



# AURA Newsletter

THE NEWSLETTER OF THE AUSTRALIAN ROCK ART RESEARCH ASSOCIATION (AURA) INC.

Volume 31, Number 1

August 2014

31/1

## CUPULES AS BREATHING HOLES

The breathing holes hypothesis (BHH) as the primary interpretation of the global phenomenon of cupules in Palaeolithic, Mesolithic and Neolithic rock art

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**Abstract.** An important step in decoding the purpose and meaning of rock art is to determine the model of reality, or worldview which cupule-makers held. While seemingly an impossible task, in fact, one aspect of worldviews is discernible by examining contemporary funerary evidence in burials to assess the prevailing model of afterlife belief. This analysis yields evidence for a hunter-gatherer worldview of naturalistic animism, where the entire environment consists of living things. Several belief sub-systems are then strongly implied including cupules as breathing holes. This hypothesis may considerably advance our understanding of their origin, classification and purpose by Palaeolithic and Mesolithic cultures. It also explains a conceptual transformation in the function of cupules during the agrarian Neolithic due the emergence of ancestorhood, and the subsequent decline of cupule-making itself.

### Introduction

Cupules, or cup-marks, are artificial depressions in rock made in antiquity by repeated hammering the point of a usually harder stone into the surface of a softer one. They are the most common type of rock art in the world, and are found in a great many Palaeolithic, Mesolithic and Neolithic sites, as well as in the Metal and Middle Ages. Some are even pounded into granite and took many hours of work implying significant persistence and dedicated effort.

Perhaps because of their unassuming ubiquity, and because they appear symbolically mute, cupules were largely ignored in the literature until the IFRAO was formed and the members of its affiliates began to rectify the situation with a succession of papers. Yet, hitherto, the vexing issue of interpretation has remained unresolved. At the *First International Cupule Conference* held in Bolivia, in 2007, a total of 71 different interpretations were presented, grouped into 11 distinct classifications (Bednarik 2010). These are: cultic or magic, utilitarian for substances, mnemonic or markers, elements of belief systems, stellar representations, topographic elements, board games, cabalistic or logographic symbolisms, receptacles for offerings, specific symbolisms, general domestic or utility use. Despite the clamour of the 71 interpretations so far identified, very few of them have a firm evidential basis, such as those for lithophones and post-holes. Most are purely speculative, so the great majority of cupules remain enigmatic

and still require a wide interpretation which can convincingly draw upon the physical evidence.

A great many taphonomic processes have ravaged surviving cupule sites, however, it seems enough remains for the overall theme of their purpose to be deduced. The *breathing holes hypothesis* is a new interpretation because breathing symbolism or representation has remained unconsidered in the literature. This new hypothesis might at first glance be an excessive 72nd interpretation, but it goes further than almost all the others by offering observations with associated explanations for the most common but puzzling characteristics of cupules. It also offers a consistent phenomenology: how cupule-makers actually perceived their handiwork.

### Background

The background to this paper comes from research into the origins and history of religion in order to create a simple overarching model for a labyrinthine subject. To be clear, I define religion wholly as the superset of cultural structures which arise and codify afterlife belief as a solution to personal mortality. The breathing holes hypothesis may be considered a belief sub-system which existed in both a non-religious and religious context. Hence some cupules are associated with a particular prevailing worldview whilst others had a funerary purpose associated with afterlife belief, yet still consistent with the worldview.

