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The Astronomical Characteristics of Late Neolithic Circular Enclosures in Light of the Most Recent Research from the Transdanubian Region

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Late Neolithic circular enclosures make up a clearly defined group of phenomena. They are the manifestation of a common Central European ideology, whose uniform cultural and time horizon can be linked to the first third of the 5th millennium B.C.E. The precise number of sites can only be estimated, since numerous circular enclosures have only been registered through aerial reconnaissance or geophysical surveys. Numerous researchers explain the common features inherent in the ground plans of the circular enclosures through the astronomical interest of their builders.

The circular enclosures can be found near or within large, open settlements, but they do not encircle the settlement and often evidence of settlement cannot be discovered within the area that they enclose. The ground plan of the one or more ditches characteristically resembles a circle, and they are divided up by symmetrically placed earthen bridges, so-called gateways, through which it is possible to enter the enclosed inner area. The ditches were characteristically accompanied by palisades, also with openings at the same points as the gateways of the ditch. The circular enclosures of the Late Neolithic Lengyel culture have the most symmetrical ground plans amongst central European earthworks.

CHARACTERISTIC FEATURES OF THE ORIENTATION OF THE CIRCULAR ENCLOSURES AND ATTEMPTS AT THEIR INTERPRETATION

The circular ditches and the symmetrical placement of earthen bridges that divide them up were noted in research early on. Their astronomical examination led to the realization that in the case of circular enclosures with four gateways the axes of symmetry for the gateways were nearly perpendicular to one another, and in many cases they pointed in the cardinal directions or their close approximation. Determining the precise direction of the gateways is made more difficult by the fact that no traces indicating the center point in the interior of the earthworks have been found using archaeological means, and traces of buildings or structures can rarely be found within the interior area that would serve as a point of reference. Lacking central points, we consider the angle measured from due north (0º) of the intersection of the gateway's axis of symmetry and the horizon to be the orientation value of the given gateway. Naturally, the local topographical conditions impact the visibility of a possible orientation target. Therefore, it is important that during excavation or geophysical surveying the horizon is also examined and appraised.

The (seeming) lack of a geometrical central point also indicates that it did not have a particular significance in the beliefs that "created" these ditched enclosures. Although precise measurements show divergence from the cardinal directions, the interest of the research towards astronomical phenomena that can be linked to these circular enclosures has not diminished. According to certain researchers the orientation of the gateways may reflect the knowledge that the given community had obtained through the regular observation of the heavens, so they have related them to the Sun, the Moon and even to stars.[1] Many have

[1] Pavúk, J. – Karlovský, V.: Astronomische Orientierung der spätneolithischen Kreisanlagen in Mitteleuropa. *Germania* 86 (2008), 465–502; Pásztor, Emília – P. Barna, Judit – Roslund, Curt: The Orientation of Rondels of the Neolithic Lengyel Culture in Central Europe. *Antiquity* 82 (2008), 910–924; Pásztor, Emília – P. Barna, Judit: A késő neolit Lengyel kultúra körárkai. Lehetséges csillagászati ismeretek a Kárpát-medencében (Circular Enclosures of the Late Neolithic Lengyel Culture. Possible Astronomical Knowledge in the Carpathian Basin). In: *Medinától Etéig: tisztelgő írások Csalog József születésének 100.* évfordulóján (From Medina to Ete: Essays Celebrating the 100th Anniversary of the Birth of József Csalog), ed. Béres, M.

also hypothesized that the structures and their orientation may have had a calendrical function, and the rising and setting of celestial objects as seen through the gateways may have indicated important days in the calendars of their creators. The early research that only considered the Sun as their subject only paid attention to the directions in which it rose and set on the summer and winter solstices. However, all of these assertions were based on the examination of a few sites and in general paid no attention to the local horizon and terrain features. The Austrian researcher Georg Zotti supplemented his examination of the orientation of 31 Austrian ditched enclosures with painstaking topographical measurements. The results indicate a close relationship between the features of the terrain at the circular enclosure sites and the placement of the gateways, although the comparative analysis could only take present day features of the terrain into account. The majority of the Austrian circular enclosures were located at sites with an average slope of 4 degrees, and the entryways were essentially always framed so as to open in the direction of the slope, as well as in many cases perpendicular to this as well. According to Zotti's position, the topography may have been a more important organizational principle in the designation of the gateways than the astronomical point of reference.[2]

THE FUNCTION OF THE CIRCULAR ENCLOSURES

The function of the circular enclosures is debated. According to the most accepted current viewpoint they may have filled various roles at the same time, and their sacred or social character was probably more important than their economic or defensive nature.[3] The fact that the circular enclosures spread throughout a large area of central Europe in a short time and in a very similar form suggests that there was a common ideological setting behind their creation, which research refers to the "circular enclosure concept". This complex ideological content may have been what defined their former function for the most part. The sacramental area that was separated and even physically enclosed from everyday (profane) life, but was open above to the sky can also be interpreted as a symbol of the cosmological center point (*axis mundi*).[4] This ancient and universal symbol was in all likelihood a part of the complex symbolic system of the circular enclosures. The connection with the sky can also provide an explanation for the astronomical aspects of the circular enclosures.

