Mediterranean Archaeology and Archaeometry, Vol. 18, No 4, (2018), pp. 1-9

DOI: 10.5281/zenodo.1472244

AN ARCHAEOASTRONOMICAL APPROACH TO THE MEGALITHIC SITES OF SAUDI ARABIA

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Received: 28/06/2018
Accepted: 01/07/2018
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ABSTRACT

This study attempts to decipher the cultural significance of standing stones left by the past civilizations in late Stone Ages. It provides a statistical list of 16 megalithic sites within Saudi Arabia with more focus on the site of Rajajil in northwest Saudi Arabia. Speculation as to their purposes differ, some were used for religious activities, burial sites, and astronomical observatories for celestial bodies.

In this study a field survey was conducted to the late 5th millennium B.C.E. site of Rajajil in Al-Jawf Region (Arabic: الجوف al-Ğawf), and some of the well preserved groups of megaliths in the site were measured in an attempt to shed some light on the bearings to know if astronomical interpretation is possible. Measurment indicated that there is a clear alignment along the north-south axis In one of the megalithic groups on the site. The general layout of the site applies to this description to a high extent too. The site belong to the Neolithic period, where societies began to think in a more complex way than before. The majority of megalithic sites including Rajajil belong to the era of agricultural revolution where agricultural activities demand astronomical knowledge, therefore its logical to see traces of astronomy dating back to that stage. Petroglyphs of celestial objects carved on some standing stones e.g. the figures carved in Kubat Altamathil megalithic site in Tabuk (Arabic: تبوك Tabūk) indicate that ancients observed the sky and recorded what they perceived. To ensure that the functional purposes of ancient archaeological sites might affect the type of inscriptions in the surroundings, I traced examples of ancient natural observatories still used to the present time e.g. (Majarda observatory, Taif) and (Hilat Alshams observatory, ABaha) and the result was positive.

The aim of this studey is to give an overview of existing possibilities of astronomical indications to stimulate further archaeoastronomical studies in saudi arabia.

KEYWORDS: Archaeoastronomy, Megaliths, Ancient Observatories, Rajajil site

1. INTRODUCTION

Megalithic sites are found in various continents, such as Asia, Africa, Europe, America and Australia. This raises an important question, what are these sites? And was this similarity a result of ancient cultural connection? Or is it simply a similar human thought? These sites reveal many cultural aspects of the life of our ancestors, they reflect advanced mentality, strong memory, and very sophisticated ability to plan. Megalithic structures are often associated with Neolithic agricultural revolution that originated from the Fertile Crescent, "what is now called Syria, Iraq, and Turkey", and then spread over subsequent periods to neighboring continents (Patton, 1993).

Studies have emerged that attempt to interpret these sites from an archaeoastronomical perspective. Unfortunately, they are few in the Arabian Peninsula although the archaeological material suitable for this type of study is available and of great value. In the twenty- first century, archaeoastronomy is starting to be considered one of the “key concepts” in the growth and progress of archaeological thinking and method (Renfrew and Bahn, 2005). More solid theoretical studies appeared, unlike the studies that spread in the 1960s and 1970s. This has resulted in the broad acceptance of cultural astronomy globally. But some disciplines still find it tough to garner the attention of Middle East scholars. Only recently, some serious studies like (Hoskin, 2001; Belmonte, González-García, and Polcaro 2013; Belmonte and González-García, 2014; González-García, Belmonte and Polcaro 2016, Liritzis et al., 2015) have emerged and aroused the curiosity of those interested in this type of archaeological studies in the area. Authoritative contributions like the encyclopedia of cosmology and myth (Ruggles, 2005) has been a great scientific value to serious scholars regardless of their disciplines, covering broad definitions and case studies from five continents, presenting deferent methodologies, and giving a complete representation of this field. It is only nowadays that this interdisciplinary field is starting to be recognized in Saudi Arabia, and the hope is that with an overarching conceptual framework, it will be possible to understand more about megalithic civilizations worldwide once comparative studies are presented from this area in line with the increasing research topics and case studies in the world.

