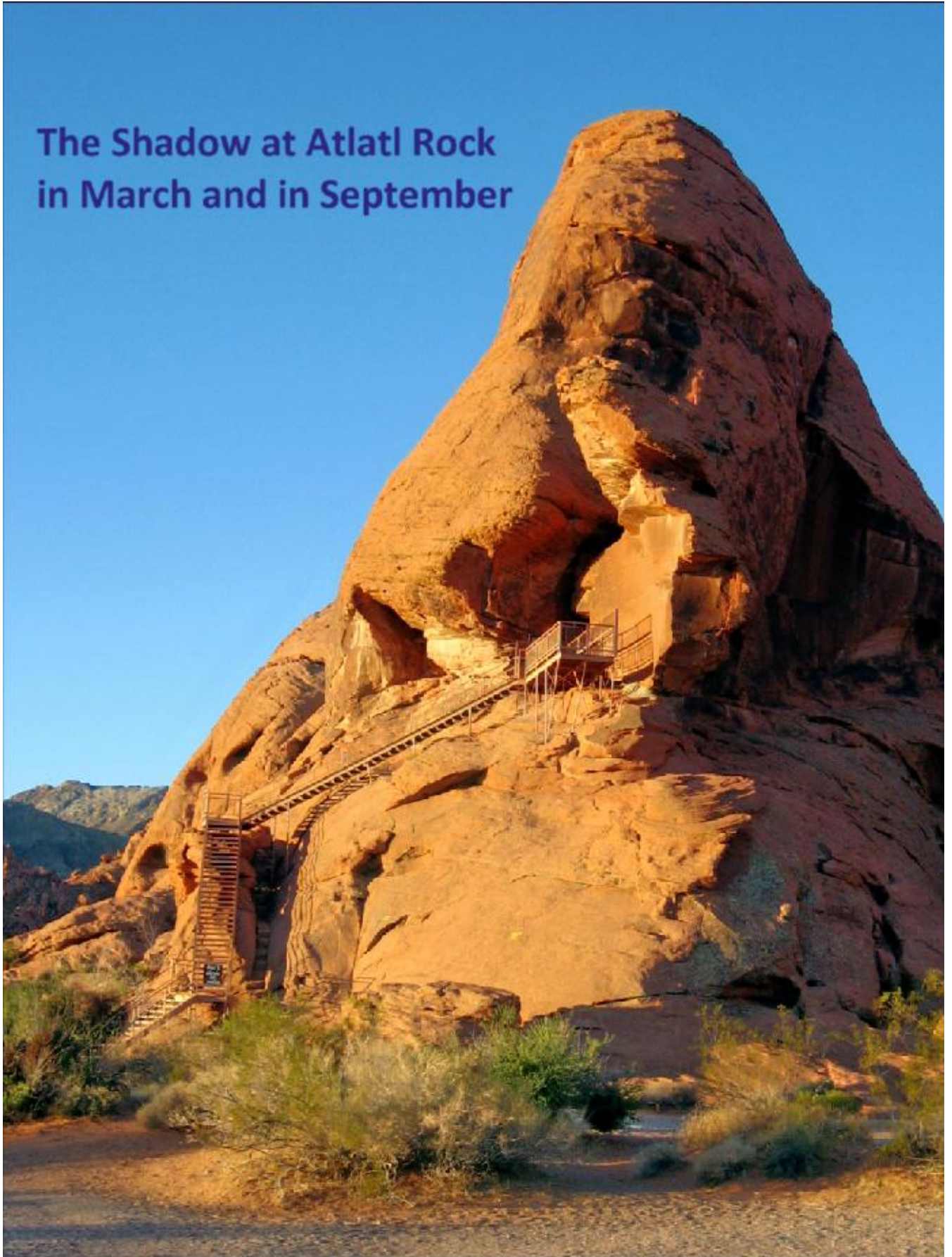


**The Shadow at Atlatl Rock
in March and in September**



The Shadow at Atlatl Rock in March and in September



An Ancient Astronomical Alignment
Discovered in the Valley of Fire State Park, NV, USA

by

Helmut Steinle
Munich, Germany

© 2024 Helmut Steinle

Foreword

Following the chance discovery in September 2008 of an alignment of a shadow cast on Atlatl Rock and three special petroglyphs there, I visited the site some more times to document, that this is an alignment that can be used to determine two specific times during a year. The alignment occurs around the equinoxes during two weeks after the start of spring in March and during two weeks before the start of fall in September. The events occur in reverse order with respect to the equinoxes.

To visit Atlatl Rock, a convenient time is in fall as the weather is very stable then. Thus, most of the findings that are presented here have been obtained and documented in the fall of 2017 (September 17 - 21), 2018 (September 13 - 16), and 2023 (September 17 - 22).

To verify the symmetry of events between fall and spring and to extend the times covered, I visited the site again in spring 2023 (March 24 - April 06). The expected symmetry of events was successfully demonstrated and the data are used to extend the observed time span to 17 days before/after equinox.



Contents

	page
Foreword	2
Introduction	5
Location and Description of the Site	6
The Markers	8
Equinoxes and Solar Quarter Days	11
The Sun around Autumnal Equinox	12
The Shadow at Atlatl Rock	14
The Primary Shadow Movement between following Days around the Equinoxes	16
The Secondary Shadow Movement on Each Day	18
The Resulting General Picture Over a Year	20
What is Marked?	22
Timetable for Future Observations	23
Appendix	24 - 29
Links and Contact	



The discovery photo!

Atlatl Rock on September 09, 2008 at 11:30 am PDT

Introduction

During two weeks each in March/April and in September, an interesting alignment between the shadow, which is cast on Atlatl Rock between sunrise and noon, is visible.

The wall with the Atlatl Rock petroglyphs (markings on a rock) is facing almost perfectly east. A rock south of the wall casts a shadow on the wall, which after sunrise each day, due to the movement of the sun across the sky, moves from top left to lower right.

Once the shadow tip has reached the lower end of the wall with the petroglyphs, the upper edge of the shadow is an almost perfect straight line that cuts the rock into two halves: one sunlit, the other, where all the petroglyphs are, in shadow.

The changing position of this shadow line between following days in March/April and in September with respect to three outstanding petroglyphs is proposed to have been used to intentionally mark a time in the middle between winter and summer that was of interest to ancient people.

The position of the three markers above all other petroglyphs at Atlatl Rock is a strong indicator that they were made before or at least at the same time as the other petroglyphs that are all below and to the left of a diagonal line that connects two of the markers.

