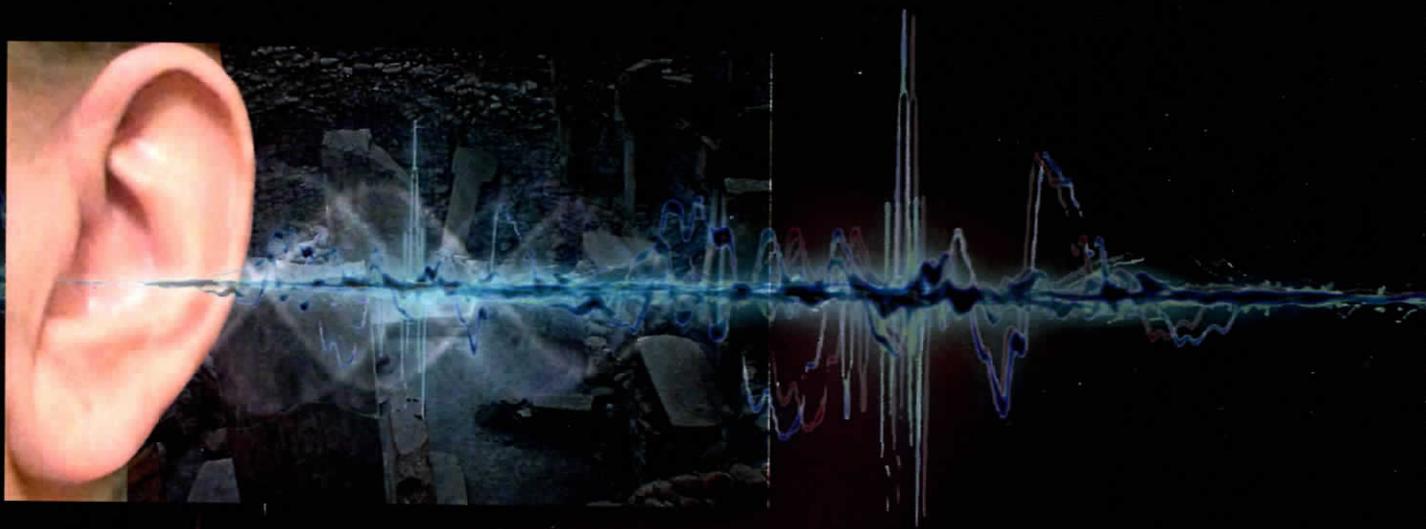


ARCHAEOACOUSTICS II

The Archaeology of Sound



Publication of the 2015 Conference in Istanbul

Including a Bonus Report on Sogmatar

Edited by Linda C. Eneix

Prologue by Fernando A. Coimbra

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2016
Year of Global Understanding



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Preliminary Archaeoacoustic Analysis of a Temple in the Ancient Site of Sogmatar in South-East Turkey

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ABSTRACT - The archaeoacoustic properties and physical phenomena of an ancient site in South East Anatolia (Turkey) were studied. An experiment of resonance and research of local physical phenomena by UV photography took place over one day to establish its properties using SBSA protocol. This archaeological site was described from ancient times as a religious and knowledge centre. This preliminary study in an underground structure carved in the rock found some interesting peculiarities that confirm resonance phenomenon at those frequencies affecting brain activities. On a side wall, we also identified a strong magnetic field in this temple that is without explanation.

KEYWORDS: Archaeoacoustics, Sogmatar, Hypogeum, altered state of mind

Introduction

Archaeoacoustics is a complementary methodology of archaeology, which can bring a different dimension and understanding of sacred sites, for example exploring the relationship between human brain activity at a particular site. After six years of research at a number of sites throughout Europe, our group hypothesises that the geographic location of sites is not a random act, but rather due to the characteristics of that place. This may have enabled people to have a number of experiences such as feeling closer to their gods. In most of these sacred sites we discovered particular physical phenomena that have an affect on the brain and brain waves in particular. It is therefore important to not disregard the emotional component of

human brain activity at a sacred location, a point of view researched since 2010 [2,3,4,5,6,7,8,9,10,11,12].