The earliest known megalithic sites were set up about 9,000 years B.C.E. in Asia (Reingruber, 2005), then sites were built in Africa, and according to (Rosen & Brophy, 2005) the oldest site in Africa is probably Napata dating about 6800 B.C.E., then sites occurred in Europe during the Late Neolithic period to the Copper Age (4500-1500 B.C.E.). This study sheds light on the site of Rajajil, a 5th millennium B.C.E. site (Gebel, 2016). The purpose of this study is revealing the cultural indications of such sites in Arabia.

2. MEGALITHIC SITES OF SAUDI ARABIA

Megalithic sites spread throughout the Arabian Peninsula some in the central regions and others in the northern Arabian Peninsula, such as Jordan, as well as in the far south, such as Yemen (as shown in Figure 1).

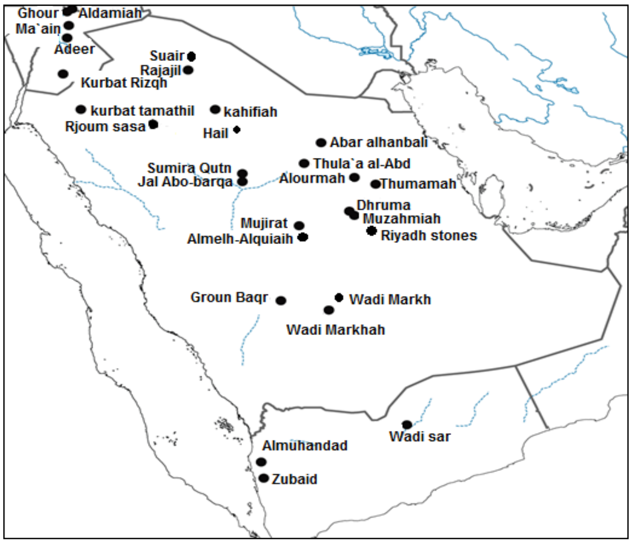

Figure 1. A map of megalithic sites within the Arabian Peninsula

The size of these megaliths varies from one site to another, and the layout of the site also differs. Standing stones are found either in the form of an alignment, a stone circle or a monolith.

2.1. *MEGALITHIC SITES IN NORTHWEST SAUDI ARABIA*

The north-western region of the Kingdom is considered an area of great importance due to its unique location in the ancient world. It is a region rich in geological and geographic aspects. It encompasses a large area of the Arabian Peninsula. It is also characterized by an environment suitable for life and stability. It was an active settlement area, and this is evident from the large number of archaeological finds in various sites. Excavations enabled scientists to develop an historical sequence based on the archaeological material discovered, from the Stone Age to the present time. One of the first settlement sites in the region is the site of Shuweihtia dating back to more than a million years ago, making it the oldest settlement site in the Arabian Peninsula to date (Whalen et al., 1989). This region also contains two sites registered on the UNESCO World Heritage List, the multi-temporal site of Al-Hajar in Al-Ula, which includes major Nabataean remains, and the Hail rock art site. As for megalithic sites, this part of Saudi Arabia has one the most significant sites in terms of preservation, complexity and size. See Table 1 for a list of sites from Hail, Tabouk and Al-Jouf.

Table 1. Megalithic sites in north-west Saudi Arabia.

Site	Region	longitude	Latitude	Type
1- Rjajil	Jouf	E 40° 13′ 13′′	N 29° 48′ 45′′	Standing stones
2- Souier	Jouf	E 40° 23′ 30′′	N 30° 02′ 45′′	Standing stones
3- Hail stones	Hail	E 42° 14′ 46′′	N 27° 20′ 09′′	Standing stones
4- Alkhifia	Hail	Near hail city E 42° 14′ 46′′	Near hail city N 27° 20′ 09′′	Standing stones
5- Kubat Tamathil	Tabuk	Near Al Athem center E 37° 33′ 44′′	Near Al Athem center N 27° 39′ 19′′	Standing stones
6-Rjoum Sasa	Tabuk	Near "Taima" E 38° 32′ 0. 11′′	Near "Taima" N 27° 37′ 0. 9′′	Standing stones

