Archaeoastronomy
and Ancient Technologies

The Barec of "Piani del Monte Avaro" (Bergamo, Italy)

Anna Gastaldelli

The Astronomical Observatory of Brera (external collaborator), National Institute of Astrophysics (INAF), Milano, Italian Republic; agastaldelli@virgilio.it

Abstract

This article outlines some archaeoastronomical results about an Iron Age site gained during the "Practical Archeoastronomy Course" held the 24th and 25th of June 2017 by Prof. Adriano Gaspani. The Iron Age settlement is called "Barec dei Piani del Monte Avaro". On it where found a closed enclosure of stones formed by an elliptical drywall inside which there are some megalithic structures: a monolith on a lithic platform, another monolith on which was placed on purpose a big rock with a perfectly vertical vein of white quartz oriented astronomically in accordance with the megalithic structure. At the top of the *barec* there is a large erratic monolith that overhangs all the stones of the drywall. The dry stone enclosure was found to be contemporary to monolithic structures. Within the enclosure lie, in the lower area, the remainders of a probable hut bottom. The site was active during the 6th century BC and the people that most likely attended to it was the celtic tribe of the Orobi who belonged, as well as all the tribes spread in the area now known as Lombardy (located between 45° and 46° North geographical latitude) to the Golasecca Culture. This civilization dates back to the first part of Iron Age and derives from the Canegrate culture of the 13th century BC which in turn is linked to the ancient culture of Halstatt, the oldest Celts lived in Northern Europe. The results of this astronomical survey are the detection of three alignments directed toward important directions, associated with the rising and the setting of the Moon at the southern extreme standstill, that proved this complex to be a Moon Sanctuary.

Keywords: Astronomy, archeoastronomy, Moon, Rigel, *barec*, Celts, Gaspani.

Introduction

During the "Practical Archeoastronomy Course" held the 24th and 25th of June 2017 by Prof. Adriano Gaspani, we went to the Iron Age settlement called "Barec dei Piani del Monte Avaro" in order to carry out the astronomical survey of the site. We measured any alignments and their orientations, both the horizontal angles and their converted astronomical azimuths as well as the vertical ones and their conversion to angular heights.

Object of study

The *barec* is a closed enclosure of stones formed by an elliptical drywall inside which there is a megalithic structure, a massive stone located on the top side of the drywall (hereafter M1) a monolith on a lithic platform (hereafter M2), another monolith on which was placed on purpose a big rock (hereafter M3) with a perfectly vertical vein of white quartz that served as collimator toward the western horizon, and some other big stones. The complex realizes a set of three

astronomical lines: M1 to M2, M1 to M3 and M2 to M3. The dry stone enclosure is not contemporary to the monolithic structures, seem to be more recent of a couple of century. Within the enclosure lie, in the lower area, the remainders of a probable proto-historic hut bottom. The megalithic site might be active during the 6th-4th century BC as the Lepontic (Celtic) inscriptions recently found few kilometres away from the site witness (Casini, Fossati, Motta, 2011). The people that most likely attended to it was the Celtic tribe of the Orobi who belonged, as well as all the tribes spread in the area now known as Lombardy (located between 45° and 46° North latitude at that time) to the Golasecca Culture (Gaspani, 2006)**.** This civilization dates back to the first part of Iron Age and derives from the Canegrate culture of the 13th century BC which in turn is linked to the ancient culture of Halstatt, the oldest Celts lived in Northern Europe (Gaspani,1999). According to Gaspani (Gaspani, 1999) the Golasecca people had a nice knowledge of the sky and of the motion of main celestial bodies. The astronomy practised by Golasecchians was of the Celtic kind, so we will look at some relevant aspects to our analysis that belongs to Celtic astronomy. Celts divided time into weeks, fifteenth and months through observations made by their druids that studied the lunar cycle (Gaspani, 2016). They were able to predict the lunar phases and use them for ritual purposes attributing to the Moon a religious importance. In general, the sacred places lying on the Italian Alps are characterized mainly by the presence of large erratic boulders naturally oriented along significant astronomical directions (Gaspani, 2009), secondly from the proximity to woods, waters such as springs or rivers or lakes and stones as the Celtic tradition also wants (Gaspani, 2016, 2013). Cup marks lie on the boulders, petroglyphs and grooves usually are symbols of a ritual use (Gaspani,1999) (fig.1 and 2).