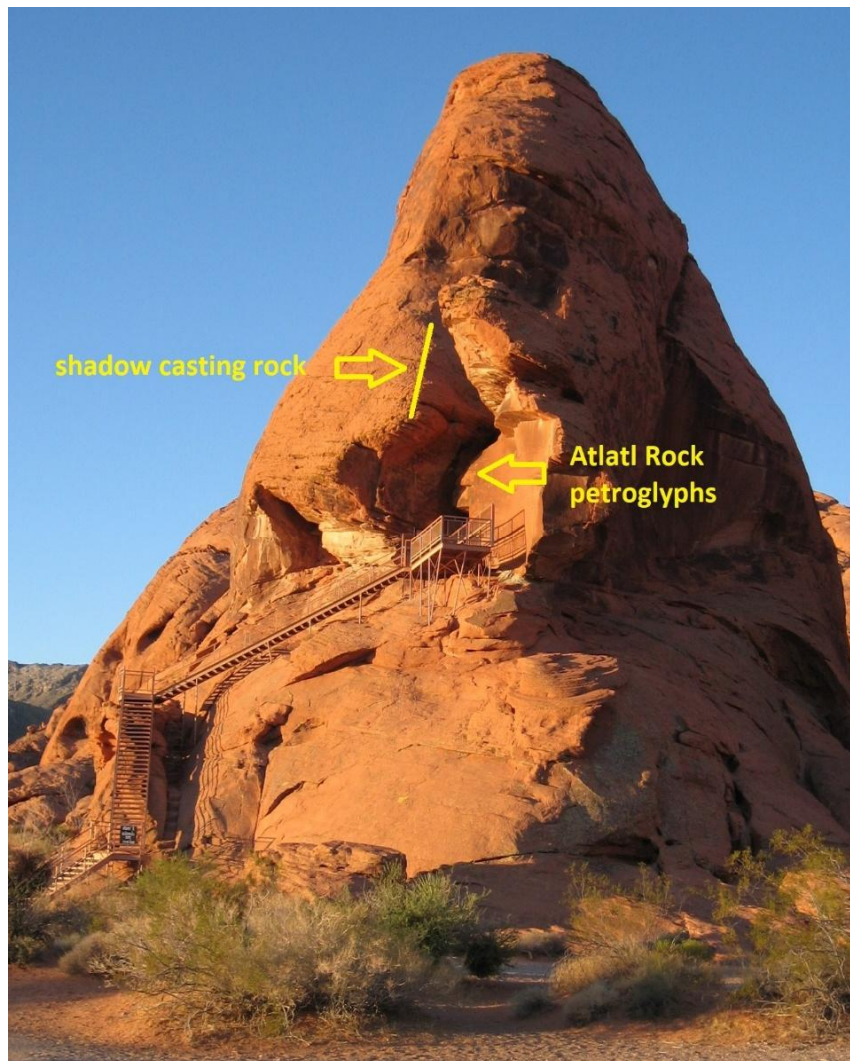
An information sign at the site states that the petroglyphs are more than 4000 years old.

At the lower right at Atlatl Rock, below the modern platform, there are more petroglyphs of a completely different style, which are probably of younger age (and of course, unfortunately, there are modern graffiti).

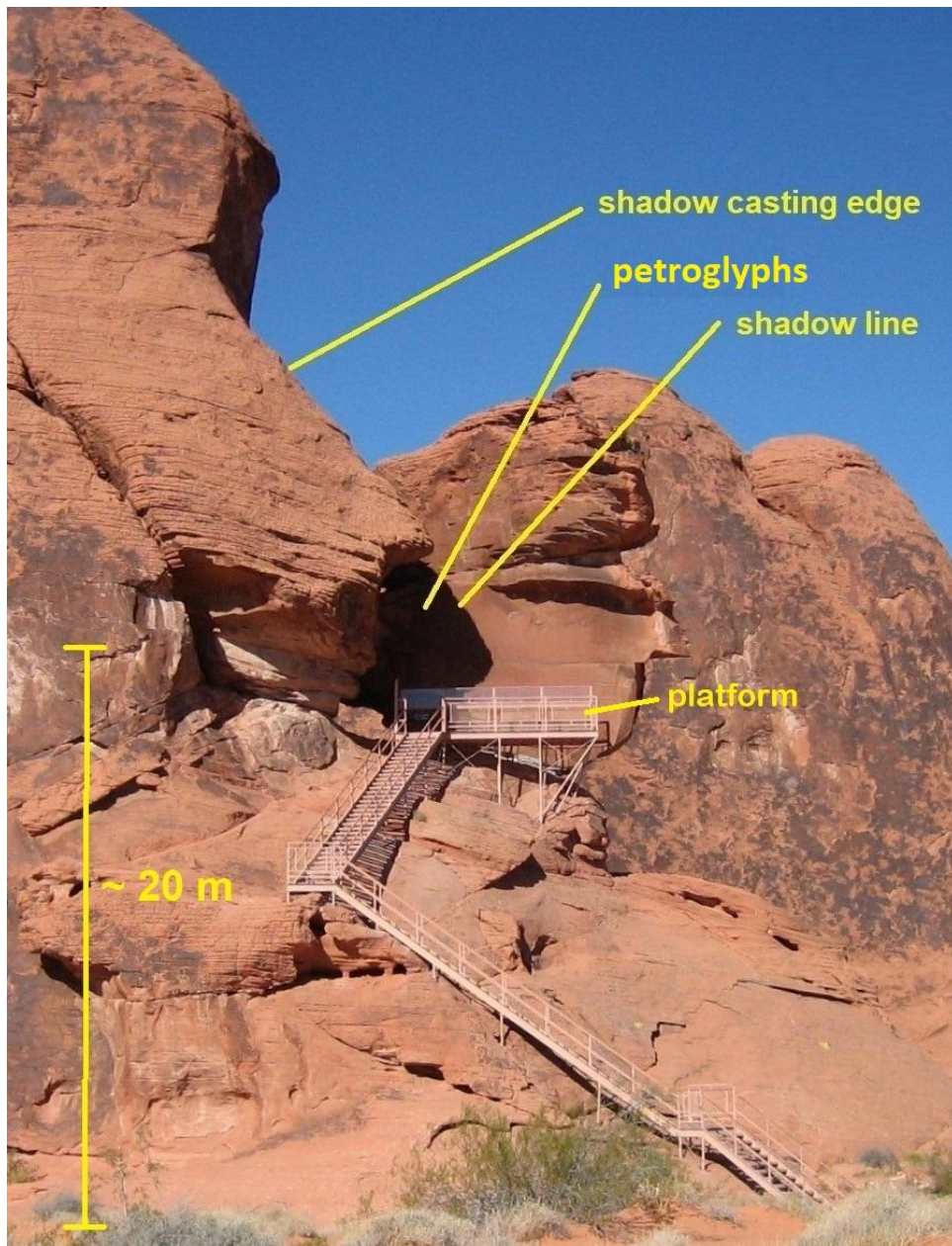
Location and Description of the Site

Atlatl Rock is a very easily accessible petroglyph site. It is located in the Valley of Fire State Park about 80 miles NE of Las Vegas, Nevada, USA.