“Sacred sites” can be considered those geographical locations that a particular social group deems worthy of respect and veneration; typically places of worship and/or used for other religious or ritualistic purposes. As such, they can be desecrated or defiled, and in ancient times were likely protected in some way. The ancient Greeks used the term ‘*topos*’ to refer to the physical, observable features of a locale, and the word ‘*chora*’ to refer to those qualities of a location that could trigger the imagination evoking a mythical presence ^[15].

This preliminary study yielded results for a possible explanation as to why this

¹ SB Research Group (SBRG) is an international and interdisciplinary project team of researchers, researching the archaeoacoustic properties of ancient sites and temples throughout Europe (www.sbresearchgoup.eu).

particular site in Turkey was considered sacred since ancient times.

Sogmatar

This research took place in a hypogeum temple located in Sogmatar (Turkey) [16]. The ruins of Sogmatar lie 57 km. from the ancient town of Harran in South-East Anatolia. There is an unexplored tumulus at Sogmatar which stands like a hill at 60 meters high (Fig. 1). Upon it lie the remains of walls and turrets dating from the second century A.D., while within the present day village are the remains of various temples [22].



Fig. 1 – The tumulus: **above** taken from the hill in front of it, **below** taken from Sogmatar village.

Sogmatar was a center for Septimism, which derived from the Cult of Sin (the moon god) in Harran, and also for the Marillaha cult, lord of the gods. The most important remains are that of an open-air temple where

the sacred planets were worshipped and sacrifices performed. In another temple, Pognon Cave which was hollowed out of the surrounding rock, its inner walls bear Syriac writing and reliefs depicting human figures believed to represent the planets [14]. These reliefs are not in good condition, however the original structure is well preserved. And became the main focus of this preliminary research.

Sogmatar was an important cult centre in which the people of Harran worshipped the moon and planetary gods during the Abgar Kingdom. The subterranean temple examined belonged to the god Sin, god of the moon. Around the village can be found six mausoleums with a square and circular plan, for this reason Sogmatar came to be known as “The Town of Seven Temples”. In front of the tumulus (Fig. 1) close to the village is a sacred hill.

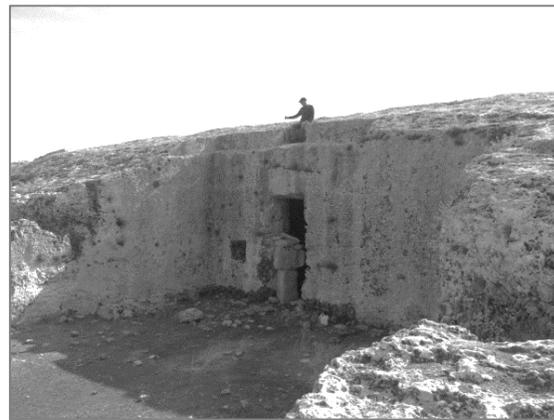


Fig. 2 – A tomb carved in the sacred hill in Sogmatar. The person seated over it gives the proportion.

In this hill are carved some tombs which today are used by the local villagers as a sheepfold (Fig. 2). On its slopes are reliefs of these Gods (Fig. 3) and along with tablets and inscriptions engraved on the rock surface [17]. (Fig. 4).



Fig. 3 – Some images of the gods carved in the hill.

The ruins of Sogmatar are 57 kilometres from Harran, an ancient and storied city set in southwest Turkey, close to the Syrian border.



Fig. 4 – Inscription in Syriac language carved on the sacred hill.

Harran was an important trade centre as far back as the third millennium BC. The Ebla tablets which were discovered in Ebla, Syria date from circa 2500 to 2250 BC and contain the first reference to the ancient city: namely an account of a ruler of Harran who married an Eblaitic princess named Zugalum, who became the “Queen of Harran”^[18].

Harran remained a coveted merchant outpost, due to its strategic location well into 1900 BC. Ammianus Marcellinus, a fourth-century Roman historian, describes its strategic location: “*From there [Harran] two different royal highways lead to Persia: the one on the left through Adiabene and over the Tigris; the one on the right through Assyria and across the Euphrates*”^[23].

