promoted that this landscape-connection between nature and cultural property is, in itself, of heritage value.

¹⁸ Quoted from the Organic Act creating Yellowstone National Park on March 1, 1872

Working within this framework, the very first Geoparks were established in Western countries. Geoparks are projects that combine protection of geoheritage, education and sustainable local development through an original, worldwide network of exchange and cooperation. Whilst the first four Geoparks, established around 2000, were all based on geological heritage exclusively, the trend is now towards a growing diversity of definitions and aims for such protected areas (Gonzalez-Tejada *et al.*, 2017: 10). Geopark sites “must not just have a geological significance, but also ecological, archaeological, historical or cultural” (Farsani *et al.*, 2011:70); of these four criteria, the archaeological is certainly not the most commonly considered. Although historically the prehistoric rock art at Valcamonica (Italy, in 1979) and the urban sites of Mohenjo-Daro (Pakistan, in 1980) were amongst the first considered, only 15 out of the current 437 parks (national parks, regional parks and other protected areas) are archaeologically significant areas, even though the word “archaeology” crops up in one form or another in the definition of 30% of all properties¹⁹. Besides, those 15 archaeological parks are all labelled purely as cultural properties, showing that the landscape-connection, which is so crucial to the preservation and recognition of archaeological art, has not found its way into the scope of international institutions dealing with heritage properties. Unfortunately, there are cases where this has been shown to be detrimental to the preservation of such sites, for example the Abourma (Djibouti) rock engravings, was added to the UNESCO’s tentative list in 2015. Despite the geological interest of the 1,500m high basalt body where the engravings are located, and of the immediate environment of the rock art sites, this property is viewed and registered as being of only cultural interest; as we can consider as a result, it is mentioned on the Unesco website that many engravings are in the process of being rubbed out by weather conditions and the impact of global warming on the surface of the rock²⁰. This should be enough to bring home the need to preserve also the immediate surroundings and the natural support of many rock art sites across the planet.

In that it approaches cultural and natural heritage collectively, the Geopark program is particularly apt to promote and preserve archaeological landscapes. In China, for instance, which has become a veritable research and development centre for this program, with no less than 37 Geoparks in 2018, 12 of these mention archaeological interest on their home page.

¹⁹ These figures based on a keynote look-up in the UNESCO World Heritage online list, 03/04/2018

²⁰ To see more information on this property : “whc.unesco.org/en/listesindicatives/5957/”

3.2. Specific constraints on the management of archaeological landscapes

Institutional and administrative management of archaeological landscapes may present several types of pertinent constraints.

Some of them are related to the nature of the archaeological property making it essential to include all parts of the site in the protected perimeter in order to maintain its semantic integrity. Some archaeological sites come within easily definable physical or symbolic boundaries, as with urban centres such as Tikal (Guatemala), a prime example of Mayan art and architecture, whose classic boundaries have become those of the national park. Yet in other cases, the criterion for regrouping a set of archaeological sites rests on material traces showing that they belong to the same ancient culture or identity. The mixed Rock Islands Southern Lagoon – or Chelbacheb – site (Palau) is home to not only many wooded limestone islands and a coral reef, but also archaeological remains and rock art sites, scattered across two separate island groups over a total area of 1,000km². Preserving and developing such an extensive domain therefore requires facilities, infrastructures, finance and human input on a much larger scale than with smaller properties²¹.

Other possible constraints will relate to the dual nature of the property, both natural and cultural. On the previously mentioned Tassili N'Ajjer mixed site, a unique, technically coherent set of paintings and engravings spanning a period of over 10,000 years, stands next to ancient crystal structures and sedimentary successions. This site comes now entirely under a set of organization and management rules outlined by Algeria's Ministry of Culture pursuant to the Law n°98-04 on Cultural Heritage, which now applies to "all areas remarkable for (...) the importance of the cultural properties located there and inseparable from their natural environment"²² (Art. 38:7), and provides that, whether they be prehistoric rock art sites or present-day urban areas, they must be managed under a global land development system. At the other end of the spectrum, South Africa's Maloti-Drakensberg Park, which houses a combination of rock paintings and remarkable geological support, is run through a dual management system involving different agencies and government departments including environment or culture, all of which makes the project singularly complicated to manage (Smith & Duval, 2013).

