

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 a site in South East Anatolia (Turkey), described from ancient times as a religious and knowledge centre, were studied. An experiment of resonance and research of local physical phenomena by UV photography took place over one day to establish the properties of this underground site using SBSA protocol. The preliminary study found some interesting peculiarities that confirm a deep knowledge of resonance phenomenon at frequencies suspected to affect brain activity. On a side wall, we also identified a strong magnetic field that is without explanation.

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

Introduction

Archaeoacoustics is a field of study complementary to archaeology, by which exploring sound behaviour of ancient ritual and ceremonial sites can bring a different dimension and understanding to the interpretation of their use. After six years of research at a number of sites throughout Europe, our group hypothesizes that the geographic location of cultic sites is not a random act, but rather driven by the geologic characteristics of that place. For the people who used the sites, such characteristics may have accelerated a number of emotional experiences such as feeling closer to their gods. In most of these sites we discovered physical phenomena that have been seen to have an effect on brain waves in particular. It is therefore important to consider 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. 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 particular site in Turkey was considered sacred since ancient times.

Sogmatar

Our research took place in a subterranean shrine located in Sogmatar (Turkey) ^[16]. The ruins of Sogmatar lie 57 kilometres from Harran, an ancient and storied city set in south-east Turkey, close to the Syrian border. 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 an important religious centre in which the people of Harran worshipped the moon and planetary gods which derived from the Cult of Sin (the moon god), elsewhere dating as far back as the 1st Millennium BCE, and also for the Marillaha cult, lord of the gods. 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 on which were 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) along with tablets and inscriptions engraved on the rock surface^[17] (Fig. 4).

The most important remains are that of an open-air temple where the planets were worshipped and sacrifices performed. Nearby, “Pognon’s Cave” was hollowed out of the surrounding rock, its inner walls bearing 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 thus became the main focus of this preliminary research.



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



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



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

Historical Context of the Area

Only thirty five miles from Sogmatar, the ancient town of 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 Eblaite 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]

In Harran, 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 Harran (called *Ehulhul*) with the passion, dedication and religious zeal of one who understood the god Sin’s importance^[18].



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



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

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 Harran 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].

A Curious Notion

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 destroyed the temples and village of Sogmatar. After considering this description we were curious to analyze this ancient town to confirm this ancient assumption of magnetic phenomena affecting brain activity or impressing the people of that age.

Because the majority of temples were totally destroyed, it was decided to explore the only temple that preserved the original aspect and was not burned and destroyed like the others: "Pognon's Cave".

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 192KHz (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].

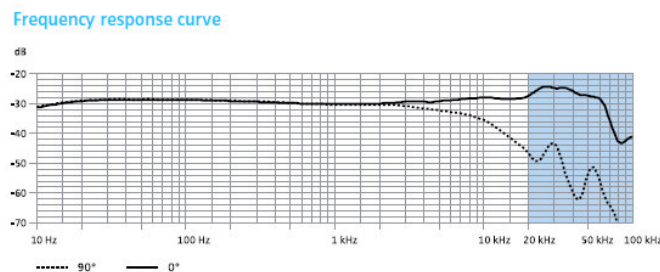


Fig. 7 - The extremely flat response of Sennheiser MKH 3020 microphones with a greater sensitivity both in low frequencies and infrasound than in the ultrasound field.

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.

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 soft-ware post-processing. Dantec Dynamics is the leading provider of laser optical measurement systems and sensors for fluid flow characterization and materials testing.

Results

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

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 necessary for scientific use.



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 vocalizes 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 sought 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 has been observed to have an impact on brain activity.