Figure 1. Grooves on Megalithic structure (photo by the author)

Figure 2. Monolith of "red serizzo", a local stone, placed on a platform and veined by an astronomically oriented white quartz vertical line (photo by the author).

Methods and Calculations

The "*barec*" of the "Piani del Monte Avaro" lies at a height of 1762 Mt on the local profile of the geocentric ellipsoid WGS84. The geographical coordinates of the great boulder placed on the top of the lithic enclosure, referred to the same ellipsoid, are:

$$\varphi= 46\ 00\ '\ 38\ "88\ N;\ \lambda= 9\ 35\ '\ 50\ "64\ E;\ altitude = 1762\ meters$$

The *barec* is located in an area not far from coniferous woods. In ancient times there flowed a stream that today is no longer seen but today at a short distance there is a reservoir of modest dimensions that is used as trough for goats and cows perhaps a rest of the ancient stream. There is an iron mine now abandoned but we think extremely important for the life of an Iron Age tribe. During 1996 some Golasecchian's ceramics have been found inside the "barec" of Piani dell'Avaro. They have been given to the Soprintendenza Archeologica della Lombardia (The Italian Government Archaeological Institution) that dated this rests to the VI century BC unfortunately they have not been published yet. At this very moment we don't know where they are. During the measurement session we carried out some measurements using a GPS receiver equipped with an external antenna mounted on a tripod and a topographic compass Wilkie mod. 9610. In the first place was materialized on the ground a GPS baseline starting from the point PT033 placed at a geographic latitude of 46° 00' 12".30 N and a geographic longitude of 9° 35' 07".5, at an altitude of 1725 MT, corresponding to a point located near a small church named "Cappella degli Alpini", placed in the air line at about 900 MT from the barec large monolith on which was materialized the other extreme of the base. The PT034 point whose geographic coordinates referred to the WGS84 ellipsoid are as follows: 46° 00' 38".88 N, longitude 9° 35' 50" E and quota equal to 1783 MT compared to the profile of the geocentric ellipsoid WGS84

(fig. 3). The profile of the geoid (NIMA EGM96) passes 48.2 meters above the local profile of the WGS84 ellipsoid.
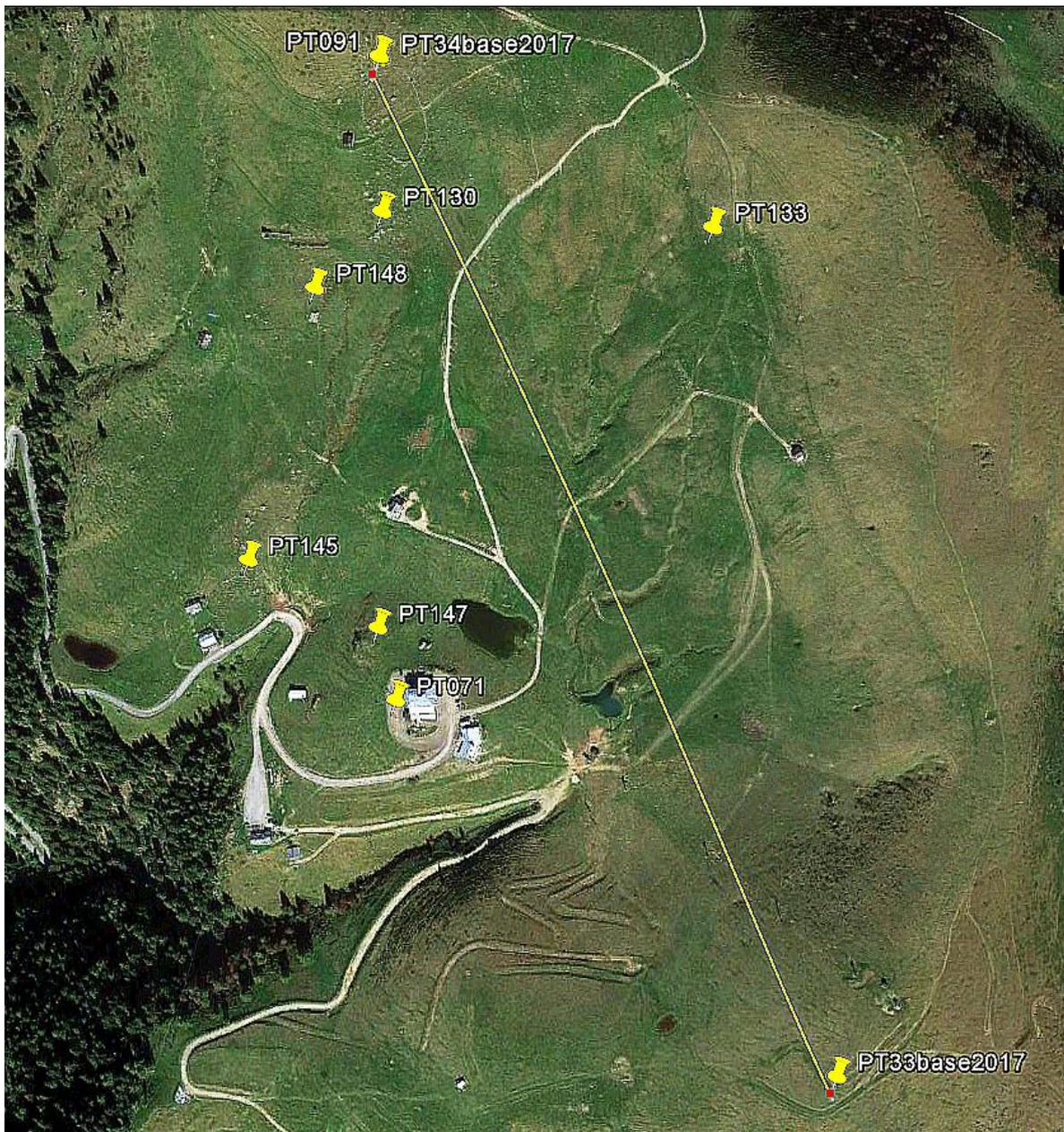