It is very probable that early hominins noted two essential qualities to being alive: *blood* and *breathing*. Also, that the presence of just one of these essentials is not enough to animate people. The usage and fascination of red ochre to hominins globally, for many millennia, has already long been recognised (Peabody 1927; Wreschner 1980). The argument is strong that most red ochre found in the archaeological record was originally symbolic or a functional representation of blood. But what of the second essential to life, *air*? A cupped hand over someone's mouth and nose quickly makes them lifeless even when plenty of life-giving blood is present. Movement of leaves on plants shows that air animates them too. Did air have early symbolism? For me, this was a significant loose end, a theoretical Palaeolithic belief system for which no evidence seemed to exist, so I held the assumption that it was unverifiable. Then, while studying the La Ferrassie Neanderthal child burial, an unexpected insight was provided by the sepulchral slab of burial LF6. *The reason this stone was laid with cupules facing down onto human remains is why it is arguably the single most important artefact of the whole Palaeolithic*. It speaks to us from the past like a Rosetta Stone, yet is further unique in that it does not come from the hand of modern humans! When I first started my research I had a passing knowledge of cupules but was unaware of the global scale of the phenomenon. It was the LF6 artefact that led me to the rock art literature with an interpretation of cupules already crystallising in my mind, so I proceeded to look for significant contradictions. I don't find any, which is why this hypothesis is now presented for learned criticism.

### Worldviews

Every culture existed, or now exists, with a coherent worldview. This is a *model of reality* within which all knowledge (ideas, concepts and beliefs) exist. Prior to the modern scientific era worldviews also included a mechanism for afterlife as a solution to the primordial problem of personal mortality. Although some individuals and even a few cultures did not require death-denying beliefs, they were in a small minority. I submit that studying early worldviews without considering an integrated basis for afterlife belief is akin to studying the emergence of counting systems and ignoring that humans have five digits on each hand; it is an incomplete evaluation. A worldview may persist for thousands of years but natural selection of ideas within human cultures may also trigger a rare paradigm shift from one to another. In such a paradigm shift all previous knowledge is transformed or destroyed as the fundamentally different ideas underpinning a new worldview travel like a wave-front from culture to culture. There were two principal global worldviews prior to the modern era.

First, *psychological animism* (Read 1915), also *naturalistic animism* (Taylor 2010), is where the entire environment is considered to be self-aware and alive. This is *Manaism* (Maret 1909) or *animatism* firmly in its non-spiritual sense (Clarke 2006). Nearly everything in the natural world: animals, insects, trees, streams, grassy hills, clouds, the sun and moon have a quality of movement which gives the appearance of a living quality with the notable exception of bare rock. Various elements of the environment may also appear to exhibit

a form of personhood. Naturalistic animism likely predates the emergence of the *H. sapiens* species itself some 700 ka, so is presumably the oldest model of reality. Arguably, Palaeolithic humans globally, all the hunter-gatherers, held to it. Reportedly, it is the belief system of the Tasaday and Pygmies who still live in a Palaeolithic manner (Smith 1985). In this worldview afterlife is achieved by physical rebirth, identity and adulthood are lost at death where the newly deceased were expected to be reborn into the same family or tribe. Rebirth belief is implied by primary burials only, corpses curled in a foetal manner (mimicking the womb), red ochre sprinkling and offerings placed in the pelvic region which were symbolic for reproduction.

Practices indicating the emerging concept of ancestorhood begin in the Natufian culture (Pearson 2000). Skull removal and caching first appears c. 9000 BCE, at Jerf-al-Ahmar, northern Syria (Kornienko 2009). It quickly became prevalent in other nearby PPNA sites such as at Tell Qaramel (Kanjou 2009). Sophisticated mortuary traditions spread eastward into Asia and westward through Europe. They suddenly appear in the British Isles from 3500 BCE (Bristow 2001). I argue that *spirituality is a Neolithic phenomenon*, and it is the fundamental of the second or successor global worldview. The essence of spirituality (from the Latin 'spiritus' for 'breathing') is the concept of a *disembodied identity*. This is usually considered as an intangible double, for humans, existing during life and persisting after death where identity and adulthood are, to some degree, preserved. Natural objects are no longer directly alive, but indirectly, inhabited by ancestors, nature spirits or gods. These are beliefs of *animism*, and a spiritual afterlife is evidenced by secondary burials and multiple burials (ancestral shrines, *totemism*); ochre painting of dry bones, also deliberately broken ('killed') objects as grave goods intended to be sent into the afterlife with the deceased. Holistically, such funerary evidence strongly indicates that the concept of the existence of spiritual identities and the preservation of adulthood in afterlife was entwined with the Neolithic revolution itself. As spread the knowledge of farming, settlement-building and domesticating animals, so spread spirituality, becoming a hugely important feature of human cultures since. Notably, the Australian Aboriginal peoples were isolated from global developments and independently conceived of spirituality. However, unlike the rest of the world, they have a very weak concept of preservation of personal identity after death; also they never fully abandoned the naturalistic animism worldview. The Aboriginal conception of Dreaming is arguably a relic, a fusion of the belief in a living landscape inhabited by humans and spirits. The paradigm shift to a spiritual worldview was not complete in Aboriginal culture by the time of European interaction.

