*Mediterranean Archaeology and Archaeometry, Vol. 9, No. 2, pp. 61-69*


# TOPOGRAPHICAL AND ASTRONOMICAL ANALYSIS ON THE NEOLITHIC "ALTAR" OF MONTE D'ACCODDI IN SARDINIA

**P. Pili[3], E. Realini[2], D. Sampietro[2], M. P. Zedda[4], E. Franzoni, G. Magli[*1]**

*[1] Faculty of Civil Architecture, Politecnico di Milano, Milano 20133,Italy,*
*[2] Geomatics Laboratory, Politecnico di Milano (Como Campus), Como 22100, Italy,*
*[3] Mandas, Sardinia;*
*[4] Isili, Sardinia*

**Received:** 15/11/2008
**Accepted:** 29/11/2008

*Corresponding author: G. Magli,*
*giulio.magli@polimi.it*

## ABSTRACT

The pre-historic 'altar' of Monte d'Accoddi - near Sassari, Sardinia - is a unique monument in the whole Mediterranean area. It is indeed a huge "pyramid" constructed out of cyclopean masonry, but it exhibits a monumental access ramp similar to the Mesopotamian Ziggurats. The monument is extremely ancient since its first phases of construction date back to 3200 BC; it is usually interpreted as a sacred center perhaps devoted to the "Mother Earth". Although pretty little is known about pre-nuragic religion, astronomical alignments have been documented in contemporary sites in Sardinia. Therefore, with the aim of contributing to the interpretation of such a unique construction, we have carried out a new, complete archaeoastronomical survey of this monument and its annexes, which is presented here. It turns out that, the presence of astronomical references at the site becomes apparent if the alignments defined by the menhirs located in the fields nearby are analyzed. Indeed, there exists convincing evidence that, from the summit of the platform, lines of sight at the eastern horizon guided by a white limestone menhir and by a reddish stone menhir located at some two hundreds meters from the monument framed the rising of the Sun at winter solstice, pointing to the rising of Sirius and to the southern extreme declination of Venus respectively, while the same menhirs were likely used as backsights for the standstills of the Moon as observed from the eastern corners of the monument.

**KEYWORDS:** Monte d' Accoddi, altar, Pre-nuragic Sardinia, Astronomical alignments, menhir.

## THE PREHISTORIC MONUMENT OF MONTE D'ACCODDI

The 'altar' of Monte d'Accoddi is located some 8km north of the modern town of Sassari, Sardinia (lat. 40° 46′, lon. 8° 26′, h. 60m AMSL, see Figure 1). The area has been subjected to intensive farming and human activities, but the monument remained buried up to the 1950s, when it was first excavated by the archaeologist Ercole Contu (Contu, 1953a, 1953b 1984). Subsequently, Santo Tinè operated other excavations (Tinè, 1987, 1989) and a reconstruction of the upper terrace, which appears today as a two-step pyramid with a monumental access ramp (see Figure 2).

However, only the ramp and the lower step are authentic, and it is actually rather doubtful that the upper part was originally conceived as a sort of terraced altar; it seems more likely that the monument had a change in the slope of the exterior flanks, like the Egyptian pyramid of south Dashour, and that only a small flattened area was located on the top. In any case, due to the access ramp which distinguishes it from the pyramids, the Monte d'Accoddi monument is a unique in the whole Mediterranean area.