2.2. *MEGALITHIC SITES OF RIYADH*

Riyadh is the capital city of Saudi Arabia. It is situated in the centre of the Arabian Peninsula. There are many megalithic sites Riyadh such as the Riyadh standing stones located in the north of the wadi Al-Dawasir, as well as those of Mount Al-Arma, Muzahmiya, Mujirat south of Dawadmi, Abar Hanbali in the province of Al-Majma`ah, Dhruma and the site of Quaiya. See Table 2 for Riyadh sites.

Table 2. Megalithic sites in Riyadh.

Site	Region	longitude	Latitude	Type
1- Riyadh stones	Riyadh	E 44° 20′ 53′′	N 21° 00′ 25′′	Standing stones
2- Mount Al-Arma	Riyadh	E 46° 16′ 32′′	N 25° 51′ 14′′	Standing stones
3- Muzahmiya	Riyadh	E 46° 18′ 53′′	N 24° 21′ 20′′	Standing stones
4- Mujirat	Riyadh	E 44° 26′ 18′′	N 24° 14′ 49′′	Standing stones
5- Abar Hanbali	Riyadh	E 45° 04′ 37′′	N 27° 19′ 16′′	Standing stones
6- Dhruma	Riyadh	E 46° 7′60′′	N 24° 35′ 60′′	Standing stones
7- Quaiya	Riyadh	E 45° 16′ 50′′	N 24° 3′ 56′′	Standing stones

Table 3. Megalithic sites in Qassim.

Site	Region	longitude	Latitude	Type
1- Jal Abu Baraka	Qassim	N 44° 23′ 34′′	N 26° 17′ 30′′	Standing stones
2- Thula`a al-Abd	Qassim	Near Thulah E 43° 57′ 46. 84′′	Near Thulah N 25° 58′ 23. 62′′	Standing stones
3- Samira Cotton	Qassim	Near Cotton E 42° 20′ 4. 77′′	Near Cotton N 25° 59′ 75′′	Standing stones

2.3. *MEGALITHIC SITES OF QASSIM*

Qassim is one of the thirteen administrative regions of Saudi Arabia. Located at the heart of the kingdom. There are several megalithic sites in Qassim area, such as: the site of Jal Abu Baraka (Alshaya, 2009), the site of Thula`a al-Abd and the site of Samira Cotton demonstrated. See Table 3 for Qassim sites.

3. FIELD STUDY (RAJAJIL MEGALITHIC SITE)

Rajajil site is located in Sakaka / Al-Jouf, it is one of the most important megalithic sites in Saudi Arabia. This site was excavated during the comprehensive survey of the lands of Saudi Arabia under the supervision of the Department of Antiquities and Museums in 1965.

The site was described by the two western historians, Fred Winnet and Willem Reed, in their journey through Wadi Sarhan in 1962, they referred to it as a large stone circle, where standing stones were erected in separate collections (Winnett & Reed, 1970). The Archaeology Department sent teams to survey the site from 1965, during which time the researchers were able to study the site better. The site dates back to the end of the fifth millennium B.C.E., according to the Results of Rajajil Joint Archaeological Project (Gebel, 2016).

In the study reviled in this paper more focus was made in the fenced area (as shown in Figure 2). This area contains standing stones and many stone tools, arrowheads, and fragments of other tools, which are found within the fence and also without.