Figure 3. The GPS baseline materialized at the Piani del Monte Avaro and used to calibrate the magnetic azimuths measured by transforming them into astronomical azimuths (photo from Google Earth).

Solving the GPS baseline and calibration of the magnetic azimuths

In this section we outline the numerical technique used in order to solve the GPS baseline in order to calibrate the magnetic azimuths transforming them in astronomical ones. Let P1(φ1, λ1) and P2(φ2, λ2) the extrema of the baseline, N is the North Celestial Pole and G is the centre of the Earth (WGS84 ellipsoid) (fig. 4), Solving the spherical triangle P1-N-P2 we will obtain the astronomical azimuth Az of orientation of the baseline. Once known the extreme points geographic coordinates of the GPS baseline, the astronomical azimuth of orientation was calculated comparing the magnetic and astronomical azimuth of the same baseline.
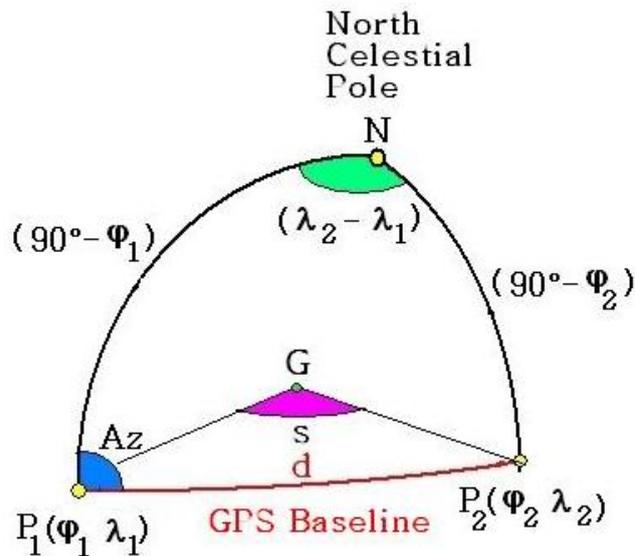
Figure 4. The spherical triangle solved in order to carry out the geodetic/astronomical azimuth of orientation of the baseline P1→P2.