INTERPRETATION OF THE ORIENTATION OF THE CIRCULAR ENCLOSURES

The following can be stated on the basis of the archaeoastronomical examination of more than fifty Lengyel culture circular enclosures identified at sites in the Carpathian Basin (in Austria, Bohemia, Moravia, Slovakia and Hungary). More than 90% of the gateways found on the eastern side of the ditched enclosures studied looked out on a point on the eastern horizon where the sun would rise sometime during the year. When plotted on a graph of how many degrees the eastern gateways were from due north it can clearly be seen that the direction of essentially every gateway was within the two extremes – sunrise on the winter and summer solstices – of the annual movement of the Sun (*Fig. 1*). Further groupings can be discerned within this arc, but no significant concentrations can be seen at the point of the sunrise on the days of either the

– Szabó, J. (Szentes: Koszta József Múzeum, 2009), 205–215; Zotti, Georg: Astronomische Aspekte der Kreisgrabenanlagen in Niederösterreich. In: *Mittelneolithische Kreisgrabenanlagen in Niederösterreich,* ed. Melichar, Peter – Neubauer, Wolfgang. Mitteilungen der Prähistorischen Kommission, Band 71 (Wien: Österreichische Akademie der Wissenschaften, 2010), 136–167.

2 The research was performed within the context of the ASTRONIM project. Zotti, Georg – Neubauer, Wolfgang: Astronomical and Topographical Orientation of Kreisgrabenanlagen in Lower Austria. In: *SEAC 2011 Stars and Stones: Voyages in Archaeoastronomy and Cultural Astronomy, Proceedings of the SEAC 2011 Conference*, ed. Pimenta, F. – Ribeiro, N. – Silva, F. – Campion, N. – Joaquinito, A. – Tirapicos, L. BAR IS 2720 (Oxford: Archaeopress, 2015), 188–200.

3 Melichar, Peter – Neubauer, Wolfgang: *Mittelneolitische Kreisgrabenanlagen in Niederösterreich. Geophysikalisch-archäologische Prospektion - ein interdisciplinäres Forschungprojekt*. Mitteilungen der Prähistorischen Kommission Band 71. (Wien: Verlag Österreichischen Akademie der Wissenschaften, 2010).

4 Eliade, Mircea: *Traité d'histoire des religions* (Patterns in Comparative Religion) (Paris: Editions Payot, 1949), 365–390. Id.: *The Sacred and The Profane: The Nature of Religion* (Orlando: Harcourt, 1959), 28–34.

winter/summer solstices or the spring/fall equinoxes, which would indicate a heightened meaning for these dates. The minor peaks seen on the curve of the graph perhaps mark those days or periods that were more prominent for the people of the Lengyel culture. These perhaps could have been festival periods, such as the times of basic agricultural work for these farming societies (sowing, harvest).

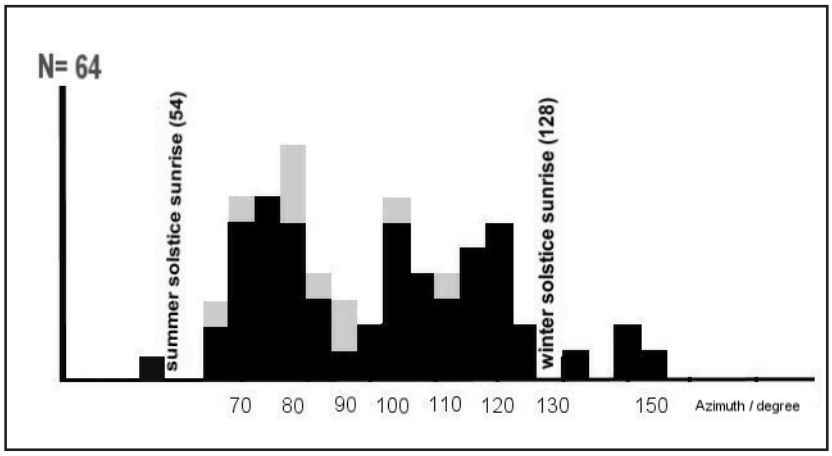


Fig. 1: Orientation of the 'eastern' gateways of the circular enclosures included in the archaeoastronomical examination (circular enclosures compiled up to 2008 in black and data from circular enclosures published since 2008 in grey)