²¹ To see more information on this property: "whc.unesco.org/en/list/1386/"

²² To see the complete draft law : "www.cnrpah.org/pci-bnd/images/loi98.pdf" (in french)

Yet another major source of constraints relates to the real estate value and ownership of the protected area and the archaeological area. Geopark programs aim to trigger awareness and local property management with neighbouring communities, but scaling management at a local level only, where community and identity concerns come into play, as well as territorial and economic issues, can only lead to failure (Barthes *et al*, 2014). On the other hand, a fully international approach to property assessment and management is today viewed as archaic; in current debates amongst heritage anthropologists, emphasis is put on promoting cultural diversity as opposed to a restrictively global notion of heritage (Cormier-Salem & Guillaud, 2016). Finally, in cases where the archaeological heritage is associated with minority cultures or their territory, or to marginal sections of a country's territory (such as border areas, disputed areas or military zones), national authorities cannot reasonably be expected to engage, promote, manage or maintain "patrimonialization" processes with the same degree of dedication as in the case of properties pertaining closely to the core identity of the country or to its key economic or political assets. Nevertheless, the contrary may occur where archaeological sites and areas are strategically situated on or close to the international border that separates two modern states. An interesting contrasting instance can be mentioned in the case of the Santa Ana-La Florida site, located some 60 kms away from the modern frontier between Ecuador and Peru in the upper Amazon. Most of this region had been under scrutiny and border conflicts between the two countries for the past 200 years. After the 1999 peace talks the area was opened to the public and archaeological research began on the Ecuadorian side in 2001. By 2002 a series of early sites were found along with a major ceremonial center. Further research on the sites showed that all were part of a newly discovered pre-columbian culture that extended its cultural area beyond the modern international border all the way to the Marañón, a major affluent of the Amazon. The Mayo Chinchipe-Marañón culture was recognized on both sides of the border and investments were made to study and preserve the unique architecture that characterized at least two major sites. Ecuador spent some 700 000,00 US dollars protecting and valorizing the Santa Ana-La Florida site (Valdez, 2008; 2014; 2016; Olivera Núñez 2014).

A workable, sustainable course of action requires involving partners on many levels. One example of this is the ancient Han dynasty administrative capital set in the unique natural environment of the Nine Bend River gorges in China's Mount Wuyi Region, a valuable cultural asset to both local populations and society at large. Whilst being included in UNESCO's mixed world heritage list since 1979, it is also a natural reservation under state

control and ownership, managed under Fujian Province's strict code for heritage management. Conclusively, local administrative bodies, as well as a follow-up centre, periodically assess the status of the archaeological property and the natural environment as well as the conformity to legislation. Such a multi-level management system, in addition to promoting awareness, has led to both a sustained high level of conservation and an influx of foreign tourists²³.

Sometimes, the space may even extend across more than one country or continue into a separate protected area. Such is the case with Tanzania's Ngorongoro Conservation Area (mixed world heritage)²⁴, which extends into the Serengeti National Park as well as to other sections of the Serengeti-Mara ecosystem. In an area of such rich archaeological potential, situated as it is in the birthplace of our species, and with ecosystemic, archaeological and landscape connections extending all around, neighbouring partners must collaborate in constructing the story through which to build awareness and promote the site to audiences.

Finally, every Geopark should take into account experiences and information from sister institutions and likewise share their own: heritage projects as a whole do need to work and speak together if progress is to be achieved in "patrimonialization" processes (Mc Keever & Zouros, 2005). On a related note, it has been observed that some heritage properties had deteriorated in the first stages of their opening to visitors. Morocco's Arganaia Biosphere Reserve, established in 1998 under UNESCO's Man and Biosphere program, was never properly assessed until ten years later, when the first UNESCO survey (2009) found that irreparable damage had already been inflicted as a result of urban development (El Fasskaoui, 2009). Moreover, the principle policy to integrate tourist attraction and local economic development was never implemented (ibid: 16). In the case of archaeological landscapes, such a lack of follow-up is a threat to both the integrity and preservation of the property and to its long-term conservation and enhancing. Indeed, in today's context of shifting the focus of cultural valuation from the object itself (as viewed by curators) to the expectations of society, attendance and visitor satisfaction studies are essential to adjusting reflexive contents. Regarding Geoparks, as well as protected areas in general, this would suggest that too little attention is being paid to the long-term tourism viability of the properties (Gonzalez-Tejada et al., 2017).