### Breathing holes hypothesis (BHH)

The BHH requires the following *a priori* assumptions about worldviews. It assumes that the hunter-gatherer cultures of the Palaeolithic and Mesolithic, globally, held a prevailing worldview of naturalistic animism. Also, that during the Neolithic there was a progressive paradigm shift to a spiritual worldview due to the emergence of the concept of ancestorhood in settled cultures.

| Worldview paradigm   | Landscape cupules   | Funerary cupules  |
|--|---|---|
| <p><b>1.</b> Naturalistic animism, also ‘life-force worldview’*<br/><i>Humans consider that all discrete environmental objects are physically alive.</i></p> <p>[Palaeolithic and Mesolithic]</p>  | <p><b>1a.</b> Cupule breathing brings inert rock surfaces alive, <i>completing the living environment.</i><br/>Movement and air-flow are perceived signatures of life.</p> <p>Part of a belief system: the naturalistic animism worldview</p> | <p><b>1b.</b> Cupule breathing in proximity to the remains of a deceased human ensures afterlife by <i>physical rebirth.</i></p> <p>Part of a belief system: ‘stone breathing traditions’*</p>                                  |
| <p><b>2.</b> Spirituality, also ‘spiritual worldview’*<br/><i>Humans believe that disembodied identities exist: ancestors, nature spirits and gods which inhabit environmental objects.</i></p> <p>[Neolithic to the Historical era]</p> | <p><b>2a.</b> <i>Obsolete concept.</i></p>  | <p><b>2b.</b> Cupule breathing at an ancestral site ensures afterlife, <i>spiritual persistence</i> for the deceased in an abode or realm of the ancestors.</p> <p>Part of a belief system: ‘natural spiritual traditions’*</p> |

\* Major belief systems (Clifford 2012)

**Table 1.** BHH high-level typology of cupules as elements of belief systems.

The BHH is as follows: during the hunter-gatherer worldview of naturalistic animism cupules in rock art were intended to be functional breathing holes to make rock alive. There are two types: *landscape cupules* which *complete the environment* consistent with the general worldview; and *funerary cupules* which are specific to sites of excarnation or burial. These were intended to ensure afterlife by breathing new life into the recently deceased by way of *physical rebirth*. Because of the paradigm shift from a living landscape to a spiritually inhabited landscape the earlier landscape cupules became obsolete and funerary cupules were conceptually transformed. Settled cultures of the Neolithic made *funerary cupules* in rock art at ancestral sites, where breathing rock ensured *spiritual persistence* in the afterlife.

Cupules as breathing holes can be grouped into an existing classification: ‘elements of a belief system’. However, these elements were not mere symbolisms, abstractions or pictograms, they were considered *functional representations*. Cupule-makers believed their rock art had a very real and effective beneficial influence upon their own lives, directly during the Palaeolithic, or indirectly during the Neolithic onward, by benefitting their ancestors. It is hypothesised that cupules were first hammered into bedrock, boulders and loose rocks as breathing holes intended bring such inert surfaces alive within a global worldview of naturalistic animism. Dust from hammering temporarily suspended in the air may have been interpreted as the rock already ‘breathing’ while the cupule was being made. Bringing rock alive was *completing* the environment and likely had several perceived benefits. Living rock may have helped ensure providence for hunting and foraging, it may have been considered good for general health, even a defence against mortality, as it was better to dwell in a fully living landscape. There may have been an element of control arising where a massive mountain became ‘indebted’ to humans which had populated its rocks with breathing holes, invigorating it. Similarly, the ‘protective power’ of the landscape might be harnessed in this way. Funerary cupules facilitated afterlife: breathing new life into physical remains,

originally by rebirth, then during the Neolithic, by ensuring spiritual progression.