It can be rightfully hypothesized that the building of a structure that was important to the community, spatially separated from profane activities and that required a great investment of energy would be related to some sort of festival, and its commencement, the ritual of its determination would have been linked to an event – the *sunrise* on a special day – that was an important part of their body of beliefs. The main objective of the rituals related to its construction therefore presumably could have been to make the appointed area sacred and to link the orientation that represented a crucial element of the foundation ritual with the heavens (see cosmic axes).

Construction (foundation) rites from this period and area have been indicated by archaeological observations.[5] These were performed for ritual spaces such as community structures, but also for dwellings. The Sun, either the direction in which it rises or just the celestial body itself, often played an important role in these rituals. According to our theory, the direction of the eastern gateway of these circular enclosures was oriented towards the sunrise of a particular day (festival?), and so on the basis of this we contend that the Sun played a fundamental role in the system of beliefs that determined the ideological backdrop to the construction of the circular enclosures. Although the phrase solar observatory is often used for these earthworks, we do not agree with this choice of words/designation, since their function was not to perfect a theoretical formulation through the regular observation of the celestial body.

According to the construction ritual we have reconstructed, the location of the eastern gateway was determined by the direction of the rising sun at that time, while the directions of the other gateways were only designated during construction. In the case of earthworks with four gateways, in general the western gateway was determined by lengthening the foundation line (the imaginary axis connecting the center of the circle and the eastern gateway, at a length corresponding to the radius of the circular enclosure), and then the locations of the north and south gateways were determined in a perpendicular direction from this (the east-west axis). The regular, circular ground plan also theoretically symbolized the Sun.[6]

However, there are also five known earthworks (*see fig. 1*), whose orientation lands outside the range of the Sun on the eastern horizon, so they weaken the theory outlined above on orientation based on the Sun. At the same time the difference can be relatively easily justified: perhaps the builders were not careful enough and did not begin to orient the eastern gateway precisely at sunrise, thereby it faced further to the south, no longer within the range of the Sun.

[5] e.g. Regenye, Judit: Házkultusz – házzal kapcsolatos rítusok a lengyeli kultúrában / Cultic aspect of the house – Rituals connected with the house of the Lengyel Culture. *Ősrégészeti Levelek / Prehistoric Newsletter* 13 (2011 [2013]), 102–112.

[6] Raczky, Pál – Anders, Alexandra – Hajdú, Zsigmond – Nagy, Emese Gyöngyvér: Zwischen Himmel und Erde – Polgár-Csőszhalom, eine Siedlung in Ostungarn. In: *Zeitreise Heldenberg: Geheimnisvolle Kreigräben: Katalog zur Niederösterreichischen Landesausstellung 2005*, ed. Daim, Falko – Neubauer, Wolfgang (St. Pölten: Niederösterreichische Landesmuseums, 2005), 203–209.

The relationship between the gateway and the slope observed in the Austrian circular enclosures also seemingly contradicts the above interpretations. Although no examinations similar to the Austrian topographical research have been performed on the circular enclosures of the Lengyel culture from the other regional groups, certain common characteristics may already be established. It is known that the majority of the ditched enclosures, and this is not just true of the Austrian sites, are not located on hilltops, but instead on the gentle slopes of hills. The majority were located on slopes that face towards the path of the sun. The topographical conditions of the sacred space (the circular enclosure) are determined by the cultural traditions of the community; however ethnographic research and vernacular traditions do not tell us anything about the role of the slope in their body of beliefs. Therefore, we are only able to provide a functional explanation for the selection of sloping terrain in the case of the circular enclosures: these sites (slopes) were selected to provide a good view of the path of the Sun.

Each ditched enclosure presumably belonged to several settlements, and as a sacred space held cosmological significance to the community. This is reflected in every characteristic of the circular enclosure: the site selection, their placement, the determination of the direction of the eastern gateway and in their ground plans.