The petroglyphs of interest are on the left (south) of a straight, smooth rock wall that is almost perfectly facing east. They are at a height of about 20 m (estimated), easily visible from the ground. To help modern visitors, there is a platform mounted at the height of the petroglyphs reachable by stairs.



View from north-northeast (parking lot)
at 6:51 am PDT on September 21, 2010 (20 minutes after sunrise)

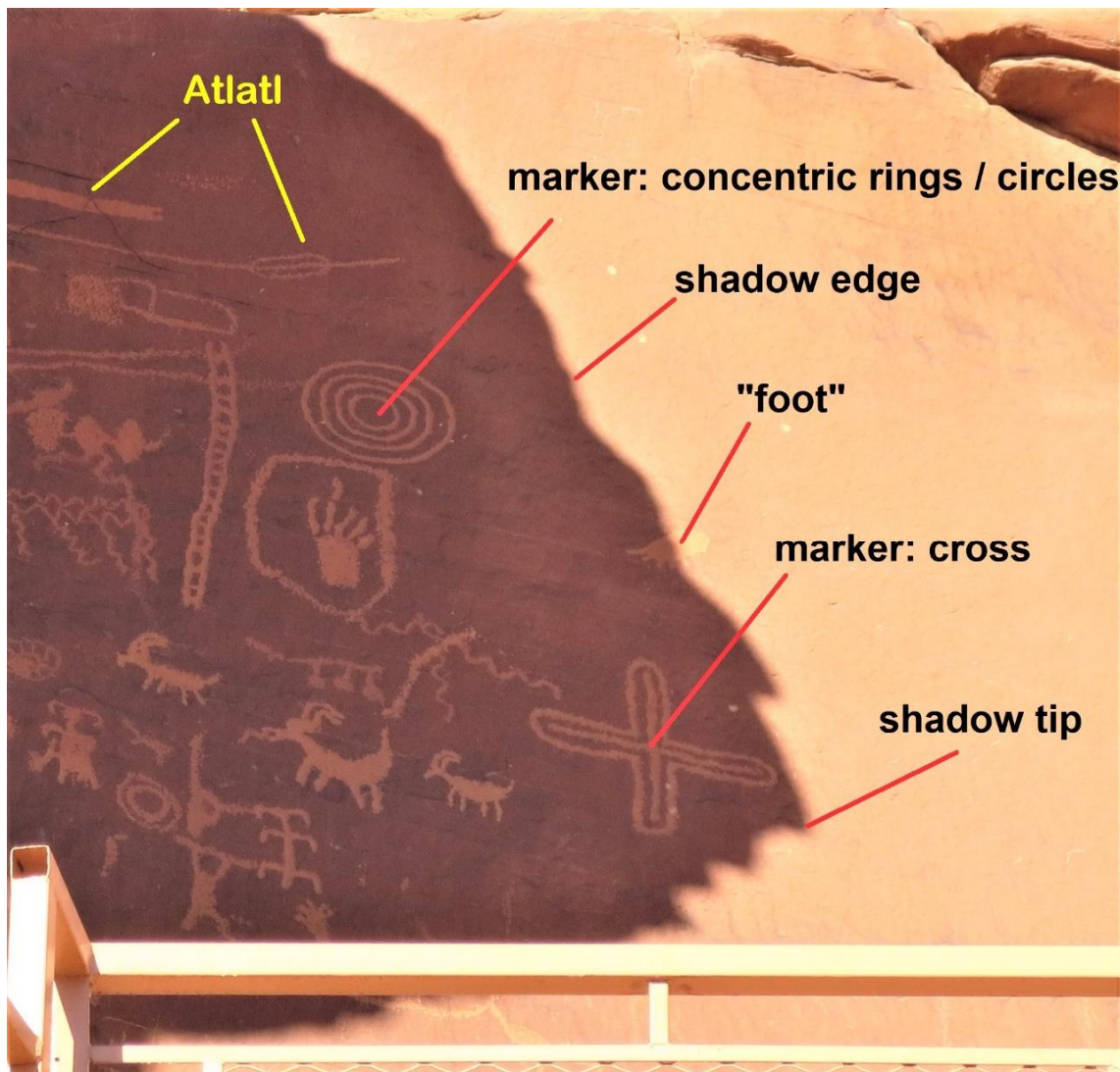


View from east at 9:25 am PDT on September 21, 2010

The shadow at Atlatl Rock is cast by a rock south of the wall that has an almost perfect straight upper edge with an inclination that is almost parallel to the path of the rising Sun in the morning (in March/April and in September) until noon. Thus, once the shadow has progressed on the wall until its tip has reached the lower end of the wall with the petroglyphs (around 10 am PDT), a straight upper shadow line is visible.

The Markers

At the Atlatl Rock site, there are three outstanding petroglyphs, which are proposed to be used to indicate two special times during a year, which are close to the equinoxes in spring and fall.



The markers are four concentric circles, an outlined cross, and a petroglyph that I call "foot" because of its shape.

All other petroglyphs at Atlatl Rock are below and to the left of a line (the shadow edge!) connecting the circles and the cross!



concentric circles
estimated diameter
30 cm



outlined cross
estimated size
50 cm x 50 cm



"foot"
estimated size
15 cm

Concentric circles like the ones at Atlatl Rock are known to be a symbol for the Sun as described e.g. by Patterson (1992) ¹ and Zoll (2014) ².

No clear association of the outlined cross with equal bars like the one at Atlatl Rock as a sign for equinox is found in the literature although it seems very obvious to me that this is the case especially here at Atlatl Rock (equinox = equal length of day and night; middle between winter and summer).

The "foot" is the only petroglyph that is above a line connecting the upper edges of the concentric circles and the cross.