Not only did Harran have easy access to both the Assyrian and Babylonian roads, but also to the road north of the Euphrates which provided easy access to Malatiah and Asia Minor. Harran remained an important site

for a long time, including throughout the Assyrian, Hittite, Middle and Neo-Assyrian, Neo-Babylonian, Persian, Seleucid, Roman, Islamic, Mandaean and Crusader periods. To say it was resilient would be an understatement, however it was eventually destroyed by the Mongol invasion ^[18].



Fig. 5 – A possible location of the Temple of Sin, Haran.

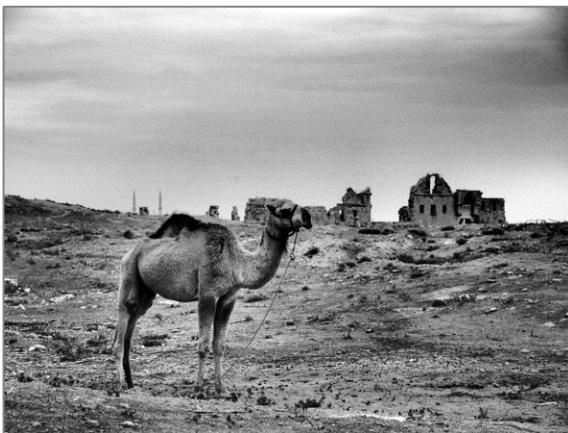


Fig. 6 – The ruins of Haran destroyed by Mongol invasion

In Haran, reference is made to the Temple of Sin, however its exact location has been difficult to locate (Fig. 5). Several Assyrian kings describe its rebuilding and excavations suggest that a large mud-brick building close to the present day university ruins, date to the end of the third millennium

BC. This is one possible location of the legendary temple, where a treaty was created in the time of Hammurapi (1.728-1.686 BC), the sixth Amorite king of Babylon. In fact, the last king of Babylon, Nabonidus (556-539 BC) rebuilt the Temple of Sin and his mother presided over it as the temple priestess. The Cylinders of Nabonidus (four in total) refer to cuneiform inscriptions of the king and describe how he repaired three temples in Mesopotamia, including the sanctuary of the moon-god Sin in Haran (called *Ehulhul*) with the passion, dedication and religious zeal of one who understood the god Sin's importance^[18].

The God Sin.

The god Sin was the Sumerian 'Father of the Gods' and 'Lord of Wisdom'. Sin was also known as Nanna, the Mesopotamian moon-god, a Sumerian deity who was the son of the gods, Enlil and Ninlil. The Semitic moon-god, Su'en/Sin, was a separate deity, but merged with Nanna from the Akkadian Empire (circa 2.334 BC – circa 2.154 BC) onwards ^[18 24, 25, 26, 27]. Not surprisingly, the original meaning of Nanna has been lost. However, what we do know is that the lunar god's primary seats of worship were in Ur in the south and in Haran in the north of Mesopotamia ^[18, 24, 25, 26, 27].

Images dating from circa 2500 BC depict the god Sin as an old man, often riding on a winged bull. His father, Enil, was known as the Bull of Heaven and thus the bull became one of Sin's symbols. Many images also feature Sin with a flowing beard of lapis lazuli (a deep-blue stone, revered in antiquity and which appears to have been mistaken in the Old Testament as sapphire). But these were not Sin's only symbols; he is also associated with the crescent and the tripod, unsurprisingly, each a Pagan figure.

Sin's primary sanctuary was the House of Great Light at Ur and it was here that the role of En Priestess, a powerful title bestowed on a man or woman, which entailed much political power, appears to have first developed [18, 24, 25, 26, 27].

Nabonidus was passionate about the restoration of the Temple of Sin in Harran, but his devotion came with a price. The restoration was a controversial decision and one that shocked the religious authorities, for a Babylonian king was expected to venerate the supreme god Marduk, not Sin [16, 24, 25, 26, 27].