Richard Bradley researches the 4th millennium BCE rock art sites of northern England and Scotland, mostly comprising cupules and, in many places, ring-marks. He observes:

Where the rock carvings in the natural landscape often commanded a view over the surrounding area, those found inside these cairns were turned inwards towards the burial. The funeral rites required the inversion of normal procedures (Bradley 1997).

The basis of the conceptual variation in cupule meaning, that he describes, is now apparent.

#### Further observations from the BHH

If the BHH is broadly correct then observations arising from this understanding will be consistent with the physical evidence. While accepting that there is stylistic variation between cultures, if the hypothesis is to be quickly disproved then at least some of the following observations will not be found at most sites.

##### i. *Cupules should be similar on both horizontal and vertical surfaces*

Cupule similarity, where they appear on horizontal and vertical rock surfaces at a single site, supports the BHH interpretation. If horizontal cupules were ritual receptacles and vertical ones stellar maps, for example, then two distinct sets should be discernible. At such a site, some characteristics of size, orientation, frequency, separation, associated glyphs etc., would be expected to be consistently different between each set. If the BHH holds then this latter situation is very rarely evidenced.

##### ii. *Cupules should exhibit a tendency for a maximum depth to diameter ratio*

Cupules as breathing holes imply that they should be as deep as possible with respect to their diameter. Human and animal airway orifices are, of course, deep structures so they provide a universal model to inspire this characteristic to the limit of

the hammerstone technology available at a given site.

iii. *Cupules should frequently be in pairs*

Unlike the mouth the primary function of nostrils is for breathing so it is suggested that most cupules are nostril representations rather than mouth representations. Where the size is uniform and pattern random this will remain ambiguous. However, many cupules should appear in distinct pairs. The explanation from the BHH is that these are *nostril pair* representations.

iv. *Cupules should frequently exhibit dualistic size variation*

The hypothesis of cupules as *pareidolia*, face-like imagery, becomes more successful in a modified form: where eyes are not represented, but mouths and nostrils are. Where size variation does exist, it is expected that a large cupule is accompanied by several smaller ones. In such a mixture, particularly when the smaller are very numerous or paired then larger ones were probably intended as mouth-like while smaller ones were intended as nostril-like. The BHH explains floret cupule patterns, a single large cupule encircled by smaller ones, as a mouth representation with several nostril pairs. It predicts that encircling cupules will more frequently be of an even number than odd number.

v. *Associated lines and grooves are expected to be in a meaningful context*

The BHH has one corollary which is that lines associated with cupules are attempts to represent *air-flow* issuing to and from a breathing hole. This interpretation is especially strong when lines radiate outwards from the edge of a cupule. Ring-marks and spirals are also air-flows. While a wavy or spiral line is conceptually more consistent with representing an air-flow to the modern mind, it is entirely reasonable that straight lines might also have fulfilled this role to the Palaeolithic mind. Arguably, it follows that abstract straight lines seen in Palaeolithic art are often stylised air-flows.

vi. *Cupule characteristics should be globally consistent transcending distinct cultures*

