Mediterranean Archaeology and Archaeometry, Vol. 16, No 4,(2016), pp. 401-406

10.5281/zenodo.220963

LATE CHALCOLITHIC SOLAR-CHTHONIC ROCK-CUT STRUCTURES FOR TIME MEASURING IN THE EASTERN RHODOPES, BULGARIA

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Received: 03/03/2016
Accepted: 30/04/2016
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ABSTRACT

Our paper is focused on Late Chalcolithic solar-chthonic rock-cut structures for time measuring. Here we present two objects from the Eastern Rhodopes, Bulgaria – two additionally processed natural caves, which can be used for determining of the winter solstice – the beginning of one calendar cycle.
Tangarduk Kaya cave sanctuary is situated near the village of Ilinitsa, Kardgali district. The different parts of the cave are formed after natural processes of Karst formation and human activity. At the level of the cave gallery floor the entrance aperture is widened and its vertical section is in a special form if they see from the inside outwards. The end of the gallery is obviously formed as altar. Archaeoastronomical investigations show that Tangarduk Kaya cave sanctuary could be connected with the cult of the Great Mother-Goddess. In the period between 3000 - 2000 B.C. the projection of the entrance aperture during the winter solstice reached 0.4 m from the base of the altar. Besides, this cave sanctuary could be used for determining of the year's duration and its beginning, with enough accuracy.
The other rock–cut object Parmakla Kaya cave sanctuary near the village of Nochevo, Asenovgrad Municipality is in the same category. In the bedrock there is a natural cave, which is additionally processed. Orientation of the main axis of the cave is also in the meridian. Solar projection of the entrance on the day of the winter solstice is with a maximum length along the central axis. This also allows determining the duration of the solar tropical year.
On the vertical part of the rock massif, whose front is south oriented about 40 trapezoidal niches are carved. They are divided into two groups around the entrance of the cave. Probably, they are integrally related to the monument and their orientation allows observation of different shade effects during the movement of the sun on the celestial sphere.

KEYWORDS: rock and cave sanctuaries, solar projections, solar culminations, cult of the Great Mother – Goddess.

1. INTRODUCTION

Rock-cut monuments as cave sanctuaries semantically bear the idea of interaction of the spatial boundaries of the chthonic medium and the sun. Space and time are different for prehistoric people and for us. The idea of physical time almost does not exist in prehistoric thinking. Time measuring is needed for serving the material (economy and hunting) and ritual (customs related to various deities) practices of the societies.

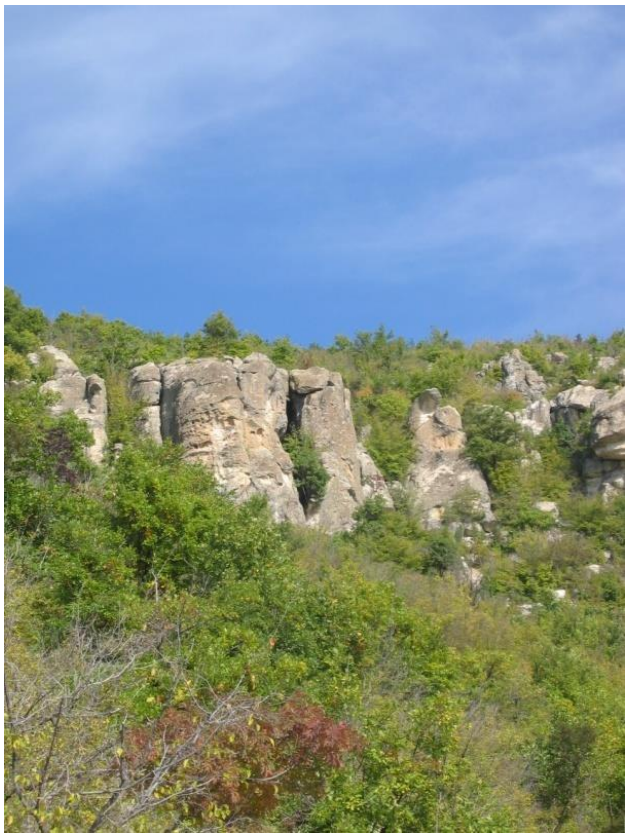

Figure 1. Karst rock massif of the Tangarduk Kaya cave sanctuary

The shape of the cross section of such caverns is specific. They are additionally processed tectonic cracks in the rock volume. The shape of the cave entrance is similar to leaf. Conditionally we can divide it of three parts:

Upper - highly elongated further styled with phallic shape;

Middle part - forming the main part of the gallery with elliptic shape. Most likely, this geometry is related to its functional purpose - to provide physical movement inside the sanctuary and to ensure the stay of the participants in rituals seated. This form has been used for acoustic effects during ceremonies.