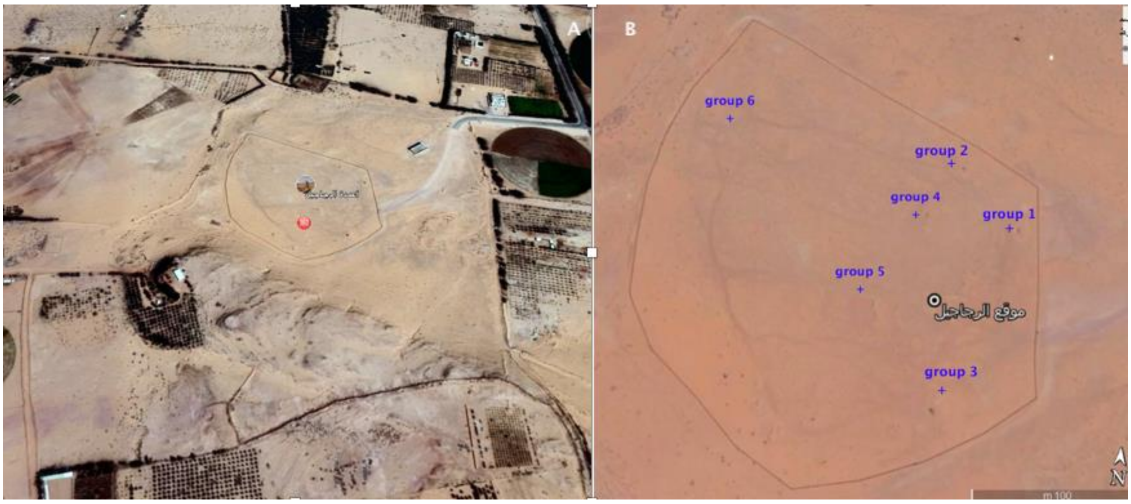

Figure 2. A. General view of the site; (B) The fenced area is the boundary of the field work.

3.1. SITE DESCRIPTION

The site is situated between a hill on the south, and a low slope on the north, with an altitude of 600m above sea level. A panoramic photo with a wide-angle view of the site is shown in Figure 3. A 360° view can be found online in at Rajajil Archaeological Site (2011).

Figure 3. panoramic photo of the site location.

In the conducted survey of the site in 2016 only six groups could still possibly be measured. The existing groups have lost some of the stones through time in comparison to the first archaeological plan of the site done in 1977 (as shown in Figure 4). The rest of the groups are disturbed by either vandalism or natural erosion. It is clear that all standing stones in the six groups were erected according to a certain plan and were not randomly placed. Most of the stone rows seem to be aligned towards the North-South Axis. The highest existing standing stone is about 4.20 meters and the smallest is around 50cm. This highest stone is part of a group located on the southern side of the fence. Other standing stones in the site are within the range of two to three and four meters high. As for the measurement procedure, the alignment was calculated by measuring the azimuth, the angle from north, of the structure and the altitude of the horizon it faces. The azimuth was measured using a compass with a precision of a degree. The declination was calculated using the same formulae as "GETDEC", the program referred to in Astronomy in Prehistoric Britain and Ireland (Ruggles, 2005, p.169) and can be found online in (Ruggles, 2018). See Table 4 for details of the approximate measurements.

Table 4. details of the groups.

Group number	alignment	Latitude	Longitude	Azimuth	Apparent declination
1	NS	+29 81 30	+39 29 32	0°	+80 19 36
2	NS	+29 48 47	+39 00 00	3°	+79 46 58
3	NS	+29 48 48	+36 16 27	8°	+80 00 32
4	NNW-SSE	+29 48 44	+30 09 37	348°	+79 36 18
5	NW	+29 48 49	+38 25 11	354°	+79 23 35
6	NW	+29 48 42	+37 29 44	352°	+79 50 48

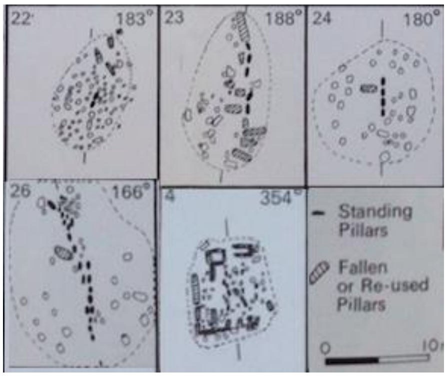

Figure 4. The groups included in this study as drawn in the 1st archeological plan of the site (Parr et al,1978)

3.1.1 Group 1

This is the most distinguished group in the site because it is still in a very good condition. The row of standing stones is precisely aligned upon the North-South Axis.