THE RESULTS TO THE PRESENT OF THE RESEARCH PROGRAM RELATED TO THE LENGYEL CULTURE CIRCULAR ENCLOSURES IN THE TRANSDANUBIAN REGION

The solar orientation of the circular enclosures also inspired the research group formed through the leadership of Judit P. Barna to employ archaeoastronomical examinations amongst their methods. The research program is studying earthworks, including Neolithic circular enclosures, in Zala County in their natural environment, looking at them as man-made landscape shaping phenomena. In addition it is also evaluating the role the earthworks played in the prehistoric settlement network. In particular they are emphasizing the consideration that the celestial "landscape" – the sky together with its characteristic and conspicuous atmospheric and astronomical phenomena – is an organic part of the concept of landscape.

There are around 30 known sites in the Transdanubian region where Late Neolithic circular enclosures have been detected on the surface. The majority of these have been identified through rescue excavations or

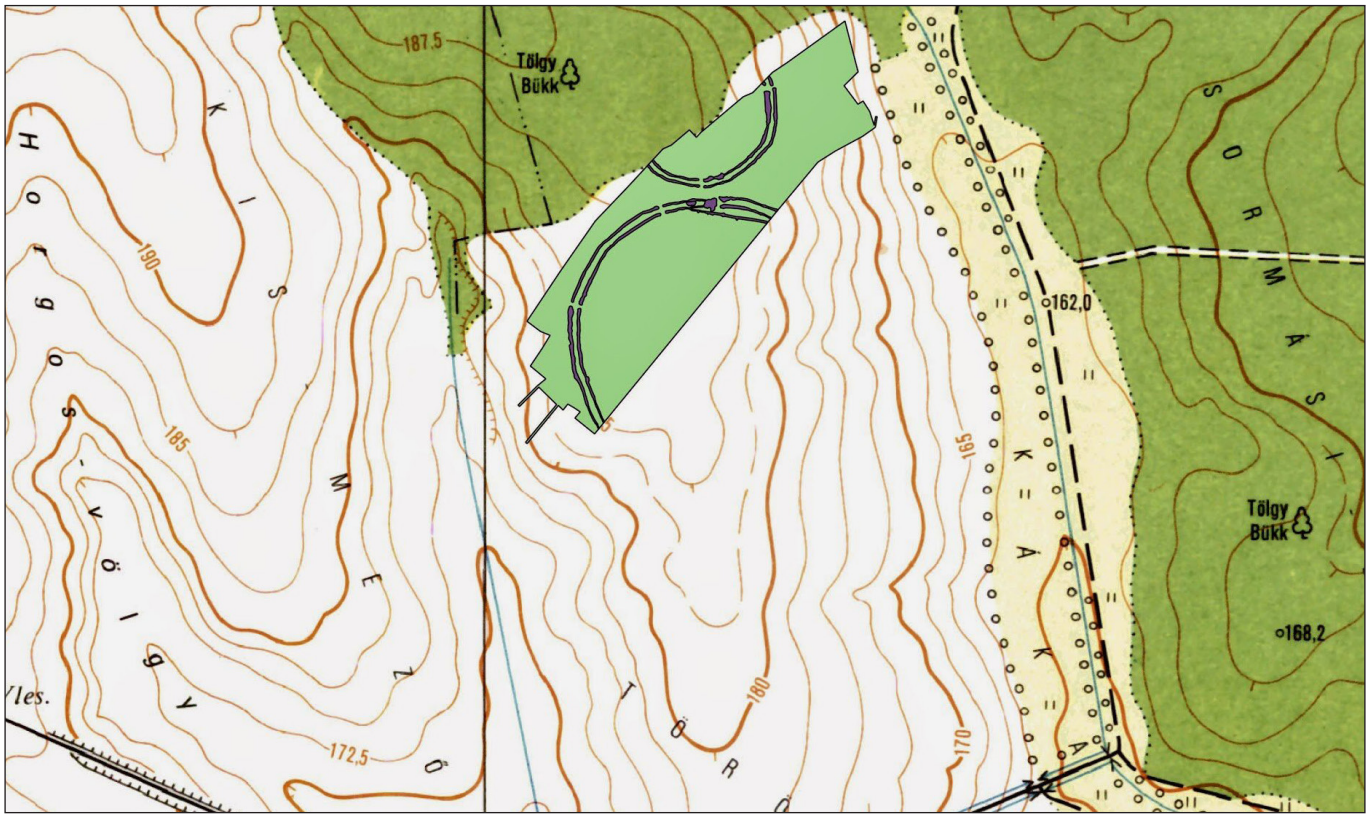


Fig. 2a: Sormás-Török-földek ditch systems along the right-of-way of the M7 expressway

discovered within the framework of research projects.[7] Presently the circular enclosures that can be considered the earliest are known from the southwestern Transdanubian region, from the period of the emergence of the Lengyel culture.