The Thesis

Al Mas'udi, [897-952 AD], an ancient Arab historian and geographer, was one of the first to combine history and scientific geography in a large-scale work, *"The Meadows of Gold and Mines of Gems"*. He wrote a lot about Sogmatar in the part: "Sacred buildings and monuments of the Sabians of Harran". Beyond the myth it is interesting to read this text: *"At the extreme boundaries of the Earth stands an ancient temple, which is round and has seven doors on each side and a lofty dome which has also seven sides and is famous throughout the land for its extraordinary height and admirable construction. On top of the dome is a kind precious stone or crystal as large as a bull's head, dispelling darkness for a great distance...Many great kings of old have tried to get hold of this stone, but with no success: all those who tried, fell lifeless at a distance of 10 feet...even if one uses spears, arrows or other similar contrivances, these similarly stop and fall mid-air at a distance of 10 feet...To this date, there is no means for a man to get hold of this stone. Those so daring or foolish to think they could demolish the temple would*

be struck by instant death. Certain sages explained this phenomenon as being caused by certain magnetic stones placed at a regular distance all around the temple" [20, 21].

In this text the author speaks about the presence of physical phenomena before the Mongol invasion, which like Harran destroyed the temples and village of Sogmatar. After this description we were curious to analyze this ancient town for confirming this ancient assumption of magnetic phenomena affecting brain activity or impressing the people of that age.

Because the majority of temples are totally destroyed, it was decided to explore the only temple that preserved the original aspect and was not burned and destroyed like the others.

Materials and Methods

The equipment used by our group for recording sound and noise consisted of a dynamic high-end recorder extended in the ultrasound and infrasound field with a maximum sampling rate of 192 KHz (Tascam DR-680). Use of gain control in recording devices is very delicate. In quiet locations, maximum gain for recording is used; in more noisy environments gain is determined with 0,775V/0dB AES/EBU standard. The microphones used have a wide dynamic range and a flat response at different frequencies (Sennheiser MKH 3020, frequency response of 10Hz - 50.000Hz) with shielded cables (Mogami Gold Edition XLR) and gold-plated connectors [2,3,4,5,6,8,9,10,11,12].

Praat program version 4.2.1 from the University of Toronto and Audacity open-source program version 2.0.2, both for

Windows were used to analyze the various recorded tracks.

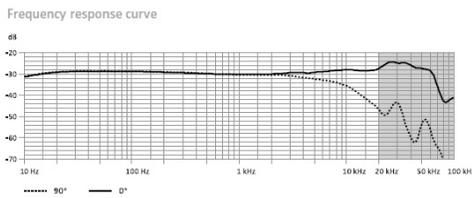


Fig. 7 - The extremely flat response of Sennheiser MKH 3020 microphones with a greater sensitivity both in low frequencies and infrasound than in the ultrasound field.

Before recording a spectrum analyzer, Spectran NF-3010 from the German factory Aaronia AG, was used to search for electromagnetic phenomena that could be present in the surrounding environment leading to a potential negative influence of the results.

To make visible the shape of the magnetic field, UV photography and a vector program for PC (PIV – Particle Image Velocimetry) was used. This consisted of a modified Canon EOS 1100D digital camera [13], with its anti-aliasing filter removed. The camera used was modified in Canon’s Italian factory¹. In the ultraviolet band (UV) the absorption of lenses of normal optics (not with calcium fluoride and quartz lenses for forensic use) is very strong, usually a normal optic is unable to allow electromagnetic waves below 320-350nm to pass through, but it is sufficient for analysing the UVA band (400-315nm) where it is possible to perceive the movement and the behaviour of dust suspended in the air and gas flow as water

steam which orientate themselves as a dipole in the magnetic field [14].

Particle Image Velocimetry (PIV) by Dantec Dynamics from Denmark was the software used to analyse this movement in the UV video and photographs taken. PIV is used in industry as an intuitive measurement technique to measure two or three components of velocity in a variety of flows. The application of PIV in research and industry is widespread, due to its ease of use and accurate data representation. As easy and intuitive as PIV is, it involves many cross-disciplinary challenges, from classical optics and imaging to the use of dedicated state-of-the-art digital electronics and lasers. The principle of PIV working is very simple: two consecutive shots illuminate a slice or volume of a flow field with particles suspended in the flow. The scattered light from the particles is recorded in two consecutive images on one or several digital cameras. The images are sub-divided into smaller areas for calculating the mean particle displacement between two corresponding sub-areas. The particle displacement is calculated using cross-correlation or Least Squares Matching techniques. Since the time between the shots is known, the particle velocity can be determined. Taking into account the magnification of the optical setup, the absolute velocity field can be derived. The velocities calculated from an image pair are an instantaneous snapshot of the flow viewed by the cameras. PIV results are an accurate representation of the flow presented to the user and viewers in an easy to understand and visual manner. The presentation is aided by advanced software post-processing. Dantec Dynamics is the leading provider of laser optical measurement systems and sensors for fluid flow characterization and materials testing.