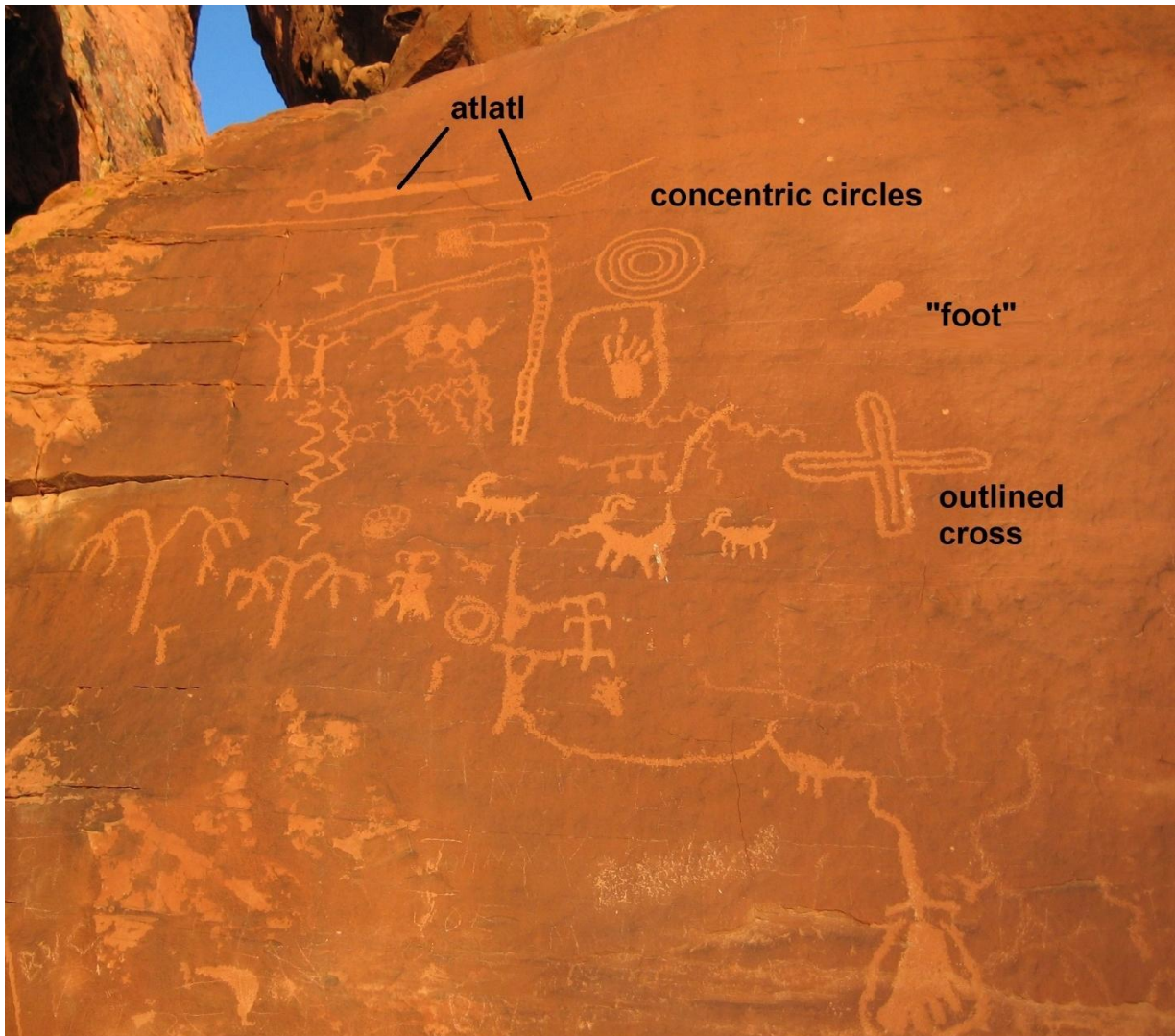
The shadow edge moves across the "foot" three to seven days after the equinox in spring and seven to three days before the equinox in fall when the other markers and petroglyphs are still (spring) or already (fall) in shadow.

The downward moving shadow edge in spring has its first contact with any petroglyph at Atlatl Rock with the foot and the last contact in fall when the shadow edge moves upward. This occurs close to the Solar Quarter Days (see below), which are two days off the equinoxes.

The position and the dimensions of the concentric circles and the outlined cross are such that the shadow edge is parallel to the centers and edges of the two markers in spring and fall.

1): Patterson Alex, A Field Guide to Rock Art Symbols of the Greater Southwest; pages 6 ff.;
Johnson Books, Boulder (May 1st 1992); ISBN 13: 978-1555660918

2): Zoll Kenneth J., Heart of the Sky, Ancient Skywatchers of Central Arizona; pages 7 ff., references therein;



Petroglyphs in full sunlight after sunrise
(in summer for better visibility)

Atlatl Rock has its name from the atlatls that are depicted there at the top of the petroglyph area.

An Atlatl (spear-thrower, spear-throwing lever) is a tool that uses leverage to achieve greater velocity in dart or javelin-throwing, and includes a bearing surface which allows the user to store energy during the throw (from Wikipedia).

Equinoxes and Solar Quarter Days

The astronomical Equinox is defined as the moment when the center of the Sun passes apparently through the plane of the Earth's equator, which is tilted with respect to the orbital plane of the Earth around the Sun (the Ecliptic). This happens twice a year: around March 20 (vernal equinox, start of spring) when the Sun apparently crosses the plane of the earth equator from south to north, and around September 22 (autumnal equinox, start of fall) when the Sun apparently crosses the plane of the earth equator from north to south.