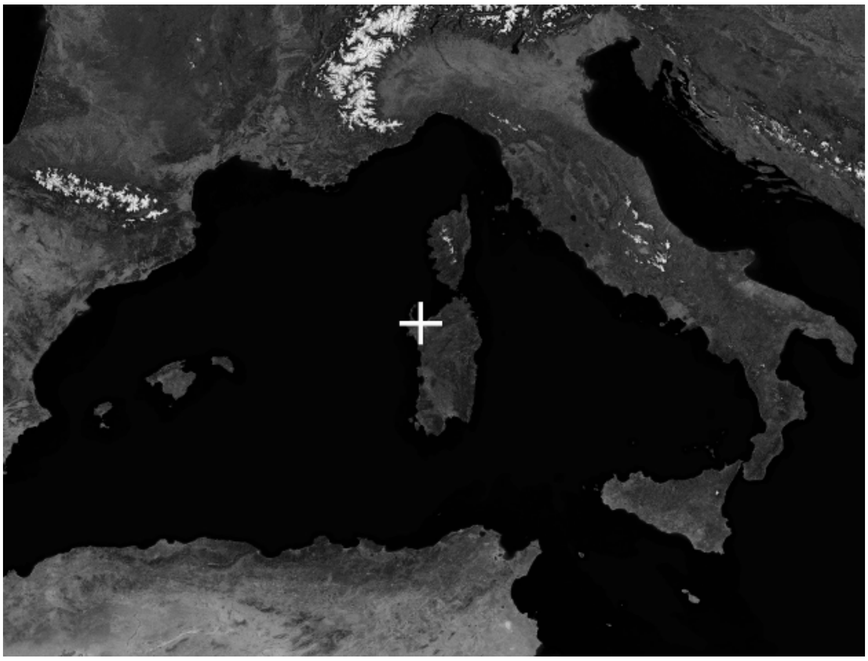

**Fig. 1: the location of Monte d'Accoddi (image source: NASA World Wind)**

The most close similarities, if any, have to be found in Mesopotamian Ziggurats, which however were built of mud bricks, while the bulk of the Monte d'Accoddi monument is composed by an earthwork encased with stone blocks joined together without mortar (we do not share the idea - commonly present in the literature - that the monument was constructed with a "primitive" technique; a careful inspection indeed shows a clear attention of the builders for the stability of the structure; for instance, huge "corner blocks" are set along the baseline).

**Fig. 2: Monte d'Accoddi**

Stratigraphy of the excavations puts Monte d'Accoddi among the most ancient stone monuments of the Mediterranean area (Contu, 2000). Actually it was constructed in two phases: a first 'altar' was built during the final phase of the Ozieri culture (around 3200 BC); later this 'altar' was included in a greater construction (in a manner similar to the way in which meso-american temples were 'renovated', building a new temple over the old one). The monument is probably contemporary to the "Dolmen phase" of funerary customs in Sardinia (Hoskin and Zedda, 1997).

The first altar was 5.50m high, built as a platform 23.80m x 27.40m wide, on which a rectangular 'temple' of 12.50m x 7.25m was standing. It should be noticed that such measures, obtained in our own survey, differ slightly from the ones published by E. Contu (Contu, 2000).

This 'temple' has been found, buried in the core of the later phase, and still retains the original casing frescoed with red okra. The ramp of the first phase was 5.5m wide and 25m long. The second phase of the monument belongs to the so-called Filigosa-Abealzu culture, which flourished between 3200 and 2700 BC circa (more recent frequentation is attested by a few traces as well). The second platform measures 35m x 31m, with a ramp 40m long. It is uncertain if the original height of the monument was the one visible today, achieved in the restoration, although this seems likely, due to the presence of part of the original stonework on the west side of the upper part of the ramp.

Not much is known of the religion of pre-nuragic Sardinia (Lilliu, 1988), but according to the archaeological finds, which include statuettes and other offerings, it is certain that Monte d'Accoddi was an important religious centre, and it seems likely, at least according to E. Contu, that fertility rites should have taken place there. According to Lilliu (Lilliu, 2001) the place was associated with the so-called 'Mother earth' divinity *"in the unusual version of Goddess of the Sky, controlling the axis mundi"*.

To complete the description of the monument, we notice the presence of a huge menhir (4m high) on the left of the ramp and of a megalithic table around 10m$^2$ wide on the right side. The table is laid on irregular stone supports, resembling a dolmen, and it is believed to have been used for sacrifices. Near the table, but not in the original position, lies a huge spheroidal stone (similar to the much later Delphi 'omphalos') as well as a smaller, similar one.