Lower part - starts from the entrance of caves and represents a groove with a characteristic rectangular shape. Heavily slanted staircase reaching the level of the surrounding terrain usually leads to the entrance.

2. TANGARDUK KAYA CAVE SANCTUARY

Tangarduk Kaya cave sanctuary is located near the village of Ilinitsa, Kardgali district. The Tangardak Kaya cave is formed in a separate Karst rock outcrop, close to the ridge of the Ilinitza, elevation h = 618.3 m, l = 25° 15′ 03.4″ j = 41° 42′ 48.6 (Figure 1). The rocks are Triassic limestone. They have been subject to the strong influence of the endogenous forces (tectonic movements). The processes of physical and chemical weathering have led to the formation of an entrance leading to a widened tectonic fissure, in the base of which there are several small terraces (Stoev et al., 2001) (Figure 2).

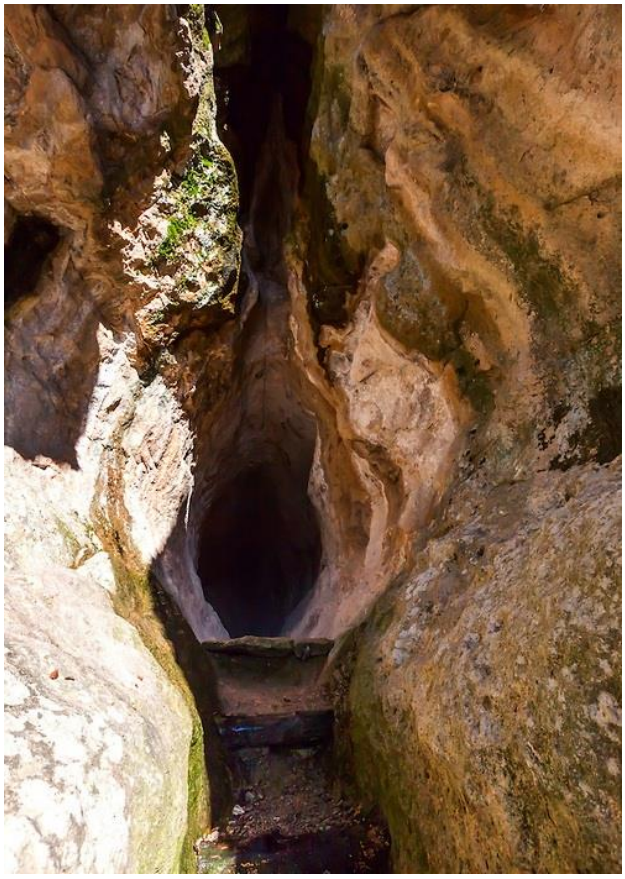

Figure 2. Entrance of the Tangarduk Kaya cave sanctuary

There are two niches on the left wall before the entrance of the cave and other two niches on the wall to the right. An artificial gallery was created following the main tectonic fissure. The gallery is 22 m long and has an average width of 1.5 m. In the foundation, following the fissure, a very sloped corridor was been created. This corridor leads to the entrance of the cave. At the ground level of the cave the entrance opening of the gallery is widened to its foundation. The vertical section, looked at from the

inside, has the form of an ellipse with a large eccentricity. The cave's bottom was shaped especially to fulfil the role of an altar (Figure 3). A small terrace is hewn out of the rock underneath the

Figure 3. Altar of the Tangarduk Kaya cave sanctuary

altar. Also, there are two neighbour zones with a nearly elliptical section in the middle of the gallery. The gallery's ceiling has a clearly expressed vault form. One registers sound increase as well as significant reverberation (a loud noise repeated as an echo) and very long echo in the focuses of the vaults. Maximal increase of the sound intensity and reverberation time are in the region of lower sound frequencies.

3. ASTRONOMICAL CALCULATIONS

The astronomical azimuth of the cave's main axis is A=15°08'12" or it is near the main meridian (North-South), and follows the development of the tectonic fissures in the Karst massif.

According to equations in spherical astronomy and geometry the equation $h_{max} = 90 - \varphi + \varepsilon$ is executed in the point of the summer solstice (where the solar declination δ is at its maximum, and equals the slope of the ecliptic ε). For the contemporary epoch, for which $\varepsilon = 23° 26' 24"$, the distance between the peak of the entrance projection and the altar's foundation is 10.60 m. In the point of the winter solstice the solar declination δ is negative and at its maximum, and equals to $-\varepsilon$. The equation $h_{min} = 90 - \varphi - \varepsilon$ is executed and the distance between the peak of the entrance projection and the altar's foundation is 1.10 m.