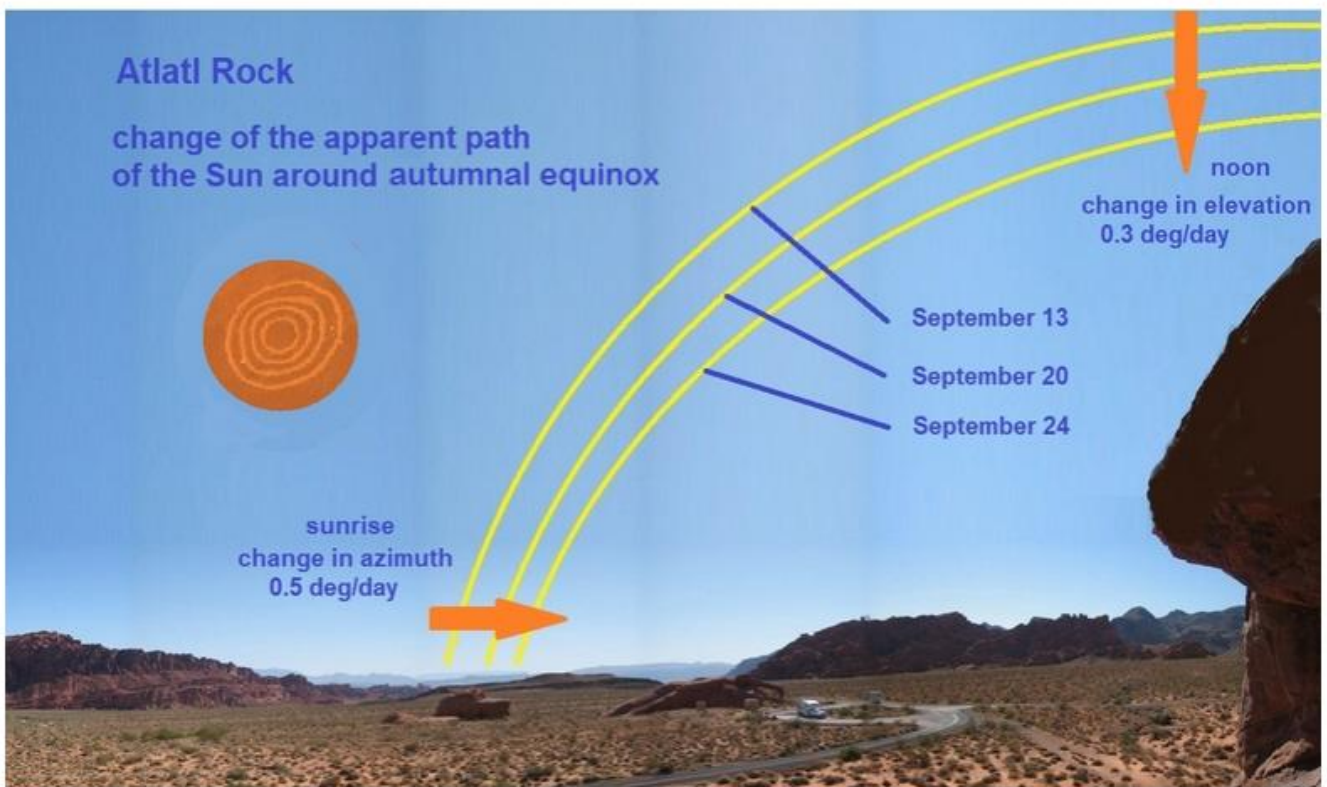
This modern (astronomical) concept of the equinoxes was unknown to the ancient people that created the petroglyphs. However, close to the equinoxes, are the Solar Quarter Days that mark the middle between winter solar standstill (solstice) and summer solar standstill and vice versa. Together with the solstices, the Solar Quarter Days divide the year into four equal parts (~ 91 days each), hence their name. The Solar Quarter Day in spring is two days after the vernal astronomical equinox; the Solar Quarter Day in fall is two days before the autumnal astronomical equinox. These dates could have been of interest to the ancient people as they may have indicated the times for seasonal actions and they were determined and observed in almost all cultures.

Contrary to the solstices in December and June, which could be determined with an accuracy of about one day by ancient sun watchers, the middle between the solstices is not directly observable by the naked eye. Thus, instead of counting each year the 91 days from a solstice, a tool to mark the time in the middle between the solstices was helpful. The alignment at Atlatl Rock provides such a tool.

I use the term "equinox" for a time span of a couple of days around the astronomical equinox including the Solar Quarter Days.

The Sun around Autumnal Equinox

In the following, the movement of the Sun around the autumnal equinox (start of fall) in September is described here as an example. The movement is in reverse order around the start of spring. (I verified this symmetry by documenting the shadow movement in spring and fall – see appendix.)



The direction (azimuth) of the point at the horizon, where the Sun is visible at sunrise, changes significantly by about 0.5 deg per day around the days of the equinoxes. (0.5 deg the apparent diameter of the Moon and the Sun.) This makes the observation of the sunrise point a very good and exact tool to mark certain dates if structures on the horizon or alignments with structures in that direction are available.

To view the alignment of markers on the horizon with the sunrise point is very dependent on the position of the observer however! It requires the observer to view from a specific spot!

The height (elevation) of the Sun changes significantly and near its highest position due south at local noon it differs by about 0.3 deg between following days. However, this change in height can hardly be measured by direct viewing.

A rock that causes a shadow on a near wall however is a perfect tool to indicate the changes in azimuth and especially in elevation. To mark certain positions of the shadow at specific dates and times gives a tool to recognize those times each year. This is the case at Atlatl Rock.

The markers and the interaction with the shadow that indicates certain dates around the equinoxes are visible easily from any position in front of the rock. They do not require a special position of the observer and thus can be viewed by many people at the same time.



Above: effect of the decreasing height of the Sun on the shadow.

Shadow at 10:45 am PDT on September 13 (left) and on September 20 (right; Solar Quarter Day).

The Shadow at Atlatl Rock

There are two types of the movement of the shadow edge across the Atlatl Rock wall.

- The primary shadow movement is caused by the change in elevation of the Sun between following days
- The secondary shadow movement is caused the changing azimuth and elevation of the Sun during one day and the effect of the change of the slope of the shadow casting rock after the Sun has reached a certain azimuth at about 10:50 am PDT.

In the following, the shadow movement in fall is described in detail. In spring, the sequence of events is reverse.

The Primary Shadow Movement:

The rock south of the Atlatl Rock wall that casts the shadow onto the wall where the petroglyphs with the Atlatl are has an almost straight upper edge which casts a shadow with a straight upper edge onto the wall. The decreasing elevation of the Sun after the summer solstice causes the upper shadow edge at Atlatl Rock to move upward between each following day. In the first couple of weeks after solstice, the change in elevation is small.

Around the equinoxes however, the change in the height of the Sun has a maximum of about 0.36 degrees each day. This causes the upper shadow edge to change its position with respect to the petroglyphs significantly between following days.

(In winter, a shadow movement around the winter solstice is probably not observable as the wall with the petroglyphs is in total shadow due to the low elevation of the sun.