²³ To see more information on this property: "whc.unesco.org/en/list/911/"

²⁴ To see more information on this property: "whc.unesco.org/en/list/39"

3.3. An interdisciplinary approach to building educational projects

Interdisciplinarity must be put at the very core in developing reflection and mediation about archaeological landscapes. Indeed, Earth and human sciences (i.e. archaeology and heritage anthropology) must each contribute from the very point of delimiting the site area so as to establish a unit that will both be logically consistent, and therefore clear to outsiders, and allow its integral preservation. The Rock Islands Southern Lagoon (or Chelbacheb) protected area is a prime example; the perimeter is primarily that of the coral-reef ecosystem that attracted human settlements over the last 3,000 years, but it also takes into account oral tradition, myths and traditional (island and marine) toponomy, all of which help assess the ancient and current symbolic boundaries of the cultural property¹⁶.

Taking into account the whole culture as well as topographical, ecosystemic, and geological criteria in the delimitation of the property is crucial to mediating it. Attracting visitors is central to Geopark managerial approach. In this context, educational and scientific contents will both promote learning about the property and also make the visit a more fulfilling experience. In a mixed site geotourism, whose main task is “the transfer and communication of geoscientific knowledge and ideas to the general public” (Gonzalez-Tejada *et al.*, 2017: 9), and cultural tourism need to integrate their mutual objectives. When operated as tourist sites, heritage properties become meaningful on three levels: the historical, the cognitive and the emotional (Davallon, 1992 : 72). In the case of archaeological landscapes, all three must be presented jointly: the historic and cognitive values (i.e. the antiquity of the archaeological site) merge together. The figure itself hints at the thinking and traditions of an ancient culture, while the choice of the subject and its location yield essential information regarding how that culture used and viewed the landscape (Graff, *et al* 2014).

The rapport between the ancient landscape in the visitor’s imagination and the actual landscape which he experiences can even be put across in the educational message, thus encouraging visitors to reflect upon the evolution of the landscape through time and enhancing the emotional value of connecting with the original site. Such a scientific and cultural project and mediation, in addition to conveying historical, reflexive and highly sensory contents to visitors, will also promote awareness regarding the future preservation of the property. For instance, in the project of Angola’s Tchitundu-Hulu archaeological site, on UNESCO’s world cultural heritage tentative list since 2017 and host to a vast collection of rock engravings made by the San people, whose current descendants are still found in neighbouring communities, approaching the rock art in a perspective that encompasses

current cultural aspects would establish a connection with religious traditions and myths still connected to the engravings, and encourage visitors to consider the landscape in a diachronic manner and become aware to the major issue of heritage preservation, which is the objective of any protected area²⁵.

Finally, the interdisciplinary approach brought to bear upon the delimitation of the archaeological area and its educational content must be maintained as the project and its scientific and cultural program as the project evolves and adjusts to changes in its environment, in order to withstand the sterilization of heritage that comes with “sanctuarization” (Crenn *et al.*, 2014). The virtuous cycle linking heritage preservation and public valuation must include research activities in a constant process of acquisition of knowledge. On the one hand, this will improve the historical and cognitive content and its reception, and also secure its future as a tourist venture and as a place of scientific research. In many protected areas, research activities such as archaeological digs will be conducted alongside tourist development under an integrated management and in accordance with legislation on heritage preservation. Research on archaeological landscapes, all the more since it belongs with both Earth and human sciences, can and must transcend its niche in the distant past and take a firm footing in present day culture and science. Publishing the knowledge thus gained, both globally to researchers and locally in the context of tourist valuation, makes the heritage dynamic while simultaneously enhancing awareness on preservation issues.