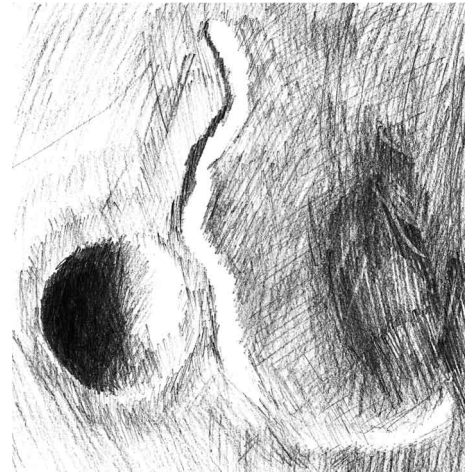
Because the BHH has functional representations from a belief system consistent with a *global* worldview, then all cultures are influenced in a similar fundamental manner. Obviously, the variations actually seen are determined locally and culturally. The principle suggested here is that of ‘common difference’ (Wilk 2004). A theme or structure is very widely, even globally shared but expressed differently by various cultures. A specific example consistent with a global worldview is the very similar floret patterns of Aurignacian cupule arrangements from Abli Blanchard, France, and Llave Chico, Bolivia (Bednarik 2008) separated by 30 000 years in time and 10 000 kilometres in distance. A further example is the Neolithic or Bronze Age floret cupules at Mt Juci, Central China (Tang Huisheng 2012). These are all convergent cultural implementations based upon similar principles of underlying belief systems. Another common global meme is that of *numerical strength*: more are stronger. Hence many cupules are more powerful than a singleton and many nostril pairs are more powerful than a single pair.

The discipline of rock art research is concerned with human-made cupules, not natural potholes which confuse

amateurs and even test experts. Yet, these natural formations, which are regarded as noise drowning out a signal, may themselves have significance. The reason is that Palaeolithic humans were likely to have interpreted natural potholes in the same manner in which they interpreted their own hand-made cupules: as breathing holes evidencing a living rock in a living landscape. Neolithic humans likely interpreted them as spiritually significant.