The Sormás-Török-földek site that has been previously studied through archaeological excavations occupies a significant place in Hungarian archaeoastronomical research. The results achieved during the study of the two Neolithic ditch systems uncovered here (including one that is a genuine Lengyel culture circular enclosure) have provided a fundamental argument that the creation of the Lengyel culture circular enclosures and the placement of the gateways indicate conscious planning, in which the Sun may have played a significant role (*Fig. 2a*).[8] The directions of the gateways that have been excavated at the Sormás-Török-földek site have provided information worthy of attention (*Fig. 2b*). When the Sun rose in the direction of gateway number 1 (15º to the north of due east) at the northern circular enclosure number I, on almost the same day it set in the direction of gateway number 1 at the southern circular enclosure number II. The legitimacy of this direction, or rather the date marked by it, is supported by the one excavated gateway at the circular enclosure at the village Sé, which also points in a direction 15º north of due east.

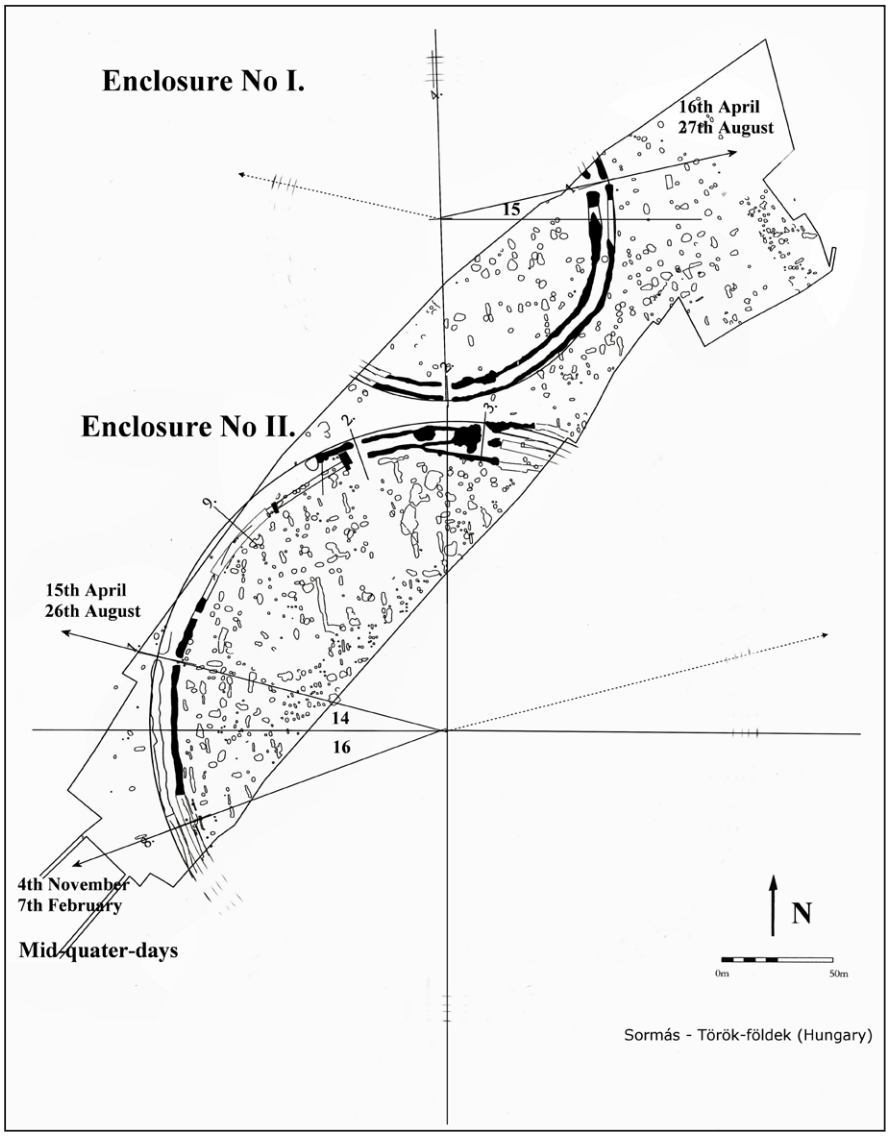
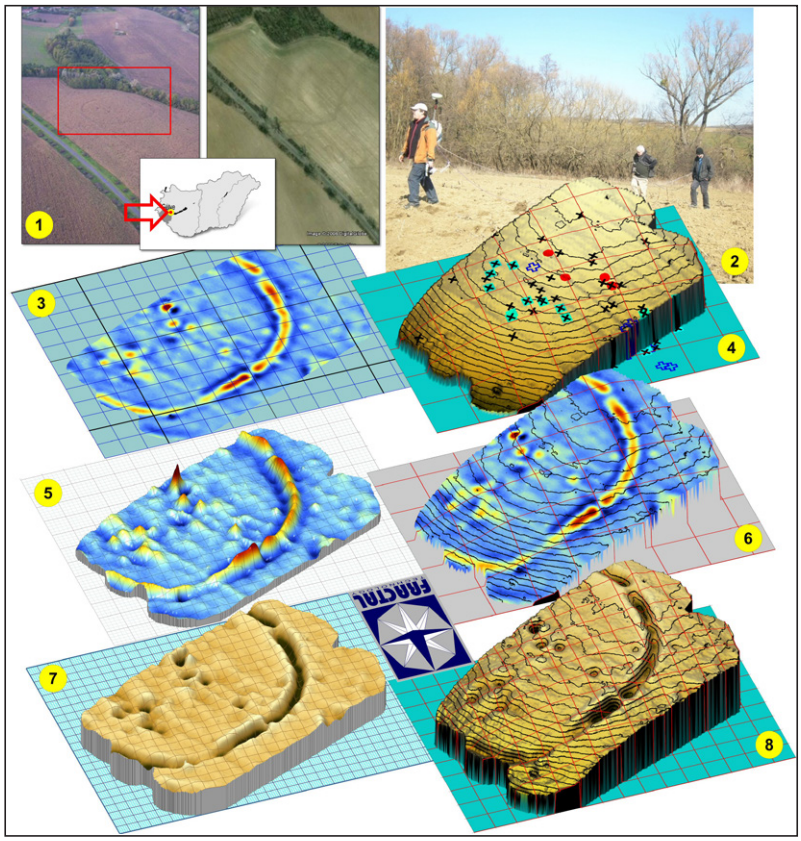