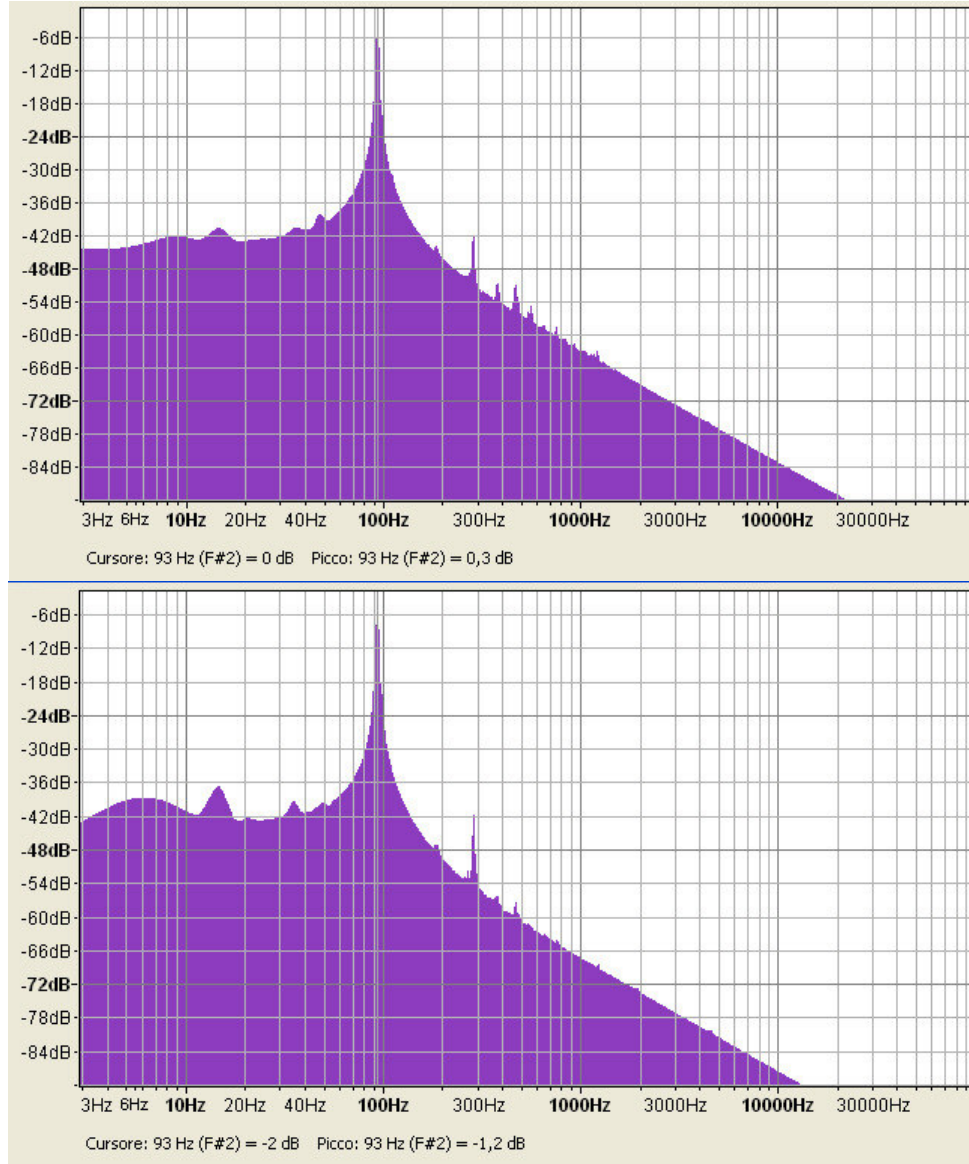


Fig. 9 – Aspects of resonance in two different moments of chanting: the resonance of the niche is always at 93Hz

In surrounding 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 note that this

frequency is present at other sacred sites in Europe, and also has a strong effect on brain waves, facilitating relaxation.^[10,12] It will be very interesting in the future to examine this phenomenon using more sophisticated devices as previously done with volunteers, for example in Italy and Slovenia^[10].

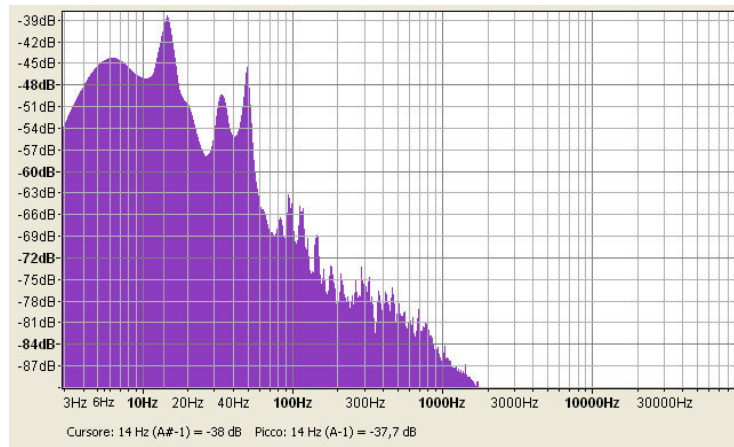


Fig. 10 – The strong peak at 14Hz with -39db of volume in the silence of the cave