**Cupule typology by belief system: examples**

*Type 1a. Landscape cupules of naturalistic animism*

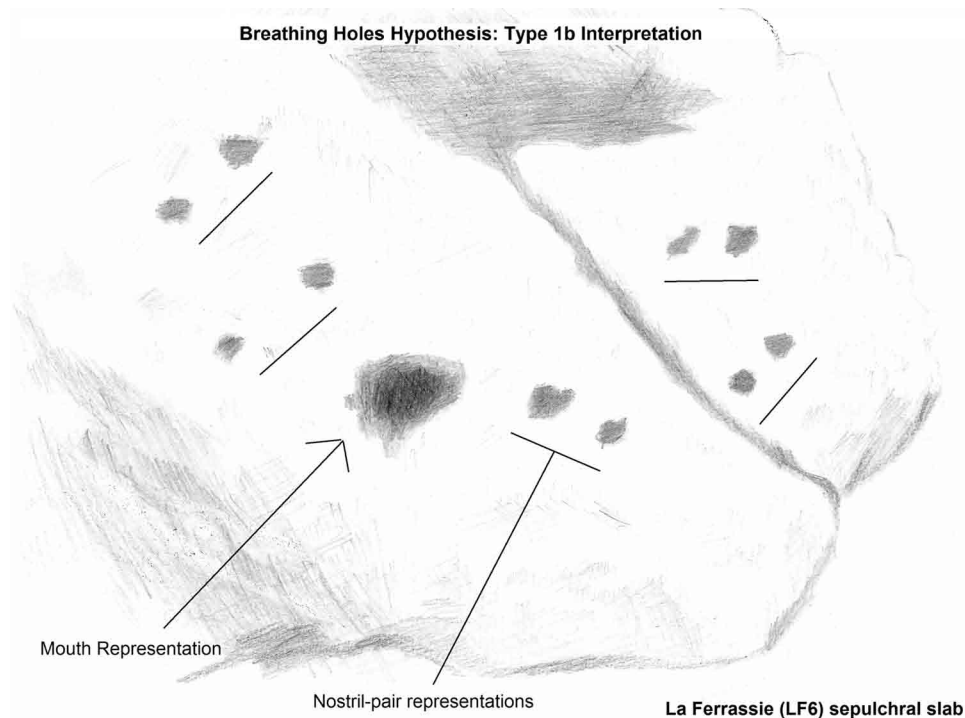


**Figure 1.** *Glyphs on a Lower Palaeolithic stone, Bhimbetka, India, offering a BHH Type 1a interpretation.*

Possibly, caves were considered as breathing holes into the earth itself, a concept providing impetus to the creation of additional, but much smaller, human-made, cupules. Auditorium Cave at the Bhimbetka cave site complex in central India yielded a boulder from *below* an undisturbed Acheulian layer (Fig. 1). It has a single cupule, one of the the oldest known examples, accompanied by a meandering grooved line (Bednarik 2005, 2006). The BHH holds that this cupule is a breathing hole and the meandering line a stylized flow of air. An archaic human devoted many hours hammering out this palaeoart for a reason. It follows that once his task was complete, is that he considered the rock had *become alive*. The nearest Acheulian site with human remains is in the Narmada Valley, notably just 40 km south of Bhimbetka. These remains (a partial cranium) are identified as *H. heidelbergensis* and date approximately 250 to 200 ka (Sankhyan 2012), also as robust *H. sapiens* about 200 ka (Bednarik 2007). The implications for palaeoanthropology are significant if such robust humans are more directly associated with the Bhimbetka cupules which imply modernity in conceptual thinking.

*Type 1b. Funerary Cupules of naturalistic animism*

The important *H. sapiens neanderthalensis* rockshelter burial at La Ferrassie, France, has cupules forming part of the grave goods of a 3 to 5-year-old child. The deliberate pit and limestone capping slab with markings strongly indicates funerary usage at about 75 to 60 ka (Pettit 2010). Most of the cupules are paired so the BHH holds them as representing *nostrils*, part of a funerary ensemble to help the rebirth



**Figure 2.** Neanderthal sepulchral slab at La Ferrassie, France.

afterlife process by ensuring that the deceased breathes again (Fig. 2). This interpretation is strengthened by noting that the slab was laid with these depressions facing *downwards* so that the rock ‘breathes’ directly onto the deceased remains. The child’s family may have felt particularly aggrieved at the loss of such a youngster and took extra measures to assist the rebirth process. Another Neanderthal child burial may have similar symbolism, at Dederiyeh Cave in Syria, dated to a contemporary period, 70 to 50 ka. There appear to be pits and dots on the edge of a stone which was placed next to the child’s skull. This is evident in a site photograph of burial No.1, but not explicitly described (Akazawa 2003). Two further Neanderthal cupule-marked stones were found at La Ferrassie; firm evidence that they had a cupule-making tradition before the similar rock art tradition of modern humans. If the BHH is correct then this is major support for the cumulative model of symbolic behaviour, and ‘*The Middle-Upper Paleolithic transition was a monumental “nonevent,” both biologically and culturally*’. (Clark 2002).

#### *Type 2a. Landscape cupules of spirituality*

The BHH holds this type to be non-existent because the *raison d’être* of spirituality itself is a solution to personal mortality. So cupules executed as *breathing hole representation or symbolism*, by a culture with a spiritual worldview, are by definition within a belief system associated with maintenance of ancestors or gods of the afterlife. In which case they have significance for benefitting the dead, and are therefore *Type 2b*.

#### *Type 2b. Funerary cupules of spirituality*

The Late Neolithic period of Malta (3500 – 2500 BCE) produced over a dozen significant megalithic structures. The original purpose of them is debated today, although ‘temple’