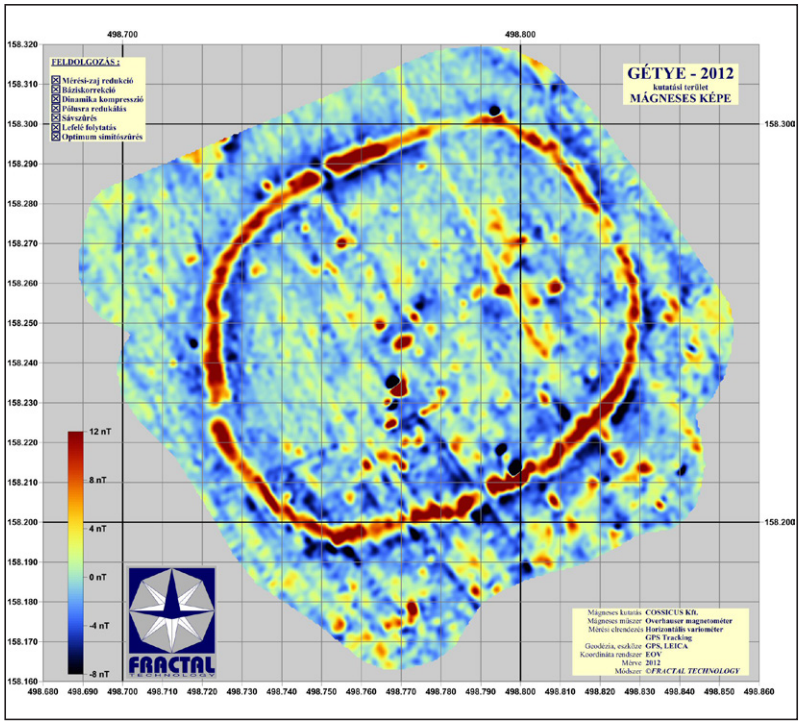
Fig. 2b: Orientation values for the excavated gateways from the dual ditch systems of Sormás-Török-földek

Gateway number 2 (to the south) at the circular enclosure number I also marked an important direction for the inhabitants of the settlement. The southern direction is where the apparent path of the Sun and every celestial body reaches its zenith and are in full strength. This is the direction that indicates the highest point of the Sun's annual path at the summer solstice. This direction is easy to precisely locate, since it is shown

[7] Bertók, Gábor – Gáti, Csilla: Neue Angaben zur Spätneolithischen Siedlungsstruktur in Südosttransdanubien. *Acta Archaeologica Hungarica* 62 (2011), 1–28; Bertók, Gábor – Gáti, Csilla: *Old Times – New Methods: Non-Invasive Archaeology in Baranya County (Hungary) 2005–2013* (Budapest–Pécs: Archaeolingua – Janus Pannonius Múzeum, 2014); P. Barna, Judit – Tokai, Zita Mária – Eke, István – Pásztor, Emília: A késő neolitikus körárkok kutatásának helyzete Zala megyében / Current Research on Late Neolithic Rondels in Zala County. *Archeometriai Műhely* 12/2 (2015), 75–88.