¹ Any new camera can be modified in this way, however Nikon, Sony and Olympus cameras can only be modified by a private technician

automatically invalidating the warranty of the firm and the camera can lose characteristics for scientific use

Results

An interesting resonance in the niche located in the center of the main room (see Fig. 8) was discovered in the presence of a male voice using a harmonic chant.

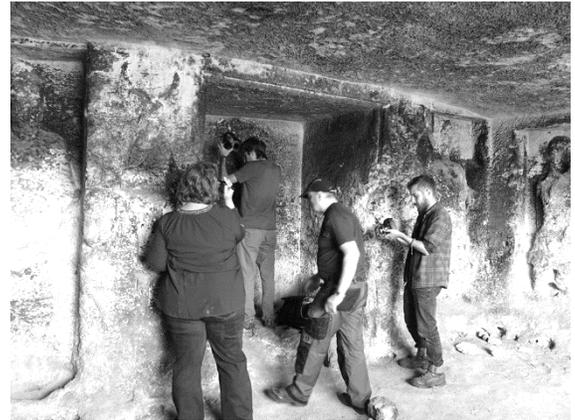


Fig. 8 – The niche located in the center of the hall where we found an interesting resonance



A resonance frequency of around 93Hz (see Fig. 8) was found. When the singer is located in the frequency node, this sound expands to all directions in the building which can potentially have a strong effect on the people present in the main room. To achieve the best effect and to avoid sound diffusion from another body, the singer needs to remain alone in the niche. Because the niche is carved in the rock without the possibility of a wrong shape it appears as if this effect was searched for by the builders. The frequency measured is comparable with other results found by our research group [2,3,4,5,6,7,8,9,10,11,12] or other researchers [19] in Europe, in particular in the range of 80-140Hz which is affecting brain activity [1,7].

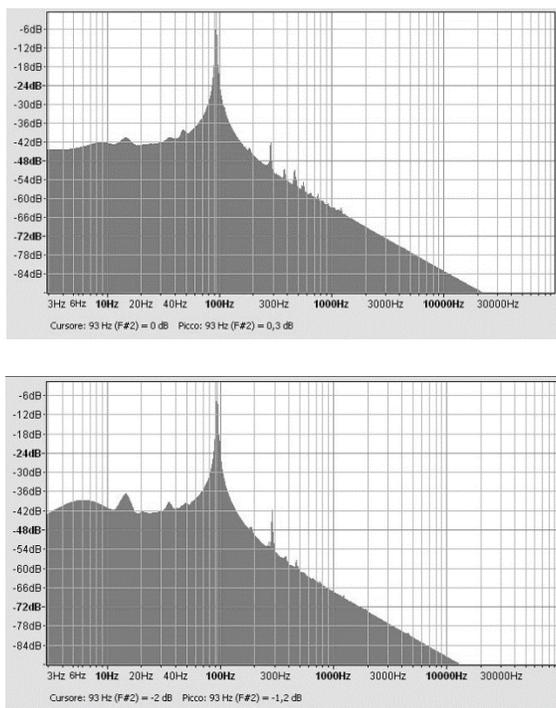


Fig. 9 – Aspects of resonance in two different moments of chanting: the resonance of the niche is always at 93Hz

With silence it is very easy to record a strong natural frequency coming from below the soil of around 14Hz which was also found outside this cave. It is important to remember this frequency is present at other

sacred sites in Europe, which has a strong effect on brain waves creating a relaxing effect [10,12]. It will be very interesting in the future to examine the effect using more sophisticated devices of volunteers in this site as previously done at other sacred sites, for example in Italy or Slovenia [10].