In the time span between 9:45 am PDT and 10:50 am PDT each day the shadow edge is very straight and almost constant in position. Therefore, 10:45 am PDT is a good reference point in time (11:00 am PDT in spring) for the description of the behavior of the shadow edge before the downward movement (secondary shadow movement) of the shadow starts.

The Secondary Shadow Movement:

Each day, after the straight and stable phase of the upper shadow edge is reached, at about 10:45 am PDT (11:00 am PDT in spring), a downward movement of the shadow edge starts. This lasts until the wall with the petroglyphs is in full shadow when the azimuth of the sun is such, that as seen from the wall, the sun is behind the wall. This is shortly before local noon, or at about 12:10 pm PDT (12:20 pm PDT in spring).

I call this the wall is in self-shadow.

Once the sun is close to the true south position (local noon) on the sky, the upper shadow edge becomes less well defined and moves quickly from left to right over the rock including the petroglyphs and the markers. The rough surface of the rock makes a good definition of the shadow impossible. Thus, it is hard to define a shadow edge after about 12:10 am PDT.

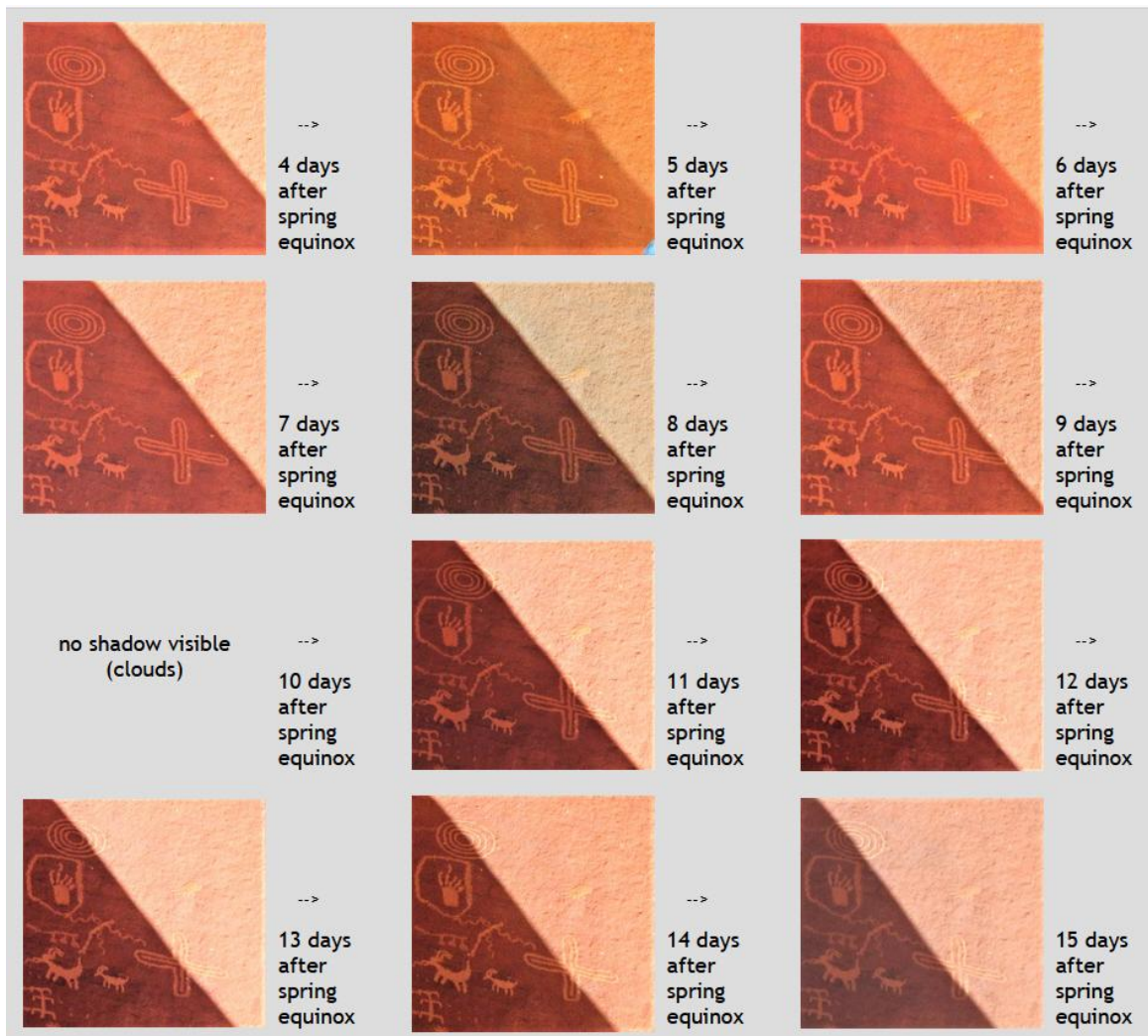


Therefore, I decided that only the primary shadow movement is considered to be of importance, as the secondary shadow movement does not provide a clear signature to determine any date.