**Figure 3.** Megalithic temple stone at Hagar Qim, Malta.

is the usual description. Human remains have not been found at most sites; however, they were largely excavated in the 19th century which effectively amounted to site clearance rather than archaeology (Trump 2002). At Hagar Qim and Mnajdra a common motif covering rectangular surfaces of monumental stone at internal entrances and niches are ‘pit-marks’, small cupules about 1 cm in diameter. Hagar Qim yielded a well-preserved rectangular block with several hundred pit-marks and a large relief pattern of twin spirals with a central ‘nose-like’ triangular separator (Fig. 3). This conflation of symbolism is important as it links cupules with the spiral motif common throughout the European megalithic cultures. Such spirals in rock art are sometimes called an ‘*oculus*’, in which case they are considered here to be misnamed. The BHH identifies the pit-marks as breathing holes and interprets the twin spirals as air-flows from nostrils, making the whole a powerful breathing representation or symbolism believed to sustain a spiritual envelope. This invigorates spirits, maintaining ancestors, gods, or both in their temple dwelling.

## Conclusion

It was probably *H. erectus* who first developed a coherent model of reality as long as one million years ago, a worldview inherited by other archaic hominins. The simplest worldview is a mirror to self-awareness: the default assumption of naturalistic animism where all discrete environmental objects are physically alive. Arguably, they also conceived that there were two fundamentals of life: blood and breathing. Later, *H. sapiens* at least, developed functional symbolism to represent and share these fundamentals using red ochre for blood, and, as the *breathing holes hypothesis* asserts, cupules for breathing with grooves for air flow. Landscape cupules were then created in otherwise inert rock to complete the living environment. Hominins were also acutely aware of personal mortality, so 'natural selection' likely met the negative abstract problem of mortality with the positive abstract solution of rebirth afterlife. Much later, perhaps between 200 and 100 ka, funerary ritual developed to allow intervention in the rebirth process. Some landscape cupules became places of exarnation where human remains were placed at representations of breathing holes to help facilitate rebirth afterlife. Funerary cupules were effectively created and subsequently used directly in burials. The primordial worldview persisted until long after archaic humans were extinct and modern humans existed alone.

During the Neolithic revolution a paradigm shift to the spiritual worldview of animism and totemism occurred because of the development of superior concepts where identity and adulthood are preserved into the afterlife. This destroyed the earlier meaning of landscape cupules as the environment was no longer alive, but inhabited by ancestral and nature spirits. Beliefs requiring cupules did survive in a modified funerary form, where they now facilitated and maintained spiritual afterlife for humans. The final demise of the global cupule-making phenomenon came with the fading of animism and ancestor worship.

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**New location of AURANET: <http://www.ifrao.com/>**

## Vandals prompt restrictions on important Nevada petroglyph site

A northern Nevada tribe is considering plans to protect sacred sites on its reservation after vandals spray-painted gang symbols and graffiti on a landmark feature.

The Pyramid Lake Paiute Tribe closed off public access to the prominent Pyramid and Great Stone Mother tufa rock formations on the lake's remote east shore after the latter's vandalism two years ago. Tribal Chairman Elwood Lowery said extensive vandalism is prompting the tribal council to consider a permanent protection plan for all cultural sites on the reservation, about 30 miles northeast of Reno.

The plan might involve a permit and fee system, he said, and only allow escorted tours of photographers, historians, scientists and the public to the sites. In the meantime, only tribal members are allowed to visit the Pyramid and Great Stone Mother.

'Vandals have caused an incredible amount of damage to our heritage over the years', Elwood told The Associated Press. 'We're denying access to the sites until we develop a program to protect the area. All options are on the table.'

Explorer John Fremont gave the lake its name when he named the pyramid-shaped rock formation on the desert lake's east shore. He and his party camped near the Pyramid in January 1844 and were the first white men to visit the lake.

The Great Stone Mother, which resembles an Indian woman sitting down near a basket, figures prominently in Paiute legend. According to legend, she wept so long for her missing children that she filled the lake with her tears before turning into stone.

Eugene Hattori, curator of anthropology at the Nevada State Museum in Carson City, told the Nevada Appeal that petroglyphs on the reservation are a national and international treasure and also need to be protected. 'Some of the vandals have removed parts of the petroglyphs with diamond saws and have decorated their fireplaces and backyards with the carvings', Hattori told the Appeal. 'This must be stopped at once ... (The petroglyphs) must be protected at all costs.'