The presence of menhirs in the nearby fields is reported in literature. We were able to locate three of them: one lies to the south of the ramp, while the other two lie in a corn field located on the east side of the monument (precise data will be given below).

The first of these two is made of white limestone, about 2.30m high; the other is made of reddish sandstone, around 1.90m high (Figure 3). The menhirs do not stick out at the horizon profile from the summit of the platform, however the horizon is only slightly more pronounced (two menhirs, say, 4.5 and 5.5 meters tall would have been sufficient to this scope, and erecting such huge stones was certainly within the abilities of the builders). All menhirs most probably belong to the first phase of the monument, while the table, which exhibits cup marks and holes, belongs more likely to the second phase (see Contu, 2000). The 'omphalos' is a unique find for such an ancient context, and therefore it is undatable.

## DISCUSSION

An archaeoastronomical analysis of the monument has already been carried out (Proverbio et al., 1991, Romano, 1992), but it did not include the possible alignments of the menhirs. As a consequence, we have subjected the whole monument to a new, complete survey which led to a partial re-assessment of the previous study.

The cyclopean walls of the platform are somewhat irregular and some sectors are partially collapsed; it is, however, possible to measure the main orientation of the sides.

**Fig. 3: the white (left) and the red menhirs.**

The building is not squared, since the east side is oriented 11°24′ west of south while the west side 14°31′; the north side is oriented 15°19' south of east. The ramp (which rests on the southern side) is quite irregular; a line connecting the middle point of the summit with that of the entrance is oriented 8°02′ west of south. These measures essentially coincide with those calculated by Aveni, Proverbio and Romano; according to these authors, the orientation of the northern side might have been conceived to indicate the minor lunar standstill; however, this alleged alignment is clearly untenable, since the azimuth of the rising Moon at minor standstill in 3200 BC at Monte d'Accoddi was 116°23′ (116°20′ at the end of the second phase around 2700 BC). In addition, the monument is obviously conceived for rituals occurring on the top, so that the possibility of 'tangential' alignments of the sides, as those documented in the Nuraghes (Zedda and Belmonte, 2004) looks unlikely. Overall, we believe that the roughly cardinal orientation of the monument per se was not dictated by astronomy (by the way, if needed, a very good 'pole star' was available at that times, since in 3000 BC the star Thuban was located at 1°30′ from the pole).

Aveni, Proverbio and Romano also measured the line connecting the centre of the 'table' and the menhir on the western side of the ramp obtaining 130°14′. Again, we confirm this measure but we consider untenable the lunar alignment to the maximum standstill proposed by these authors, first of all because the 'table' probably belongs to a later phase with respect to the menhir, and also because it is unclear from where such observations could have been carried out. The authors also mention two further menhirs: one of them is reported to be invisible from the platform, and this is probably the menhir we are calling the white one (in fact only the top of it is visible today due to the presence of a modern water reservoir). The other one is reported to have an azimuth of 107° as viewed from the top of the platform. We have not been able, however, to locate such a menhir nor on site, neither in the existing archaeological literature.

Summarizing, the existing literature on the monument did not take into account the possible astronomical significance of the menhirs located in the original position, in the fields on the eastern side of the monument. As we shall see in a while, however, the analysis of the alignments defined by such menhirs does show the likely interest of the builders for the sky. Before entering into details a comment is necessary. Since, as mentioned, the monument has been heavily restored on its top, we had to make some assumptions on the original configuration of its features. We have therefore estimated the height of the original terrace, which was very probably close to the reconstructed one, and traced as much as possible the sides of the original basement, estimating its centre at 40°46'26" north, 8°26'56" east. Then we simulated variations in the alignments, corresponding to longitudinal displacements of about 4 meters in both directions of the observation point on the summit. In the worst cases we obtain variations in the azimuths of the menhirs lower than one degree.

As mentioned, we were able to locate the three menhirs reported to be in their original position (Contu, 2000). We assigned to them the letters W, R, F respectively (see Figure 4). We give in Table 1 the following data: distance from the centre of the upper terrace, azimuth, height of the horizon and declination.