The Primary Shadow Movement between following Days around the Equinoxes

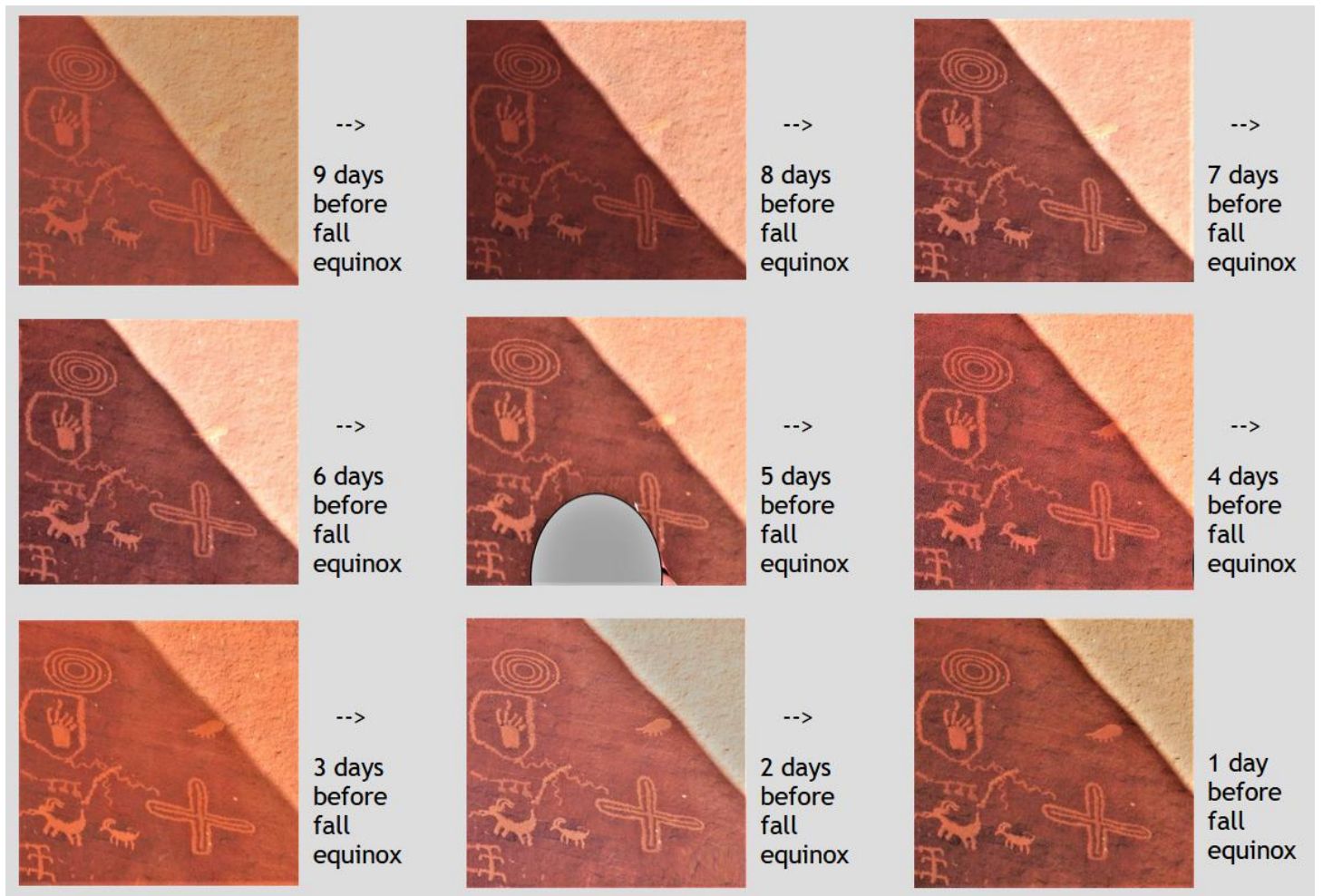
The position of the shadow at Atlatl Rock, when observed at the same time on following days, changes significantly.

In spring, this has been documented in 2023 between March 24 and April 4 (4 to 15 days after vernal equinox).



In spring, the increasing height of the Sun causes the shadow line to move downward. The pictures were taken always close to 11 am PDT

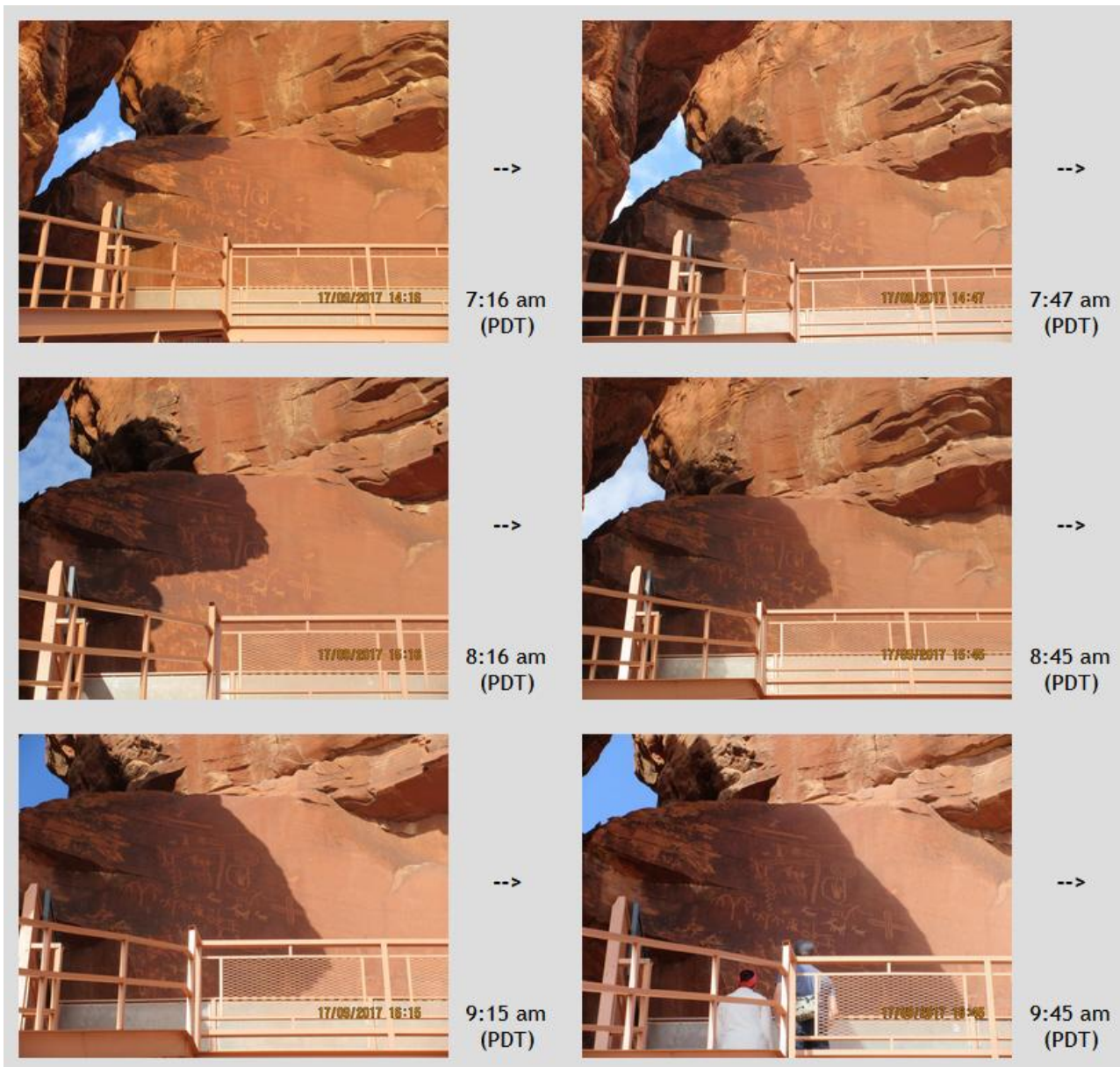
In fall, the movement of the shadow was documented in 2017 and 2018 between September 13 and September 21 (9 to 1 days before the autumnal equinox). To be comparable to the spring pictures, the time the pictures selected (they were taken every 15 minutes) was always close to 10:45 am PDT, as the same position of the sun is reached 10 minutes earlier in fall than in spring.