The group is composed of four standing stones, fixed and strong, with a North-South Axis, and a slight slope to the north. The group is surrounded by broken parts of the stones on the ground. The most important of which is a 1.60 m stone, which seems to have been broken in the past. It contains five deeply engraved circles, which are not a result of the erosion processes. There are also some inscriptions and signs on the surface. One highly representing an arrow directed up high, maybe to the sky. The measurements of the stones are as follows: in order from north to south: First - height: 3.10 m, second - height: 2.12 m, third - height: 2.75 m, fourth - height: 2.10 m (as shown in both Figure 5A and 5C). Extending side by side with a width of 2.68 meters (as shown in Figure 5 D).

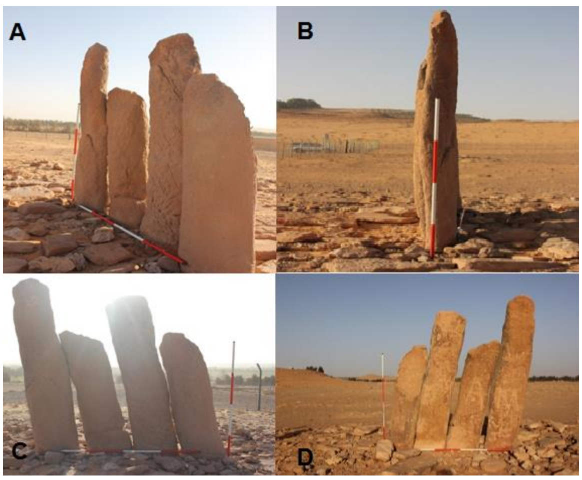

Figure 5 A. GROUP 1; (B) Facing north; (C) Facing east; (D) Facing west

3.1.2 Group 2

Two standing stones almost oriented toward the geographical north with an axis of North-South, it seems as if they are about to fall, leaning towards the west, and around them there are parts of stones on the ground. The heights of these are: 3.75 m and 2.50 m.

3.1.3 Group 3

The group is composed of four vertical standing stones. Although they seem unaligned in their current condition, they actually were aligned in the past but have since tilted over in time and ended up in this arrangement: Their heights are between 4.20 meters to 2.60 meter (Figure 6)

Figure 6. Group 3: stones probably tilted over time

3.2. *Samples of archaeological remains*

Many archaeological remains were found, some were sent to the laboratories for dating and analysis, and others were placed in AL-Jouf Museum. We must bear in mind that some of the findings belong to the civilization that built Rajajil site, but other items may have been added to it later. Therefore, the accuracy of collecting evidence is mandatory in order to help reveal the functional purposes of the site. See Figure 7 for some Samples collected from the site.

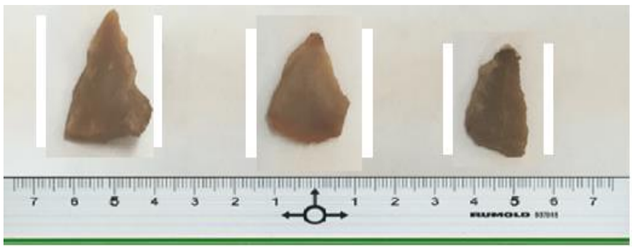

Figure 7. Lithics collected from the surface of the site of Rajajil

4. RESULTS

Measurements indicate that all the six groups measured in this study (five different stone rows and one horse shoe structure) are set along a particular axis, the North-South Axis (as shown in Figure 8). Group 1 located in the northern part of the fence is at an angle of 360 ° due north.