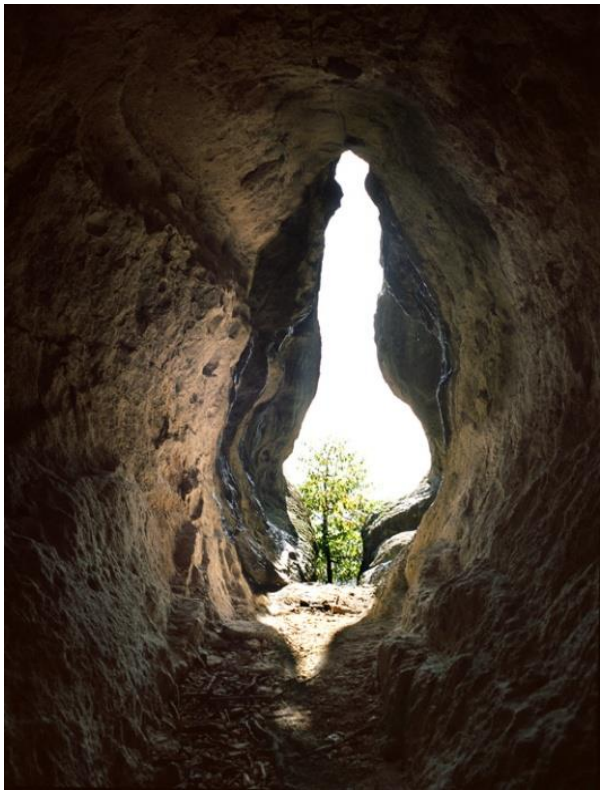

Figure 4. Entrance of the cave seen from the inside

Considering that the astronomical azimuth A of the cave's main axis is approximately 15°, the height of the Sun will decrease with one more degree (1°). Consequently, the projection will come 0.25 m closer to the altar's foundation. The Sun culminates high above the horizon during the summer and the higher outer contour of the entrance opening is projected on the floor of the gallery. During the winter, when the Sun culminates at lower heights, the lower inner contour of the entrance opening is projected (Stoeva et al., 2004) (Figure 4 and 5).

The day, in which solar beams reach the altar can be used for determining of the winter solstice – the beginning of one calendar cycle, as people thought in Eneolithic. Thus, the duration of one tropical (solar) year can be defined.

The slope of the ecliptic decreases with time. This means that in the past the solar height at noon during the winter solstice, it would have become smaller and smaller; meaning the light from the entrance's projection would have crept closer and closer to the altar. For example, between 2000 B.C.E. and 1500 B.C.E. the projection of the entrance opening did reach up to 0.4 m from the altar's

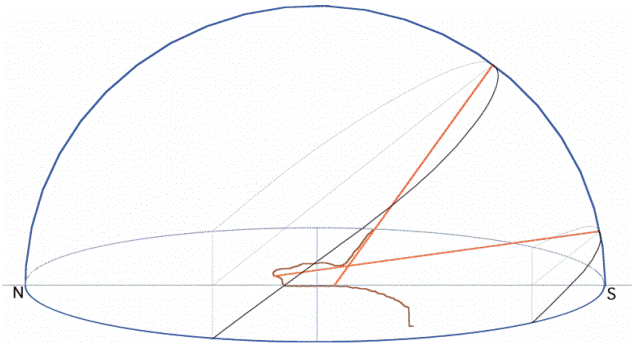

Figure 5. Vertical plan of the Tangarduk Kaya cave in the meridional plane. Solar beams at culminaton of the sun, at summer and winter solstices and the maximal projections of the entrance are evident

foundation. That is why we can suppose that the Tangarduk Kay cave sanctuary was created during the period of Late Eneolithic and Early Bronze Age (Maglova et al., 2007).

4. ROCK CUT MONUMENT PARMAKLA KAYA

Parmakla kaya cave sanctuary (Figure 6 and 7) is situated near the village of Nochevo, Asenovgrad municipality. The cave is natural, additionally processed and deepened.

Figure 6. Parmakla Kaya cave sanctuary

The cave's gallery ends with an altar (Figura 8). Orientation of the main axis of the cave is also in the main meridian. Solar projection of the entrance on the day of the winter solstice is with a maximum length along the central axis. This also allows determining the duration of the tropical (solar) year. A rocky bulge with phallic shape (Figure 9) and trapezoidal niches are hewn out of the bedrock, in the volume of which the cave is developed.

Figure 7. Entrance of the Parmakla Kaya cave sanctuary

There are about 40 trapezoidal niches on the vertical part of the rock massif, whose front is south oriented (Figura 10). They are divided into two groups around the entrance of the cave. Probably, they are integrally related to the monument and their orientation allows observation of different shade effects during the movement of the sun on the celestial sphere.