**Table 1: Data measured from the centre of the monument for the three menhirs.**

| Foresight | distance | azimuth | altitude | dec. |
|---|---|---|---|---|
| W menhir | 218 m | 119°46′ | 1°07′ | -21°34′ |
| R menhir | 236 m | 127°31′ | 0°52′ | -27°08′ |
| F menhir | 775 m | 178°11′ | 1°21′ | -48°11′ |
| Middlepoint | | 123°38′ | 1°00′ | -24°22′ |

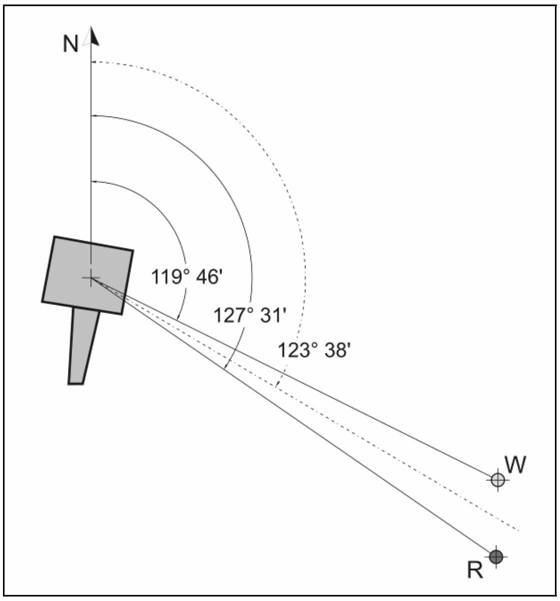


**Fig. 4: The azimuths of the two menhirs and the midpoint with respect to the centre of the monument.**

All the three menhirs appear to have been positioned to act as astronomical indicators.

First of all the menhir F, located quite far from the monument, but in plain view from it, gives a relatively good indication of due south.

To analyze the possible astronomical meaning of the white and the red menhir we start from the following observation. The azimuth of the intermediate sight point (123°38′) is extremely close to that of the Sun rising at the winter solstice, which was 123°23′ in 3200 BC, and the arc spanned between the two sightlines is 8° degrees wide. In our opinion, this is a quite strong indication for an astronomical use of the menhirs as foresights placed to observe "rising phenomena" occurring at azimuths (declinations) near that of the Sun at the winter solstice. Of course indeed, an arc of azimuths centered at the winter solstice is related to many significant astronomical phenomena, since - a part from relevant stellar targets which may be present - both the azimuths of the lunar standstills and those of the stations of the planets will lie “nearby”.

We thus start by analyzing the possibility of lunar or planetary alignments. The arc spanned is easily seen to be too thin to have been used as an efficient device to observe the lunar standstills, while of course it is too wide to be useful for (precise) winter solstice measurements. However, we notice that, among the declinations corresponding to the extreme of the "arc" (-21°34′ and -27°08′) the most southern one closely matches $-(\varepsilon+\nu)$, where $\nu$=3°24′ is the tilt of the plane of the Venus' orbit with respect to the ecliptic, and $\varepsilon$=24°03′ is the obliquity of the ecliptic in 3200 BC. Due to the extremely slow variation of the ecliptic plane, this alignment continues to hold (it actually becomes more accurate) during the whole period in which the monument might have been constructed. Thus, the red menhir seems to be related to the observation of the major extreme southern standstill of Venus (no alternative stellar target can be individuated in the considered period). The existence of oscillations in the extreme positions of Venus is readily observable by skywatchers interested in the movement of this planet and reoccurs every eight years circa. As it is well known, interest for the observation of the Venus cycle is well documented among the Mayas, especially at Uxmal (Aveni 2001; Ruggles 2005; Sprajc 1993) while for the Mediterranean area the case presented here constitutes the first possible example, at least to the present authors' knowledge.