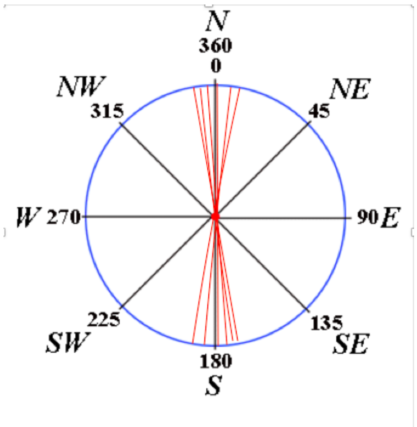

Figure 8. Orientation of 6 well-preserved groups in Rajajil

This rises an important question; how did the prehistoric inhabitants of the site know where the cardinal directions were? It seems that the builders of this site in addition to their high physical ability to transport and build these huge megalithic monuments, they had the ability to choose significant directions for it too. Due to the absence of written records of a site dating back to the fifth millennium B.C.E like Rajajil it is difficult to prove or reject this theory. Researchers in the prehistoric era are left with the option of reviewing the evidence and measuring its relevance to reality. Therefore, confirmation or disconfirmation by extra pragmatic data will then immediately strengthen or weaken the hypotheses. There are other sites with similar axis alignment like Nabta Playa, one of the most important monumental monuments in the African continent. The north-south axis in the site of Nabta is slightly lower in two degrees. This is fair enough if we consider that during the time Nabta functioned (6100-5600 B.C.E) the star that indicated the north was not as bright as the star we see today (Malville et al., 2008). Due to the precession of the equinoxes and the stars' motions, the role of the north star changes from one star to another through long periods of time, and the star closest to the Earth's north celestial pole is considered the north star. It is a point in the sky around which the stars seem to rotate, it also constitutes true north therefore it will be easy to determine where the south is, it's easy to figure it out in the northern hemisphere. In our days it is called Polaris, it appears due north in the sky to a precision better than one degree and if you find it, you've found true north. Therefore, it becomes possible to know the rest of the directions; this has made the north star very important in ancient times. In the case of Rajajil, if the site is deliberately aligned to the north than the possibility that they knew the starry skies well increases. They might have recognized Thuban; the Pole Star Around 5000 years ago Thuban (α Draconis) laying a mere 0°.1 from the pole (Norton & Ridpath, 2004). During the course of the night, the north star does not rise or set, it remains nearly in the same spot above the northern horizon year-round while the other stars circle around it. Using astronomical simulations software, the four standing stones in group 1 seem in relation with Polaris in present time. This star has a declination +89°. Therefore, it constantly appears due north in the sky to a precision better than one degree, and the angle it makes with respect to the true horizon is almost equal to the latitude of the observer. This star is in the constellation of small dipper (as shown in Figure 9).

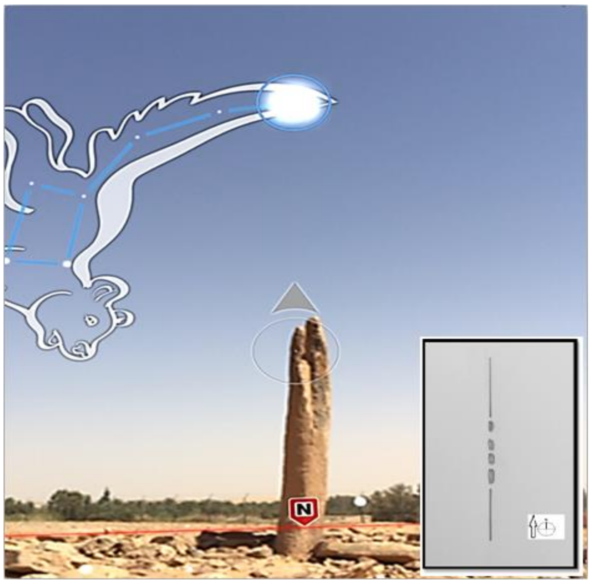

Figure 9. Simulation of the alignment found in group 1, using the software Skyview.