The average azimuth of the GPS base in the direction PT33 → PT34 obtained by processing the data was: Az = 336°.210 with an r.m.s.[1] error of ± 0°.005. The length of the baseline was equal to 896.4 meters with an r.m.s. error of ± 5 cm. The orientation azimuth of the GPS base is geodetic, but for the particular definition and orientation of the WGS84 ellipsoid, this azimuth is also astronomical. Then we collimated, both outward and return an extreme of the GPS base on the other, using a topographic Compass Wilkie mod. 9610 and with a Nikon 7x50 CFWP marine compass-binoculars in order to determine the corresponding magnetic azimuths (fig. 7). The magnetic orientation azimuth of the baseline in the direction PT33 → PT34 resulted:

Am = 333°.0 ± 0°.2 (measurement with Compass Willkie mod. 9610)

Am = 331°.1 ± 0°.1 (measurement with Nikon binoculars 7x50 CFWP)

Having available both the astronomical and magnetic azimuth of the GPS base it was possible to calculate the calibration value of the offset useful to convert all the magnetic azimuths measured in the archaeological site into the corresponding astronomical azimuths useful to perform the archaeoastronomical study.

Discussion of Results

We have identified a number 3 important alignments in the site that are astronomically significant. Two of them are supposed being lunar. The first of them is the one that joins the monolith placed on the top of the *barec* with the central boulder with cup marks (fig. 6) and the second one joining the upper monolith with a second boulder made by red "serizzo" (a metamorphic gneiss) lying in the site, placed on a platform and veined by a vertical quartz line (fig. 7); the same lined monolith is a point of collimation of an alignment starting from the great Boulder Summit and directed with excellent approximation parallel to the direction of the local astronomical meridian (fig. 8).

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[1] r.m.s. means "residual mean square" that is the standard deviation σ.

Figure 5. A phase of measurement of magnetic azimuths using Nikon marine binoculars (photo by the author).

These alignments are developed according to an astronomical azimuth of Az = 134°.5 ± 0°.2 and Az = 222°.6 ± 0°.2 and, is supposed being aligned towards the point of rise and the set of the Moon at the extreme southern standstill, when the declination of the Moon reaches the value δ = $(-ε-i)$ [2]

We have calculated the declination corresponding to the measured astronomical azimuths equal to 134°,5 and 222°.6 using the following standard formula:

$$sin(δ) = cos(Az)\ cos(φ)\ cos(h_o) + sin(φ)\ sin(h_o)$$

Where Az is the measured azimuth of the alignment, φ is the geographical latitude of the site, *h* is the height of the local profile of the horizon, obtaining δ=-29°.1. The height of the local skyline is: Az=134.5 -> ho=0° and Az=222.6 ->ho=+1°. The site is high (altitude 1740 mt, so the local horizon is depressed). The height of the skiline was measuered by the clinometer and after, during the computations, it was syntetized by a DTM using STRM data (STRM =Shuttle Radar Topography Mapping). For the azimuth Az=222°.6 referring to the second supposed lunar line, we obtained δ=-29°.9. The computed average topocentric declination of the Moon during the I millennium BC was δ=-29°.2. Since the difference between the observed declination and the computed one was Δδ=+0°.1 for the line pointing to the rising point of the Moon, and Δδ=+0°.7 for the line pointing toward the lunar setting point, we conclude that the correlation between the alignments found in the site and the Moon at the extreme southern standstill is real.

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[2] The term ε is the Obliquity of the Ecliptic, that is, the inclination of the axis of the Earth relative to the line perpendicular to its orbital plane, equal to about 23°.5; *i* is the inclination of the orbit of the Moon with respect to the orbit of the Earth which is just over 5°.1.