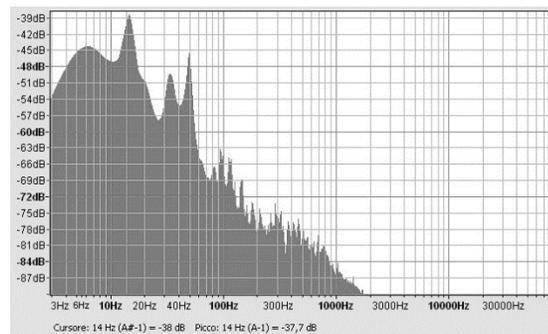


Fig. 10 – The strong peak at 14Hz with -39db of volume in the silence of the cave

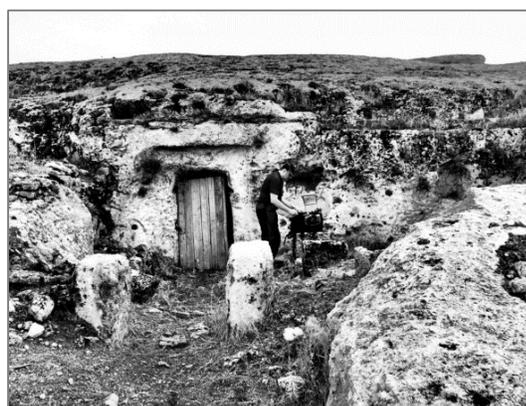
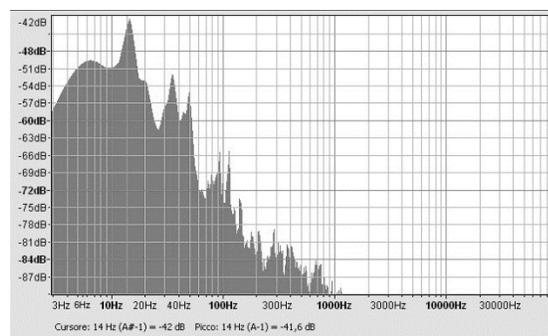


Fig. 11 – **Above:** the similar aspect of the graphic taken outside and far away from examined temple; **below:** shot of one the recording positions in Sogmatar related to above graphic: in front of a tomb carved in the sacred hill

The natural vibration is stronger inside the temple than in open air. This is normal because the temple acts like a resonance box for the people present in this cave without the interference of outside air movement. The temple appears to be in total silence when the people inside do not move themselves. But if an official makes a ritual, their voice could strongly hit the people if they are placed in the right node of resonance.

For testing the movement of the air molecules, a large number of photos and video of the main and secondary room were taken using an ultraviolet camera. Being inside a closed room with low natural light, it was unnecessary to use filters to stop infrared rays affecting the images.

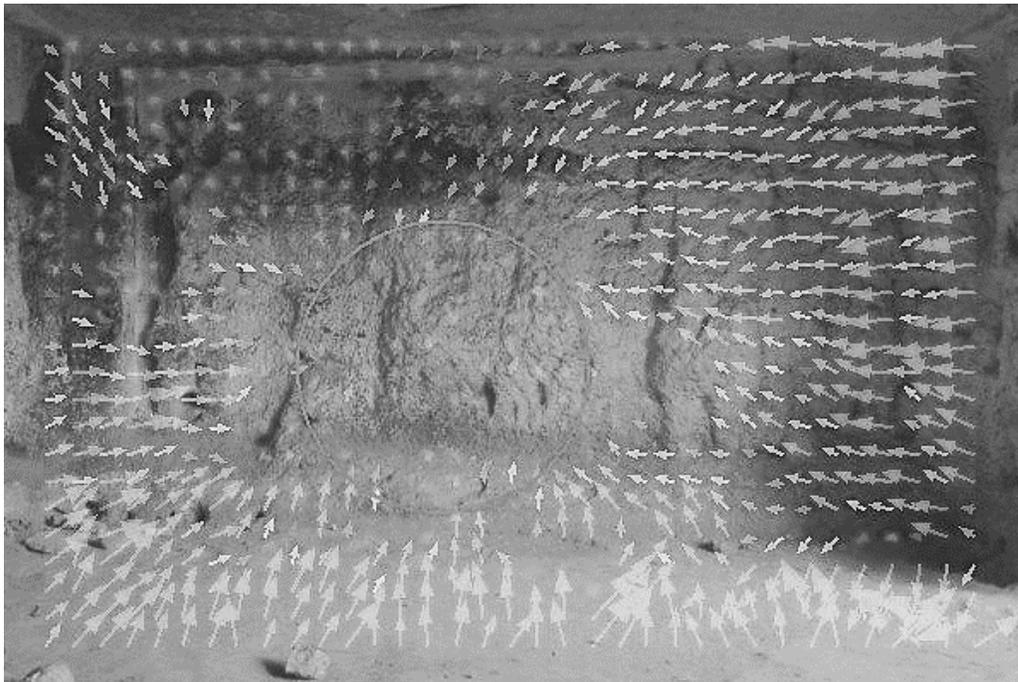
After the analysis in the PIV vector program, a strong spiral magnetic field on the wall located on the right of the central niche was observed.