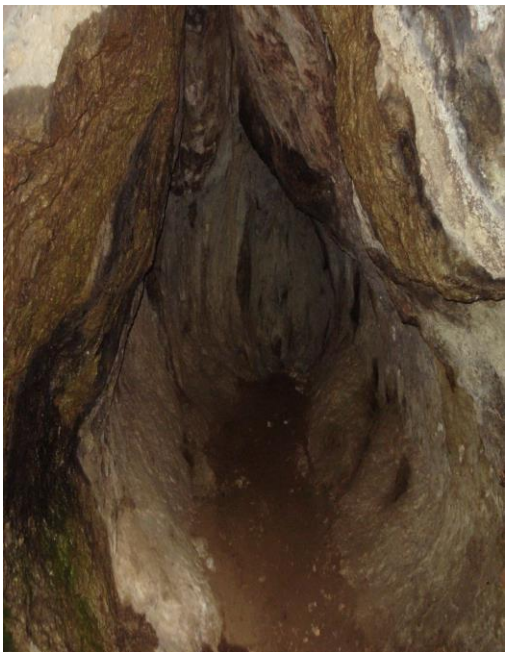

Figure 8. Altar of the Parmakla Kaya cave sanctuary

5. DISCUSSION

Eneolithic societies considered celestial sphere directly linked and dependent on the orientation of the rock – cut monuments with respect to geographical directions. All that we can interpret is reconciling the needs of economic and social life, which we find integrated in the cult of the Great Mother-Goddess.

Figure 9. A rocky bulge with phallic shape

In the Chalcolithic or Eneolithic people believe that the Sun-God enters into a sacred incestuous marriage with the Great Mother-Goddess. This marriage affirms the sacredness and became part of the central cosmic mystery - periodic renewal of the world (Eliade, 1995).

Figure 20. Trapezoidal niches are hewn out of the bedrock, in the volume of which the Parmakla Kaya cave sanctuary is developed.

The results of this research demonstrate that these rock sanctuaries can be related with the profession of the cult to the Great Mother-Goddess. Once per year solar rays penetrate into the altar, embodying the sacred marriage between the Goddes-Mother and the God-Sun.

Figure 31. Solar symbol and calendar recording in the Magura cave, Belogradchic municipality

From the same epoch, monochrome paintings are found in Bulgaria, which are pictographic record of astronomical events on the sky in the frames of one calendar cycle - the calendar friezes in the cave "Magura“, Belogradchic municipality and in the rocky complex near the village of Baylovo, Sofia District dated back to 3000 BC (Stoev and Maglova, 1992), (Figures 11-14).

Figure 42. Ithyphallic scene from the Magura cave, Belogradchic municipality

The number of days between astronomical phenomena is probably connected with cult practices in the Eneolithic society.

6. CONCLUSIONS

These two sanctuaries from the Eastern Rhodopes –Tangarduk Kaya and Parmakla Kaya are examples of observations of solar meridional culminations. Systematic observations of the positions of the entrance projections during the daily solar culminations allows one to count the days between

the winter and the summer solstice. This procedure would greatly facilitate the creation and usage of a primitive calendar and time measuring with units larger than a day.

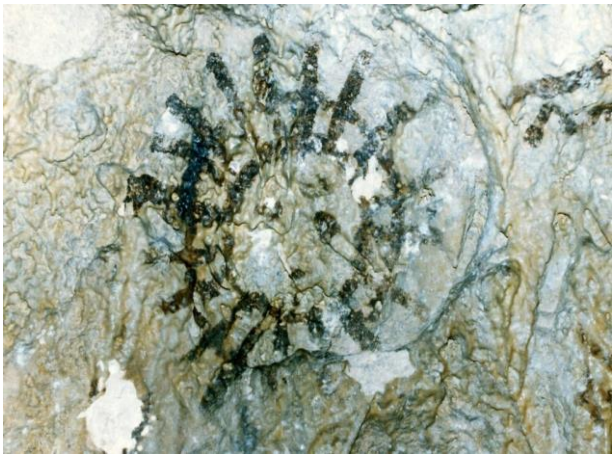

Figure 53. Solar symbol from the rocky complex near the village of Baylovo, Sofia Distric

This usage is intrinsically related with the economic, religious and daily requirements of the socium of that epoch.

Figure 64. Calendar recordings from the rocky complex near the village of Baylovo, Sofia District

ACKNOWLEDGEMENTS

We thank the anonymous reviewers for their constructive comments. This work was partially supported by the Stara Zagora Municipality, Science and Education Department. The authors would especially like to thank the students from the Astronomy school at Yuri Gagarin Public Astronomical Observatory, Stara Zagora for their work during the expeditions.

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