However, again the author is quite aware that stars change their locations in the sky over thousands of years and investigations for the era of Rajajil reveal that the star of the north was in the Dragon constellation and the sky would have appeared as we see (in Figure 10). Importantly, the movement of stars does not change the fact that the site is aligned to the north

Figure 10. The sky as seen when standing at the site in Al-Jawf in the fifth millennium B.C.E., using the public software Stellarium.

The date and time used for this image is midnight in 4500 B.C.E, an average period of the site occupation and function. The angle of view here is a base-line viewshed of a human view of about 60 degrees when looking in the north direction. The star in the centre of the screen is Thuban; the Pole Star (α Draconis).

5. DISCUSSION AND CONCLUSION

The hypothesis of the presence of astronomical indications in archaeological sites emerged as early as 1678 when John Aubrey recorded numerous megalithic monuments in southern England and then came Henry Chauncy in 1700 with similar astronomical principles to understand the orientation of churches (Hoskin, 2001). Arguably, Heinrich Nissen, working in the mid-nineteenth century was the first archeoastronomer (Ruggles, 2005).

Since then, statistical studies have been conducted and accurate measurements have resulted in the existence of precise astronomical alignments in megalithic sites that are difficult to ignore or to think of as a coincidence, especially that these sites are associated with the period of the agricultural revolution which requires high astronomical knowledge. In Britain highly accurate alignments to 0.01/0.1 degree have been disputed, the alignments within a degree and a few degrees have been accepted and supported (Ruggles and Appleton, 1984). This study shows that all the six groups measured (five different stone rows and one horse shoe structure) are set along a particular axis, the North-South Axis. The significant North- South alignments found at the Rajajil site in this preliminary study is an attempt to predict an appropriate sample for a future full-scale project that could improve various aspects of this hypothesis in Saudi Arabian megalithic sites. Monumental alignments pointing due north are found in other archaeological sites in the world, according to (Ruggles, 2005) the North- South alignments are astronomical in a broad sense, because they follow the axis of the daily motions of the stars in the sky as they move around the celestial poles. Ruggles wrote "north-south alignments relate to the daily motion of the heavens as a whole rather than to any particular celestial body or event, three different examples illustrate the reasons for keeping architecture "in tone with the cosmos" in this way: The Great North Road at Chaco Canyon; the Forbidden City in Beijing; and the pyramids of Giza" (Ruggles, 2005, p.67).

Celestial symbols in Rock art on some megaliths, such as the case of Kurbat Tamathil, Tabouk (as shown in Figure 11) increases the validity of indications supporting this theory.

Figure 11. Crescent carvings in two standing stones found in kubat attamathil

A drawing of the sun was also found alongside a star in Sakaka, where Rajajil is located (as shown in Figure 12; Al-Kabawi, 1986 p.88). Al-Kabawi (1986) hypothesized that the circles drawn around one centre with radial lines represented the sun disk. The general composition of the sun and star, may be intended to locate a certain star (or perhaps Earth) for the sun. From this perspective we are faced with the fact that there is astronomical knowledge in the prehistoric era, and in front of a new window that enables us to see the sophisticated ideas that embraced the mind of the ancient astronomers of Arabia.

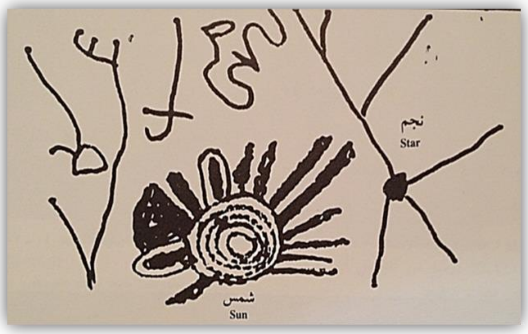

Figure 12. sun and a star in Sakaka close Rajajil site

To make sure that the functional purposes of ancient archaeological sites affect the kind of petroglyphs in its surroundings, I traced ancient natural observatories in Saudi Arabia that are still used today, for example: The Observatory of Helat Alshams "Sun Set Observatory" in Abha (as shown in Figure 13). People follow the path of the sun at certain times of the year through a hole in the mountain as it appears in section (A). The locals track the sun to see it reach its southernmost point in the sky in its journey across the horizon, in what is astronomically called the winter solstice (Gashash, 2001). Not surprisingly, Petroglyphs of celestial bodies are found at the site. In section (B) of the figure below, an image of sun carved next to geometric symbols is very evident. The aim of it is probably to illustrate the concept of the site (articles in MAA, 2017).