3.4. Local integration: what is at stake and where things stand

3.4.1. Creating “territorial awareness”²⁶

While we have seen that the touristic development of archaeological heritage is a potentially important source of revenue, visibility and employment for the countries involved, it is equally obvious that protected areas of archaeological interest are very unevenly distributed according to the geopolitical situation of those countries, vis-à-vis the classic North/South divide in economic development²⁷. Geoparks in particular, with their emphasis on sustainable local development, may seem to be rather evenly distributed between

²⁵ To see more information on this property: “whc.unesco.org/en/tentativelists/6251/” (in French)

²⁶ (Girardot 2010, in Barthes *et al.* 2014:9)

²⁷ This divide was initially called forth by Willy Brandt in 1980 as a tool to visualize and examine global underdevelopment and poverty issues; today it would require some reviewing and adjustment. Indeed, some economically “Northern” areas, such as the Ukraine, Macedonia and Moldova, currently show Human Development Index and GNP levels that would put them below Algeria, Thailand and Indonesia, whilst most Latin American countries, as well as Saudi Arabia and some Saharan countries, now enjoy levels quite similar to “Northern” countries such as Portugal or today’s “emerging” countries such as China.

economically Northern (65%) and Southern (35%) countries; but it appears that only 1 out of 5 projects have been completed in countries that may still be safely referred to as “Southern” – and no emerging countries – including only one in Africa, and none at all in the 46 “less advanced countries” currently identified in UN sources.

Yet many movements amongst politically involved field anthropologists, under the headings of “participant science” (Cormier-Salem & Guillaud, 2016), or “action anthropology”, today call out for more attention to local economic development. While these movements are mostly anchored in economically “Southern” countries (Galipaud & Guillaud, 2014), four of the ten Geoparks in those countries in 2018 (Morocco’s M'goun, Indonesia’s Gunung Sewu, Viet Nam’s Cao Bang and Tanzania’s Ngorongoro Lengai Unesco Global Geoparks) mention the appraisal of archaeological heritage on their websites.

Since 2005, the Council of Europe's Framework Convention on the Value of Cultural Heritage for Society (2005) – known as the Faro Convention – has been part of an innovative ethical paradigm²⁸ by emphasizing the primary role of the active participation of inhabitants regarding the major challenges they face (energy crisis, global warming, bankrupt economic system, etc.) (Palmer, 2009). This participation is one major objective of the Geopark program. Heritage is a part of the landscape that may be embraced by local populations in a multitude of ways. In regarding archaeological heritage in its age-old rapport with the land, the association may encourage references to genealogy, history or territory. This reference to local identity is an essential aspect in working out an agreed set of values around protected areas of archaeological interest. For example, about Tanzania’s Kondoa rock art sites, on UNESCO world heritage list since 2006, the description on the UNESCO website shows a close collaboration between locals and non-locals, not just in the construction of knowledge and in the management of the property, but also in research activities²⁹. Indeed, ancient rock art and modern living practices show strong symbolic links throughout southern Africa, exhibiting a cultural continuity that is crucial to understanding the rock art itself, and which also testifies to the importance of this heritage in today’s cultures; even today, it is both a natural resource as well as a space of symbolic expression.

In this way, involving local communities results in the creation of a network of intelligence and identity with the archaeological heritage, which in turn will favour its preservation and its recognition (Azman *et al.*, 2009).

²⁸ Unlike UNESCO, it will not focus on Science and technology to preserve European heritage, but on meanings and uses as a “social and democratic progress” in favour of European construction and a common heritage shared by citizens (Briano & Girault 2014).

²⁹ To see more information about this property: “whc.unesco.org/fr/list/1183”

3.4.2. From information to awareness, to education on the archaeological heritage

The success of a Geopark today rests on the one hand on stakeholders' awareness and appreciation towards the economic and non-economic values of heritage, and on the other hand on generating appropriate educational contents. Education in Geoparks has thus asserted itself as a means to develop a sense of identification into "responsible citizenship" (Azman *et al.*, 2010:1).

One initial key step of ensuring success is to inform the local population of the existence of a Geopark and its heritage preservation and development objectives (Gonzalez-Tejada *et al.*, 2017). Indeed, studies conducted around Malaysia's Langkawi Geopark have shown that few people are even aware of the existence of a protected area and of its boundaries; since the area holds certain resources for neighbouring communities, this lack of visibility is also conducive to unwitting encroachments that jeopardize the preservation of the area.

The next step is running awareness campaigns (Azman *et al.*, 2010), not only to foreign tourists, but also to local populations, which may prevent the sort of "dispossession" (Cormier-Salem & Guillaud, 2016:257) of the archaeological heritage, at the risk of sterilization and relinquishment by local communities (Simenel & Graff, in progress). The protected area must be made part of the everyday reality of neighbouring populations. In several Geoparks, for example in China, the Unesco websites state that awareness to the natural and cultural heritage is being enhanced on a local scale through the school system, including school trips for younger classes to the Alxa Desert UNESCO Global Geopark, collaborations between Jingpohu Unesco Global Geopark and several universities in the region, or organizing summer camps for teenagers at Taining Unesco Global Geopark³⁰.