[8] P. Barna, Judit – Pásztor, Emília: Two Neolithic Enclosures at Sormás-Török-Földek (Southwest-Transdanubia, Hungary) and their Possible Geometrical and Astronomical Role: A Case Study. In: *Monumental Questions: Prehistoric Megaliths, Mounds, and Enclosures*, ed. Calado, David – Baldia, Maxiliam – Boulanger, Matthew. BAR International Series 2122 (Oxford: Archaeopress, 2010), 119–125; P. Barna, Judit – Pásztor, Emília: Different Ways of Using Space Traces of Domestic and Ritual Activities at a Late Neolithic Settlement at Sormás-Török-földek. *Documenta Praehistorica* 38 (2011), 1–22.





by the sun every day. The importance of the north-south direction is also reflected in the relative locations of the two circular enclosures at Sormás-Török-földek. The line connecting their imaginary center points runs nearly north-south and passes through the southern gateway of the northern circular enclosure.

The direction of the possible gateway number 8 in circular enclosure number II is also connected to an interesting astronomical/calendrical event. It is in this direction that the Sun sets in the first weeks of November and February, at the time of the so-called mid-quarter days, which perhaps indicated the beginning of winter and spring on an alternative prehistoric calendar. The unexcavated sections of this dual system of circular enclosures have also been surveyed within the framework of the research program, and the evaluation of the data is ongoing.

The magnetic survey of the Gétye-Gyomgyáló-lejtős site that had been discovered through an aerial photograph was performed with the primary goal of collecting information related to its structure and ground plan (*Figs 3a-b*). We have reported on the present state of our multidisciplinary research at two conferences and in several articles.[9] The survey took place in two phases. The incomplete ground plan surveyed in the first phase (*Figs 3a, 5, 6-8*) was reconstructed according to our hypothesis, and the direction of the eastern gateway on this ground plan was at 66º. This reconstructed ground plan was verified through the results of the second phase of the survey (*Fig. 3b*).

Fig 3 a-b: Results of the magnetic survey at the Gétye-Gyomláló-lejtős site

[9] P. Barna, Judit – Tokai, Zita Mária – Pásztor, Emília – Eke, István – Puszta, Sándor – Puszta, Adrián – Busznyák, János – T. Biró, Katalin – Száraz, Csilla: Late Neolithic Circular Ditch Systems in Western-Hungary. Overview on the Present Stage of Research in Zala County, Hungary. In: *Centenary of Jaroslav Palliardi's Neolithic and Aeneolithic Relative Chronology,* ed. Jaromir, Kovarnik, in press; P. Barna, Judit – Eke, István – Puszta, Sándor – Puszta, Adrián – Busznyák, János – Tokai, Zita Mária – T. Biró, Katalin – Pásztor, Emília – Száraz, Csilla: Késő neolitikus körárok magnetométeres felmérése Gétyén (Magnetic Survey of a Late Neolithic Circular Enclosure in Gétye). In: *A táj változásai a Kárpát-Medencében* (Changes in the Landscape in the Carpathian Basin). ed. Füleky, György (Gödöllő: Környezetkímélő Agrokémiáért Alapítvány, 2012), 135–139, figs 36–37.

We discovered the Bezeréd-Teleki-dűlő II site through satellite images. The geomagnetic survey is particularly clear and resulted in a ground plan that can be easily analyzed. This plan also appears to be peculiar from the aspect of its orientation. The archaeological and archaeoastronomical processing of the data is ongoing.

THE "TEST" OF THE THEORY

Since the elaboration of our theory in 2008 several new surveyed or excavated Lengyel culture circular enclosures have been researched and published. The orientation of every one of these, including the most recently discovered circular enclosures from the Transdanubian region are in perfect harmony with our positions related to the foundation ritual and the symbolism of the circular enclosures. The orientation of the eastern gateways of the Transdanubian circular enclosures not only falls within the section of the horizon where the sun rises, but within this is also concentrated within a narrow range (±5%), thus indicating a common guiding principle suggesting a common foundation ritual (*Fig. 4*).