As far as the other menhir is concerned, it might be tempting to consider it as a sight post for the "minor southern standstill" of the same planet at declination $-(\varepsilon-\nu)$, but this "standstill" is much more difficult to be defined and observed. Actually, there exists a much more likely possibility. Indeed in the years around 2750 BC the brightest star, Sirius, was rising in "perfect" alignment with the considered direction. At that time Sirius underwent heliacal rising roughly at the same time of the summer solstice, and, as is well known, this phenomenon was observed and used for calendrical purposes in Egypt in the very same period.

Of course, we stress that - as it happens to be the case for all stellar alignments - validity depends crucially on the time of construction of the monument, a date which we do not know with certainty. In particular if the menhirs were erected during the first phase and not relocated in ancient times the Sirius alignment would be untenable (due to precession, going back and forth in time from 2750 BC the alignment becomes inaccurate; to fix ideas we mention that the declination of Sirius stays within one degree from -21°34′ in the period 3000 BC - 2500 BC).

Once the main alignments from the summit of the platform were decided, the distance of the menhirs from the basement might have been chosen in order to obtain further astronomical sightlines. In particular, the red menhir is located in an apparently non-optimal position, at a quote level slightly lower of that of the white menhir.

However in this way the two sightlines defined by the NE corner of the basement and the red menhir, and by the SE corner of the basement and the white menhir, point to the minor and the major southern lunar standstills respectively (Figure 5 - detailed data reported in Appendix, Table 2). It is difficult to think that this was due to a case since the two stones are disposed along the meridian with a good precision (within one degree).

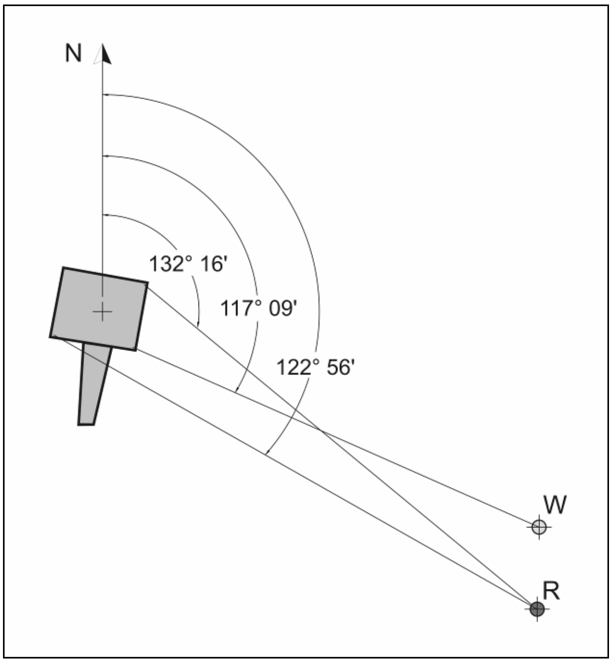


**Fig. 5: The azimuths of the two menhirs with respect to the corners of the monument.**

## ACKNOWLEDGEMENTS

The authors gratefully acknowledge Prof. Maria Brovelli of the Geomatics Laboratory of Como (Politecnico di Milano) and Mr Eugenio Muroni of the Superintendence to the archaeological sites of Porto Torres, Sardinia.

## REFERENCES

Aveni, A. (2001) *Skywatchers: A Revised and Updated Version of Skywatchers of Ancient Mexico*, University of Texas Press, Austin.

Contu E., (1953a) Monte d'Accoddi (Sassari). Singolare edificio preistorico, *Bullettino di palentologia italiana*, viii, 3-4.

Contu E., (1953b) Costruzione megalitica in località Monte d'Accoddi, *Rivista di scienze preistoriche*, viii, 199-202.

Contu E., (1984) Monte d'Accoddi. Problematiche di studio e di ricerca di un singolare monumento preistorico, In W.H. Waldren, R. Chapman, J. Lewthwaite, *The Deya Conference of Prehistory, Early Settlement in the Western Mediterranean Islands and the Peripheral Areas*, British Archaeological Reports, ccxxix, 591-08.

Contu, E. (2000) L'altare preistorico di Monte d'Accoddi" Delfino Editore, (Cagliari).