Learning about a subject or object will strongly affect one's attitudes and behaviour regarding it (Kaiser & Fuhrer, 2003). Heritage education is an integral part of the objectives of Geoparks, and is the first step in the cycle connecting heritage valuation and preservation. Educational programmes (Pagoni & Tutiaux-Guillon, 2012) can become part of the local sustainable development strategy around protected areas. For example, in the Maloti-Drakensberg Park, the position of "custodian" is awarded to members of the local community and seeks to include them in appropriation and education processes in connection with preservation (Smith & Duval, 2013). The position is actually a form of entitlement (since independent from national authorities) with revenue sourced from tourist expenditure only,

³⁰ To consult the list of Global Geoparks: "www.unesco.org/new/en/natural-sciences/environment/earth-sciences/unesco-global-geoparks/list-of-unesco-global-geoparks/"

with the role of custodian being mainly restricted to unskilled work and maintenance tasks, as opposed to the production of knowledge or even management of the property.

Conclusion

« Today, heritage may no longer be approached as a miracle cure for the ills of the globalization and commercialization of society, of which it is, actually, an ultimate declination.” (Cormier-Salem & Guillaud, 2016: 268). Heritage, in the post-digital-revolution world, tends to be shown, published and broadcast on an ever wider scale. Parallel to the expanding democratization of culture in the Western world, heritage has come to be seen as belonging to mankind as a whole, gradually discarding geographical and cognitive barriers in a bid to bequeath it to future generations with no geographic or cultural bias.

Whilst this approach, that of an “organization destined to establish [...] an intellectual and moral solidarity of mankind”³¹, has allowed, since its advent, the preservation and promotion of many archaeological treasures and their environment, “patrimonialization” processes are today put in question. With international organizations sometimes acting alone to decide just what constitutes heritage and what to make of it and where, there is an ultimate risk of cultural cherry-picking under the pretence of making all heritage properties available to society. Online accessibility through digital copies is one instance of this trend.

Immovable heritage and archaeological landscapes here serve to highlight the general issues of these “patrimonialization” processes that today concern and bring into play a wide diversity of partners. As we have seen, a fair representation of all those agencies is required, in an interdisciplinary framework as well as on multiple local, national and global levels, in order not to sever the various cognitive, emotional and political connections which make every item of heritage a unique object, at the cross-section of the various contributions of scientific researchers, conservationists, museologists and local populations. In protected areas and in Geoparks, the issue is to maintain the intrinsic logic of the property in its connection to the landscape, both ancient and modern, so as to present it to the public as a complete whole. Advances in educational processes as well as collaborative construction and constant updating of knowledge will be the key to both keeping the cultural and natural heritage in the world of the living and guaranteeing its long-term preservation.

³¹ Quoted from the preamble of the UNESCO Constitution (Freely accessible on “www.unesco.org”)