Figure 6. The line joining the large superior monolith with the Central Boulder with cup marks is aligned in the direction of Moonrise to the local natural horizon at ho=0° at the lower extreme standstill (image Google Earth).
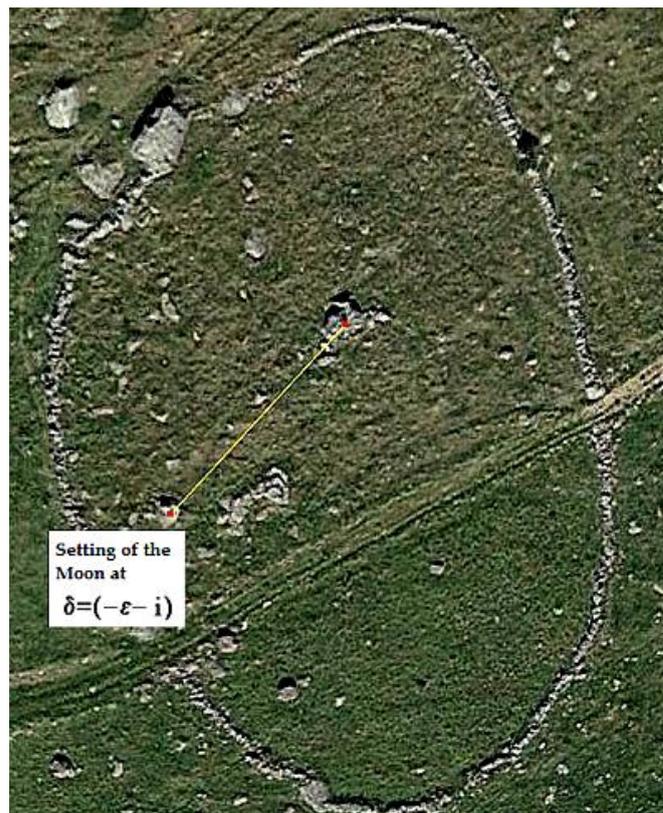

Figure 7. The line joining the boulder with cup marks with the monolith placed on the platform is aligned on the sunset point of the moon at the local natural horizon (ho=1°) at the southern extreme standstill (image Google Earth).

Figure 8. The line that joins the great boulder summit with the monolith placed on the platform is parallel with great approximation to the direction of the local astronomical meridian (image Google Earth).

This study was made with the aim to find one more typical place among many frequented by the Orobi, a tribe of Celtic origins of which we still do not know much about religious beliefs and customs and practices. Instead, the "*barec*" of "Piani dell'Avaro" proved to be a place of lunar sanctuary.

Conclusions

The only reasonably acceptable conclusion, supported by statistical and probabilistic analysis of data from multiple alignments and in particular from what arise from the three alignments show in figures 6,7, and 8, is that the *barec* was a summer lunar sanctuary active in the 6th century BC. We affirm that for two main reasons: the first is that the statistic values found for the Moon were absolutely optimum for the 6th century BC and the second is that in that area were found inscriptions in Lepontic that is proved (Casini et Al.,2011) to be the language in use during this century by Celtic Orobic people. Now we can say that this place is actually a much more complex structure from the point of view of ritual and archaeoastronomical level and that it will have to be studied for longer.

Acknowledgments

References

Casini, Fossati, Motta, 2011 - Casini, S.; Fossati, A.; Motta, F. Incisioni protostoriche e iscrizioni leponzie su roccia alle sorgenti del Grembo (Val Camisana di Carona - BG). Note preliminari. Quaderni Brembani, 2011; No.9, pp..20-39.

Gaspani, 1999 - Gaspani, A. La Cultura di Golasecca: Cielo Luna e Stelle dei Primi Celti d'Italia, Aosta, Italy: Keltia Editrice, 1999.

Gaspani, 2006 – Gaspani, A. "Qualche nota in relazione al popolamento dell'alta Valle Brembana in epoca preistorica e protostorica" in "La Chiesa Parrocchiale di Mezzoldo", a cura di Gabriele Medolago, ed. Corpo Nove, Clusone, 2006.

Gaspani, 2009 – Gaspani, A. Astronomia e antica architettura sull'arco alpino, Quaderni di Cultura Alpina No. 89, Priuli & Verlucca ed., 144 pp., Scarmagno (TO), 2009.

Gaspani, 2013 – Gaspani, A. Astronomia e Antica Spiritualità Alpina, edito dall'Associazione Culturale Fonte di Connla, Ivrea, 2013.

Gaspani, 2016 – Gaspani, A. Simbolismo Astronomico e antica spiritualità celtica in Valbrembana. In Gli Orobi: alle radici delle genti bergamasche edito dall'Associazione Culturale Terra Insubre, Varese, pag. 93-118, 2016.