Fig. 12 – Some shots of the shapes of Gods carved on the walls, ruined during the Mongol invasion.



Fig. 13 – A shot of the right wall taken by UV camera



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Fig. 14 – The same image as in figure 12 after PIV analysis: the molecules appear to be moving in a spiral field more quickly at the periphery than in the center where the movement vanishes

The right wall (as viewed from the entrance) appears to be totally immersed in a very strong magnetic field with a spiral rotating shape. In the center of this spiral there is a total quiet as in a hurricane. There is no explanation for a magnetic field of this shape and behaviour.

Conclusion

It is important to understand the relationship between ancient sites and people who built them. So archaeoacoustics should therefore not only consider analysing the acoustic properties of the site, but also all the associated physical phenomena not perceived by the ears which could potentially influence a population to

consider a particular site as being sacred. The analysis of one temple at the site of Sogmatar provides some evidence that the infrasounds and magnetic fields perceived by the original builders are important, maybe perceived as a gift from their gods. Maybe this is one of the reasons as to why the gods on the wall were carved. Moving beyond the myth, the phenomena described by Al Mas'udi, the ancient Arab historian and geographer, could be as a result of local physical phenomena, as this preliminary research appears to have discovered. In that case how did ancient people know about such phenomena, without sophisticated equipment?

Consider that within a magnetic field it is possible to perceive this by an empirical observation and in the same way is possible to value the altered state of mind reached during prayers or rituals due to the strong infrasounds discovered.

Elsewhere the resonance effect of 93Hz (ideal for a male voice) could potentially demonstrate the builders' level of knowledge of the relationship between mind and sound, as seen in Malta or Italy hypogea [4,6,9].

These results have to be considered preliminary, extending this research to the ruins of other six temples could provide further insight.