References

- Azman, N., Abdul Halim, S., Komoo, I., 2009. Integrated Public Education for Heritage Conservation : A Case for Langkawi Global Geopark. Ainsworth, G., Garnett Stephen, S., RIMBA : Sustainable Forest Livelihoods in Malaysia and Australia, Lestari : UKM : Bangi, pp.151-157
- Azman, N., Abdul Halimb, S., Puay Liuc, O., Saidinb, S., Komood, I., 2010. Public Education in Heritage Conservation for Geopark Community. *Procedia Social and Behavioral Sciences*, 7, C, pp.504-511
- Barthes, A., Alpe, Y., Martini, G., 2014. L'importance et problématiques de la dimension éducative patrimoniale dans les stratégies de labellisation des aires protégées: l'exemple des "Géoparc". Colloque francophone international cultures, territoires et développement durable, Clermont Ferrand : Ed. de l'Université Blaise Pascal, 15p.
- Batisse, M., 1982. The biosphere reserve : A tool for environmental conservation and management. *Environmental Conservation*, 9, pp.101-111
- Bednarik, R., 2002. The survival of the Murujuga (Burrup) Petroglyphs. *Rock Art Research*, 19, 1, pp.29-40
- Benjamin, W., 2000. Œuvre, Tome 2. Paris : Folio, 459p.
- Brioso, I., Girault, Y., 2014. Innovations et enjeux éthiques des politiques environnementales et patrimoniales : l'UNESCO et le Conseil de l'Europe. *Enjeux éthiques des politiques en matière d'environnement. Éthiques publiques*, 16, 1, pp.17-37
- Carabelli, R., Verdelli, L., 2007. L'espoir d'une reprise économique à Port-Saïd (Égypte) : un rôle pour le tourisme culturel et le patrimoine urbain. Duhamel, P., Knafou, R., Mondes urbains du tourisme, Paris : Belin, pp.72-90
- Clottes, J., 2002. L'art rupestre, une étude thématique et critères d'évaluation. Occasional Papers for the World Heritage Convention, Paris : ICOMOS, 15p.
- Cormier Salem, M-C., Guillaud, D., 2016. Des Mémoires récupérées aux patrimoines survalorisés : pour une démarche réflexive sur les acteurs du patrimoine. Guillaud, D., Juhé-Beaulaton, D., Cormier-Salem, M-C, Girault, Y., Ambivalences patrimoniales au Sud, mises en scène et jeux d'acteurs, Paris : Karthala, pp.258-271
- Crenn, G., Davidson, L., Gagné, N., Roustan, M., 2014. Pratiques muséales, politiques autochtones et travail des identités culturelles dans l'exposition itinérante « E tū Ake » (Nouvelle Zélande, France, Canada), 2011-2014. Research supported for the call for projects « Pratiques interculturelles dans les institutions patrimoniales », 20p.
- Croissard, P., 2007. La protection du patrimoine culturel en cas de conflit armé : enjeux et limites du cadre international. Mémoire de fin d'étude, sous la direction de Osman M.F., Lyon, Institut d'Études Politiques de Lyon, 79p.
- Davallon, J., 1992. À la recherche du produit. Patrimoines en débat : Construction de mémoire et valorisation du symbolique. Toulouse : Presses Universitaires du Mirail, n°9, 35p.
- El Fasskaoui, B., 2009. Fonctions, défis et enjeux de la gestion et du développement durables dans la Réserve de Biosphère de l'Arganeraie (Maroc). *Études caribéennes, Espaces et aires protégés: gestion intégrée et gouvernance participative* [Online],
URL : <http://journals.openedition.org/etudescaribeennes/3711> (Consulted on 17/04/2018)
- Ewague, A., Baiba, M. M., Lhamri, M., Lemjidi, A., 2016. Laghchiwat, new rock art site south of Es Smara (Moroccan Sahara). *International Newsletter On Rock Art*, 75, pp.5-11