Tribal Chairman Elwood said the tribe has stepped up patrols of cultural sites, but it is difficult for tribal police and rangers to cover such a huge area. The reservation encompasses 740 square miles.

The dirt road leading to the Pyramid and Great Stone Mother will remain closed to the public at least until the tribal council acts on a protection plan, which could take a few months, he added. Boaters are required to keep 300 m away from the rock formations. The tribe has even denied requests by professional photographers and out-of-state Native Americans to visit the site until the plan takes effect.

This includes the Winnemucca site (Fig. 1), one of the most important rock art sites in North America (Benson et al. 2013). It is located on the west side of the Winnemucca Lake subbasin, comprising distinctive deeply carved metre-scale petroglyphs that are closely spaced, forming panels on boulder-sized surfaces of a partially collapsed tufa mound.

The large, complex non-figurative motifs are formed by deeply carved lines and cupules. A carbonate crust deposited between 10 200 and 9800 calibrated years BP coats petroglyphs at the base of the mound between elevations of 1202 and 1206 m. Petroglyphs above the carbonate crust are carved into a branching form of carbonate that dates to 14.8 ka. Radiocarbon dates on a multiple-layered algal tufa on the east side of the basin, which formed at an elevation of 1205 m, as well as a sediment-core-based total inorganic carbon record for the period 17.0–9.5 ka indicate that water level in the Winnemucca Lake subbasin was constrained by spill over the Emerson Pass Sill (1207 m) for most of the time between  $12.9 \pm 0.3$  and  $\geq 9.2$  ka. These and other data indicate that the lake in the Winnemucca Lake subbasin fell beneath its spill point between 14.8 and 13.2 ka and also between 11.3 and 10.5 ka (or between 11.5 and 11.1 ka), exposing the base of the collapsed tufa mound to petroglyph production. The tufa-based  $^{14}\text{C}$  record supports decreased lake levels between 14.8–13.2 ka and 11.3–10.5 ka. Native American artefacts found in the Lahontan Basin date to the latter time interval. This does not rule out the possibility that petroglyph carving occurred between 14.8 and 13.2 ka when Pyramid Lake was relatively shallow and Winnemucca Lake had desiccated. Consequently the Winnemucca petroglyphs are the currently earliest rock art dated in North America at least, and possibly in both Americas.

Based on Associated Press report by Martin Griffith.

### REFERENCE

- Benson, L. V., E. M. Hattori, J. Southon and B. Aleck 2013. Dating North America's oldest petroglyphs, Winnemucca Lake subbasin, Nevada. *Journal of Archaeological Science* 40: 4466–4476.

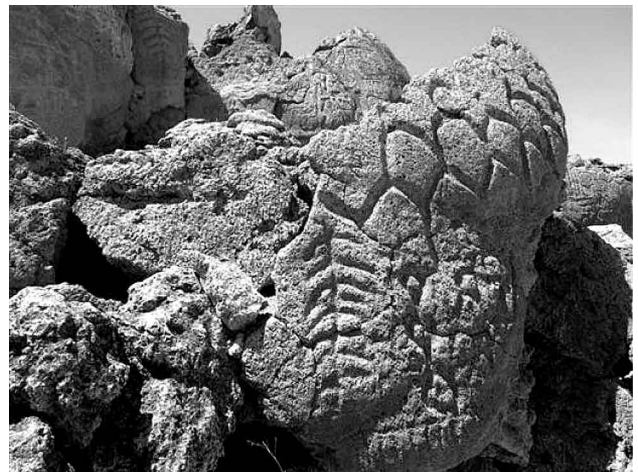
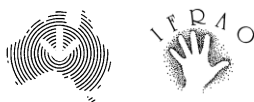


Figure 1. Winnemucca Lake petroglyphs of the Final Pleistocene (photograph by Larry Benson).



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*AURA Newsletter*

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