References

- [1] Cook, I. A.; Pajot, S. K.; Leuchter, A. F., "Ancient Architectural Acoustic Resonance Patterns and Regional Brain Activity", *Time and Mind*, Volume 1, Number 1, March 2008, pp. 95-104 (10).
- [2] P. Debertolis, H.A. Savolainen, "The phenomenon of resonance in the Labyrinth of Ravne (Bosnia-Herzegovina). Resultsof testing" Proceedings of ARSA Conference (Advanced Research in Scientific Areas), Bratislava (Slovakia), December, 3 – 7, 2012: 1133-36
- [3] P. Debertolis, N. Bisconti: "Archaeoacoustics in ancient sites" Proceedings of the "1st International Virtual Conference on Advanced Scientific Results" (SCIECONF 2013), Zilina (Slovakia) June, 10 - 14, 2013: 306-310
- [4] P. Debertolis, N. Bisconti: "Archaeoacoustics analysis and ceremonial customs in an ancient hypogeu", *Sociology Study*, Vol.3 no.10, October 2013: 803-814
- [5] P. Debertolis, S. Mizdrak, H. Savolainen: "The Research for an Archaeoacoustics Standard", Proceedings of 2nd ARSA Conference (Advanced Research in Scientific Areas), Bratislava (Slovakia), December, 3 – 7, 2013: 305-310
- [6] P. Debertolis, N. Bisconti: "Archaeoacoustics analysis of an ancient hypogeu in Italy", Proceedings of Conference "Archaeoacoustics: The Archaeology of Sound", Malta, February 19 - 22, 2014: 131-139
- [7] P. Debertolis, G. Tirelli, F. Monti: "Systems of acoustic resonance in ancient sites and related brain activity". Proceedings of Conference "Archaeoacoustics: The Archaeology of Sound", Malta, February 19 – 22, 2014: 59-65.
- [8] P. Debertolis, A. Tentov, D. Nicolić, G. Marianović, H. Savolainen, N. Earl: "Archaeoacoustic analysis of the ancient site of Kanda (Macedonia)". Proceedings of 3rd ARSA Conference (Advanced Research in Scientific Areas), Zilina (Slovakia), December, 1 – 5, 2014: 237-251.
- [9] P. Debertolis, F. Coimbra, L. Eneix: "Archaeoacoustic Analysis of the Hal Saflieni Hypogeu in Malta", *Journal of Anthropology and Archaeology*, Vol. 3 (1): 59-79.
- [10] P. Debertolis, D. Gullà: "Archaeoacoustic analysis of the ancient town of Alatri in Italy", *British Journal of Interdisciplinary Sciece*, September, Vol. 2, (3), 2015: 1-29.
- [11] P. Debertolis, M. Zivić: "Archaeoacoustic analysis of Cybele's temple, Imperial Roman Palace of Felix Romuliana, Serbia", *Journal of Anthropology and Archaeology*, Vol. 3 (2), 2015: in press.
- [12] P. Debertolis, D. Nicolić, G. Marianović, H. Savolainen, N. Earl, N. Ristevski: "Archaeoacoustic analysis of Kanda Hill in Macedonia. Study of the peculiar EM phenomena and audio frequency vibrations", Proceedings of 4th ARSA Conference (Advanced Research in Scientific Areas), Zilina (Slovakia), November 9 – 13, 2015: 169-177.
- [13] P. Debertolis, N. Earl: "Forensic Imaging in Anthropology. Use of a simple forensic camera for IR and UV anthropologic photography", The 2nd Human And Social Sciences at the Common Conference (HASSACC), Zilina (Slovakia), November, 17-21, 2014: 206-212.
- [14] P. Debertolis, D. Gullà, "Anthropological analysis of human body emissions using new photographic technologies", Proceedings in Scientific Conference "The 3rd International Virtual Conference on Advanced Scientific Results (SCIECONF-2015)", Slovakia, Žilina, May 25-29, 2015; Volume 3, Issue 1: 162-168.
- [15] P. Devereux, S. Krippner, R. Tartz, A. Fish: "A Preliminary Study on English and Welsh 'Sacred Sites' and Home Dream Reports", *Antropology of Consciousness*, Vol. 18, No. 2, September 2007: 2– 28.
- [16] R. Ellis: "The Ark of Edessa", in *Unravelling the Mysteries of Ancient Artifacts 2*, Two Year Anniversary Edition, February 2015, www.Ancient-Origins.net: 2-13.
- [17] H. J.W. Drijvers, J. F. Healey, "The Old Syriac Inscriptions of Edessa and Osroene. Texts, Translations and Commentary", Brill, 1999.
- [18] A. Gough, "Original Sin", July 2015, http://andrewgough.co.uk/articles_originalsin/

- [19] R.G. Jahn, P. Devereux, M. Ibison: "*Acoustical Resonances of Assorted Ancient Structures*", J. Acoust. Am Soc Vol. 99 No.2, February 1996: 649-658.
- [20] Masudi,, "The Meadows of Gold", The Abbasids, Routledge, 1989.
- [21] El Mas'udi, "El-Mas'udi's Historical Encyclopedia", translated by Aloys Sprenger, London, 1841.
- [22] Ministry of Culture and Tourism: "The Ruins of Sogmatar", Cultural Details of Şanlıurfa, Republic of Turkey,
<http://www.kultur.gov.tr/EN,33671/sanliurfas-archaeologicl-and-historical-tourism.html>
- [23] S. K. Ross: "Roman Edessa, Politics and Culture on the Eastern Fringes of the Roman", Routledge, 1999.
- [24] G. Pettinato: "Angeli e demoni a Babilonia. Magia e mito nelle antiche civiltà mesopotamiche". Mondadori, Milano 2001.
- [25] G. Pettinato: "I miti degli inferi assiro-babilonesi". Paideia, 2003.
- [26] G. Pettinato : "Mitologia assiro-babilonese". Utet, Torino 2005.
- [27] G. Pettinato: "Mitologia sumerica". Utet, Torino 2001.