In view of the structure and form of the circular enclosures, the greatest similarity to one another is shown in those from Transdanubia, southeastern Slovakia and Lower Austria, in other words the hypothetical area where the Lengyel culture emerged. As they spread further in space and time, the differences from the

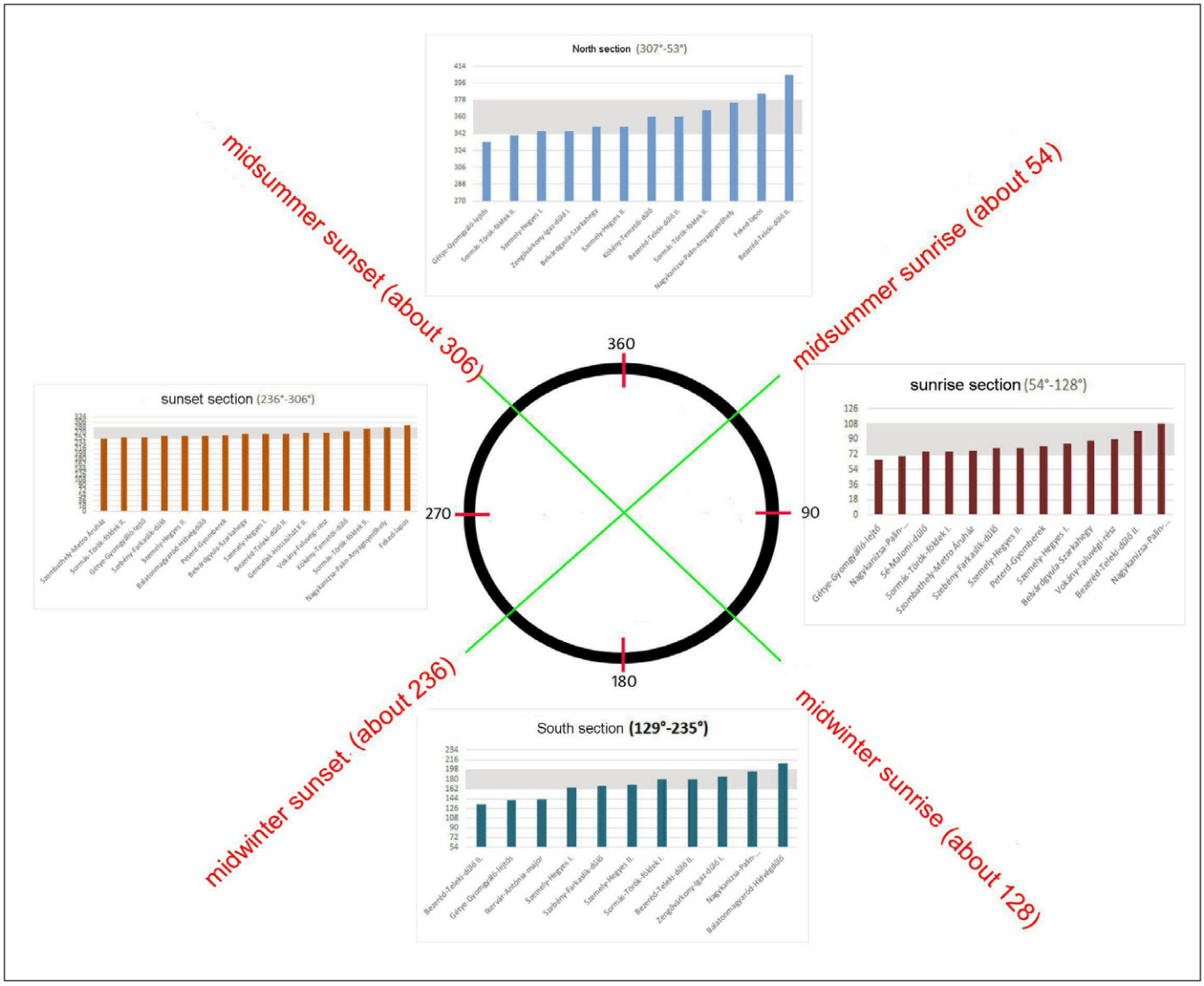


Fig.4: Orientation values for gateways of the 16 Late Neolithic earthworks in the Transdanubian region that had measurable data

"classical" Lengyel culture form are ever greater.[10] On the basis of our present knowledge it seems that these similarities manifest in their most concrete form in the orientation of the gateways, in other words in the concept that inspired the construction of the circular enclosures themselves. This principle and concept was adhered to in the Transdanubian region, a part of the area where the Lengyel culture and the circular enclosures emerged, even in the later phases of development when the structures and ground plans had gone through significant alterations, or in this sense, distortions.

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