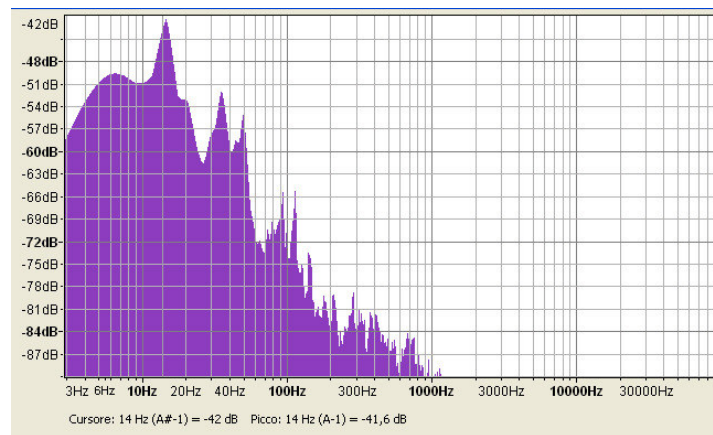


Fig. 11 – Above: the similar aspect of the graphic taken outside and far away from examined temple; below: shot of one the recording positions in Sogmatar related to above graphic: in front of a tomb carved in the sacred hill

The natural vibration is stronger inside the temple than in open air. This is normal because the enclosed space 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 individual were officiating with a voice at the right node of resonance, it would be possible to strongly impress the observers.

For testing the movement of the air molecules, a large number of photos and video were taken of the main and secondary room 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.



Fig. 12 – Images of Gods carved on the walls, ruined during the Mongol invasion.

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. 13 – Image of the right wall taken by UV camera

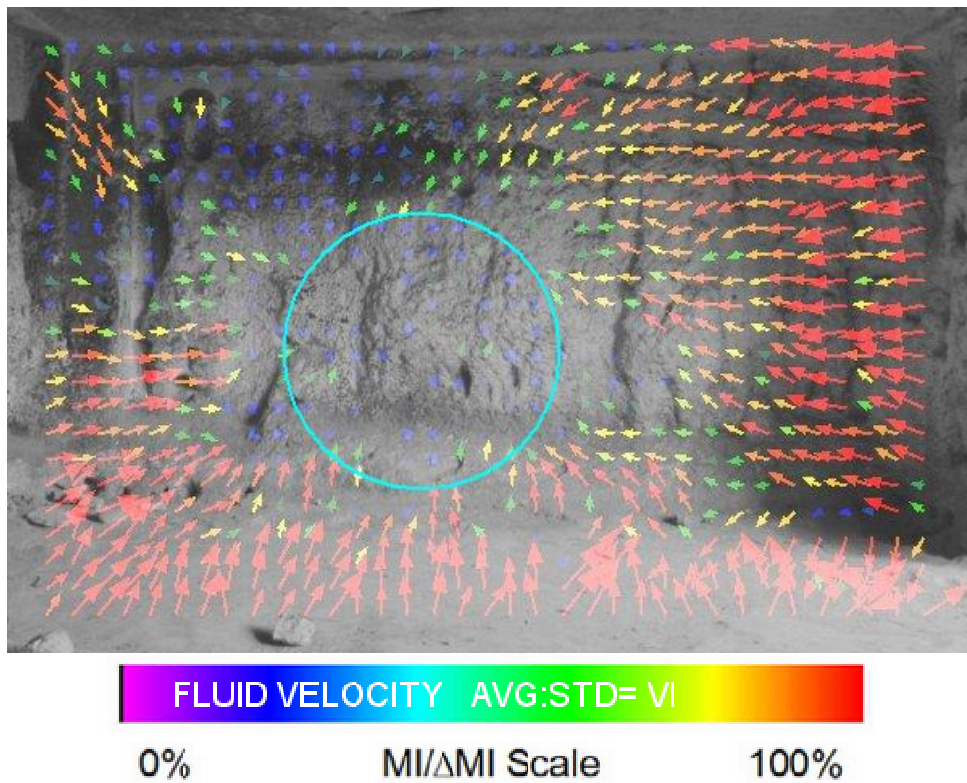


Fig. 14 – The same image after PIV analysis: the molecules appear to be moving in a spiral field more quickly at the periphery than in the center where the movement vanishes

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 total quiet like the eye of 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 analyzing the acoustic properties of the site, but also all the associated physical phenomena not perceived by the ears which could potentially influence a population and their perception of 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, perhaps understood as a gift from their gods. Maybe this is one of the reasons why the gods were carved on the wall. Moving beyond the myth, the phenomena described by Al Mas'udi, the ancient Arab historian and geographer, could be 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 it is possible to perceive a magnetic field by empirical observation and in the same way to pursue the altered state of mind reached during prayers or rituals, in the presence of strong infrasounds.

Elsewhere the resonant 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 Maltese or Italian hypogea^[4,6,9].

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

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