- Farsani, N.T., Coelho, C., Costa, C., 2011. Geotourism and Geoparks as novel strategies for socio-economic development in rural areas. *International Journal of Tourism Research*, 13, 1, pp.68–81
- Galipaud, J-C., Guillaud D., 2014. Une archéologie pour le développement. Marseille : Ed. La Discussion, 176p.
- Girault, Y., 2017. من الاهتمام بالتراث الطبيعي والثقافي إلى إدارة سياسات التراث 2017 جيرو. 36-9 التراث المقدس عالميا. في كرامتي ي.، جيرو. إ. القداسة والرهنات الجيوسياسية للتراث، مجمع الأطرش، تونس، ص 318. (Traduction) Les politiques patrimoniales de l'UNESCO : de la prise en compte du patrimoine naturel et culturel à la gouvernance internationale du patrimoine sacré. Karamti, Y., Girault, Y. Enjeux géopolitiques du patrimoine sacré. Tunis : éd. Latrach, pp.9-36
- Gonzalez-Tejada, C., Du, Y., Read, M., Girault, Y., 2017. From nature conservation to geotourism development : Examining ambivalent attitudes towards UNESCO directives with the Global Geopark Network. *International Journal of Geoheritage*, 5, 2, pp.1-20
- Graff, G., Kelany, A., 2013. Paysages gravés : la longue continuité du Wadi Abu Subeira (région d'Assouan, Egypte). *XXIth Valcamonica Symposium report*, pp.314-324
- Graff, G., Audair, L., Lemjidi, A., Ewague, A., Simenel, R., 2014. Paysages gravés: Approche comparée de l'art rupestre au sud de la Méditerranée (Égypte/Maroc). In Galipaud J-C., Guillaud, D., 2014. Une archéologie pour le développement. Marseille : La Discussion, pp.47-55
- Gutherz, X., Jallot, L., 2011. The decorated shelters of Laas Geel and the rock art of Somaliland. Montpellier : Presses Universitaires de la Méditerranée, 31p.
- Karamti, Y., Girault, Y., 2017. القداسة والرهنات الجيوسياسية للتراث (٢٠١٧) (المحرران) إ و جيرو، ي كرامتي،-. 318 ص تونس، مجمع الأطرش للكتاب المختص، (Traduction) Sacralité et enjeux politiques des patrimoines. Tunis : éd. Latrach, Tunis, 318 p.
- Kaiser, F.G., Fuhrer, U. 2003. Ecological behavior's dependency on different forms of knowledge. *Applied Psychology*, 54, pp.598-613
- Leroi Gourhan, A., 1990. Les religions de la Préhistoire. Paris : Quadrige - PUF, 156p.
- McKeever, P.J., Zouros, N., 2005. Geoparks: Celebrating earth heritage, sustaining local communities. *Episodes*, n°28, pp.274-278
- Olivera Núñez, Q., (ed.) 2014. Arqueología Alto Amazónica : los origenes de la civilización en el Perú. Lima: Apus Graph, 260 p.
- Ory-lavollée, B., Calas, M-F., Devaux, M., Chougnet, J-F., Meslay, O., Giraudin, C., 2002. La diffusion numérique du patrimoine, dimension de la politique culturelle. Report to Mme. la Ministre de la Culture et de la Communication, 143 p.
- Pagoni, M., Tutiaux-Guillon, N., 2012. Les éducations à, Quelles recherches, quels questionnements. *Spirale, Revue de recherches en éducation*, n°50, Lille : Université Lille 3, 237p.
- Palmer, R., 2009. Apport et innovation de la Convention-cadre sur la valeur du patrimoine culturel pour la société. Le patrimoine et au delà. Strasbourg : éditions du Conseil de l'Europe, pp.7-10
- Pinçon, G., Geneste, J-M., 2010. Art rupestre : la 3D, un outil de médiation du réel invisible ? *In situ, Revue des Patrimoines*, 13, 1, pp.1-3
- Rodrigue, A., 2011. La Saguia el-Hamra : contribution à l'étude de la Préhistoire du Sahara occidental. Paris : L'Harmattan, 119p.
- Simenel, R., Graff G., work in progress. Archaeological concessions in Egypt : holding up a mirror to the cultural, geopolitical, and patrimonial challenges between Egypt and the West.

- Smith, B., Duval, M., 2013. Rock art tourism in the Ukhahlamba/Drakensberg World Heritage Site : Obstacles to the development of sustainable tourism. *Journal of Sustainable Tourism*, 21, 1, pp.134-153
- Storemyr, P., 2012. The Palaeolithic rock art in Wadi Abu Subeira, Egypt : Landscape, archaeology, threats and conservation. [Online],
URL : <http://per-storemyr.net/2012/04/06/> (consulted on 20/03/2018)
- Valdez, F., 2008. Inter-zonal relationships in Ecuador. Silverman, H., Isbell, W., (eds.) *Handbook of South American Archaeology*, New York: Springer, pp.865-888
- Valdez, F., 2014. Investigaciones arqueológicas en Palanda, Santa Ana-La Florida. Olivera Núñez Q., (ed.) *Arqueología Alto Amazónica : los orígenes de la civilización en el Perú*, Lima: Apus Graph, pp. 222-245
- Valdez, F., 2016. Les patrimoines en construction, le cas de Palanda : processus et conflits autour du projet de valorisation du site archéologique de Santa Ana, Equateur . Guillaud, D., Juhé-Beaulaton, D., Cormier-Salem, MC., Girault, Y., (eds.) *Ambivalences patrimoniales au Sud : mises en scène et jeux d'acteurs*, Paris: IRD, Karthala, pp. 139-158.
- Volait, M., 2010. Dépaysements réciproques et éveil des consciences au patrimoine monumental égyptien. Humbert, J-M., *Bonaparte en Égypte : feux et lumières*. Paris : Hazan, pp.345-349