Hoskin M. and Zedda M. P., (1997) Orientations of sardinian dolmens, *Journal for the history of astronomy*, Archaeoastronomy supplement, xxviii, S1, p. 1-16.

Lilliu, G. (1988) La civiltà dei sardi dal paleolitico all'età nuragica", Eri Edizioni (Torino)

Lilliu G., (2001) Simbologia astrale nel mondo prenuragico, *L'uomo antico e il cosmo, Atti dei convegni Lincei*, clxxi, Roma, 163-234.

Proverbio E., Romano G., Aveni, A., (1991), "Astronomical orientations of Monte d'Accoddi (Sassari in Sardinia)", In "Atti coll. int. archeologia e astronomia", M. Fano Santi editor, Bretschnelder (Rome), p. 38-41

Romano G., (1992) Archeoastronomia italiana, Padova, 111-27.

Ruggles C., (2005) Ancient Astronomy, Santa Barbara, California.

Sansò F., (2006) Navigazione geodetica e rilevamento cinematico, Polipress, Milano.

Sprajc I., (1993) Venus orientations in ancient Mesoamerican architecture. In *Archaeoastronomy in the 1990s* Edited by C.L.N. Ruggles, Group D Publications, Loughborough.

Tinè S., (1987) *Nuovi scavi nel santuario di Monte d'Accoddi (SS), Annali dipartimento di studi del mondo classico e del Mediterraneo - sezione di archeologia e storia dell'arte*, ix Napoli, 9-22.

Tinè S., (1989) Monte d'Accoddi e la cultura di Ozieri, In *La cultura di Ozieri. Problematiche e nuove acquisizioni - atti del I convegno di studio*, Ozieri, 19-26.

Zedda M., Belmonte J., (2004) On the orientation of sardinian nuraghes: some clues to their interpretation, *Journal for the History of Astronomy*, xxxv, 85.

## APPENDIX

Our data have been collected with a Leica GPS1200 GPS system, connected with the Sardinian network of permanent GPS stations in real time kinematics. The accuracy of this kind of survey is of the order of few centimetres or better (there is also a complete photogrammetric reconstruction of the monument available on the website http://geomatica.como.polimi.it/elab/maccoddi/). In order to compute azimuths, the observations have been simply rototranslated from the original global cartesian reference system to a local reference system, avoiding any cartographic projection and related errors (Sansò 2006). Declinations have been computed using the GETDEC software kindly provided by Prof. Clive Ruggles.

**Table 2: Azimuth, altitude, solar and lunar declinations and suggested astronomical target for the entire monument**

| Backsight | foresight | azimuth | altitude | dec | Lunar dec | target |
|---|---|---|---|---|---|---|
| Centre altar | W menhir | 119°46′ | 1°07′ | -21°34′ | -20°54′ | Sirius (2750 ±250 BC) |
| Centre altar | R menhir | 127°31′ | 0°52′ | -27°08′ | -26°26′ | Venus -ε-v |
| Centre altar | Middlepoint W and R | 123°38′ | 1°00′ | -24°22′ | -23°41′ | Sun -ε |
| N/E corner | W menhir | 124°26′ | 1°07′ | -24°49′ | -24°08′ | |
| N/E corner | R menhir | 132°16′ | 0°52′ | -30°16′ | -29°33′ | Moon -ε-i |
| S/E corner | W menhir | 117°09′ | 1°07′ | -19°42′ | -19°03′ | Moon -ε+i |
| S/E corner | R menhir | 125°58′ | 0°52′ | -26°05′ | -25°23′ | |
| S/W corner | W menhir | 115°10′ | 1°07′ | -18°16′ | -17°37′ | |
| S/W corner | R menhir | 122°56′ | 0°52′ | -23°59′ | -23°18′ | Sun -ε |
| N/W corner | W menhir | 121°43′ | 1°07′ | -22°56′ | -22°16′ | |
| N/W corner | R menhir | 128°49′ | 0°52′ | -28°00′ | -27°18′ | |