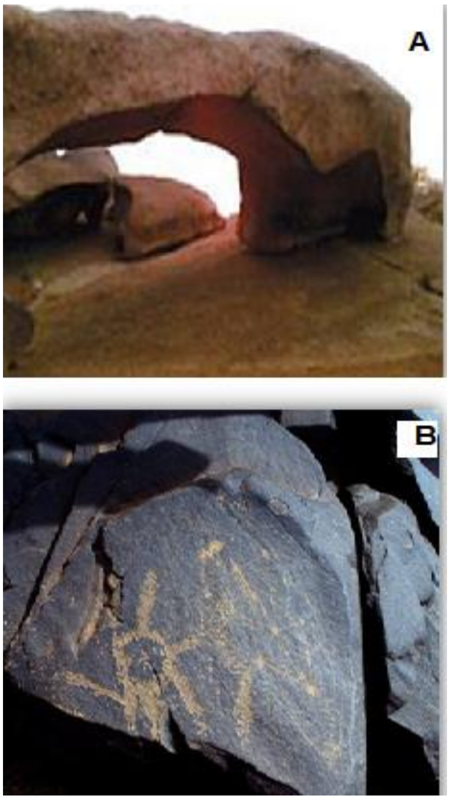

Figure 13. Geometric shape next to a carving of the sun in Helat alshams (Gashash, 2001)

There are many contemporary practices related to starwatching, especially among modern indigenous societies in Saudi Arabia that enriches our understanding of early astronomies. One of the most important observatories accredited to monitor the Arab months and the seasons of agriculture used by the ancient and still used by contemporary peoples to the present time is the astronomical observatory "khohila rock" in the village of Al-Majarada in Taif (Alyousfy, 2015). The people of the village consider it as a natural calendar for monitoring the seasons of agriculture and the beginning and end of lunar months. The external outline of the observatory is similar to standing stone sites. It is made up of "stone piles" 1.5 to 2 meters high and the distance between them is about 30 meters. Agriculture was practiced by most people in Taif, adding more evidence to support the hypothesis linking natural observatories and megalithic monuments in agricultural societies to astronomical aspects.

The main goal of this study is to start filling existing gaps in the field of cultural astronomy in the Kingdom of Saudi Arabia and to presents a number of megalithic sites that had not been exposed considerably, to give an idea of the type of Neolithic monuments found in this part of the world. Future investigations are necessary to validate the kinds of conclusions that can be drawn from this study. This research will contribute to the formation of a comprehensive view of astronomical knowledge in prehistoric stone ages and assist us in maintaining evidence about indigenous ways of life connected to astronomy for future generations.

ACKNOWLEDGEMENTS

The author would like to thank Deanship of scientific research for funding and supporting this research through the initiative of DSR Graduate Students Research Support (GSR). Also I would like to express my deepest appreciation to the organizers of "Road to the Stars " conference in Spain 2017, in which this paper was presented. I also thank Dr. Ali Almushawh, Vice Dean of Faculty Affairs at King Khalid College, Mrs. Noura Al Swailem, Dr. Alaa Al Sharida, Mrs. Sahar Ali, Prof. Azhari Mustafa Sadig, Professor of Archaeology, king Saud university, and Mr. Ahmed Al-Qaid, Director of the of General Authority for Tourism and National Heritage in Al-Jouf region for the help and support. I also thank the anonymous reviewer and Dr. Gail Higginbottom whose comments and suggestions helped improve and clarify this manuscript.

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