In fall, the decreasing height of the Sun causes the shadow line to move upward.

The Secondary Shadow Movement on Each Day

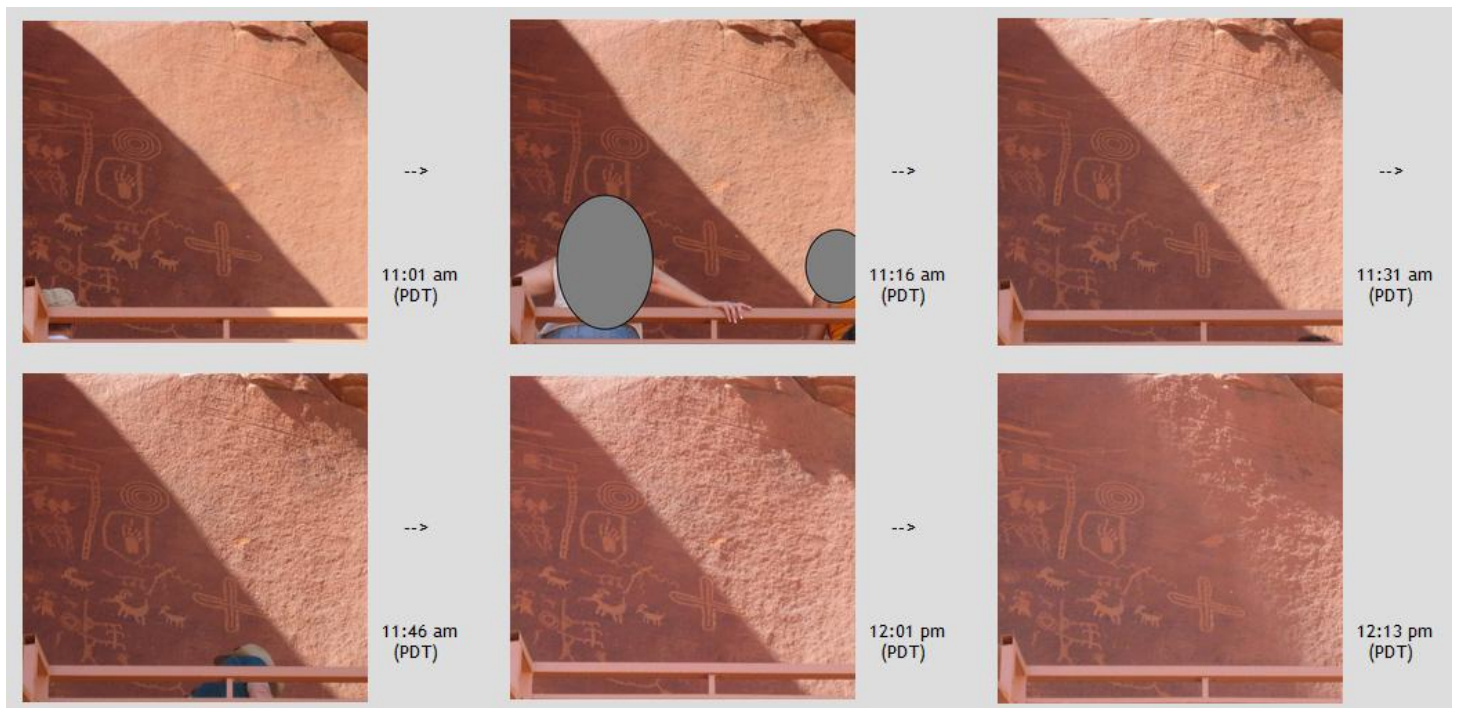
Between March and September each day after sunrise, due to the rising of the Sun and the change in azimuth and height on its path from east towards south (and west), the shadow cast onto Atlatl Rock by the rock due south, moves from top left to lower right. The two sets of pictures shown below, taken every 15 minutes from sunrise until the whole Atlatl Rock was in shadow, are from September 17, 2017.



At about 10 am PDT when the shadow tip has reached the lower end of the wall with the petroglyphs, the lower left part of the Atlatl Rock, where almost all the petroglyphs are, is in shadow. The upper end of the shadow is then an almost perfect straight line that cuts the rock into two halves: one in sunlight, the other in shadow.

This holds until about 11:00 am PDT, when the straight shadow line starts to move down towards lower left until local noon at about 12:15 pm PDT, when the whole wall is in shadow as the sun is now “behind” the wall with the petroglyphs.

(All times quoted are for September; in March, they are 10 minutes later.)



This daily movement of the shadow edge downward after about 11 am PDT is called the secondary shadow movement to distinguish it from the primary shadow movement that is between following days. Around the equinoxes, the secondary downward movement covers each day about the same distance as the primary movement does in about five days.

The Resulting General Picture Over the Year

As explained above, only the primary shadow movement is considered to be of importance, as the secondary shadow movement does not provide a clear signature to determine any date.

From the observations in 2017, 2018 and 2023 around the equinoxes the following general picture over the year (starting in summer) can be derived.

Note for the following description:

due to the variable dates of the astronomical equinoxes caused by the calendar (e.g. leap years) the date of the equinoxes can be March 19/20/21 and September 21/22/23. Also, the given dates of the events are good +/- one day as the exact time of the equinox can be at any time between the start of a day and the end.

Summer

During "summer", i.e. the time after spring equinox and before fall equinox, the upper shadow edge cast by the rock south of the Atlatl Rock wall is always below the markers that are proposed to indicate the dates near the equinoxes. More and more of the petroglyphs are always in sunlight until the wall is in self-shadow each day. Starting soon after summer solstice, the decreasing elevation of the Sun causes the shadow line to move upward between each following day and more and more petroglyphs are again in the shadow zone.

In the weeks before the fall equinox the interaction of the shadow line and the markers is as follows (equinox at September 22 assumed).

About 18 days prior to the equinox (~ Sept. 4), the shadow line, approaching the markers from below, touches for the first time the lower part of the concentric circles and the cross. Between the following days, it continues to move upward.

Around 14 days prior to the equinox (~ Sept. 8), the shadow edge connects the centers of the markers. The upward movement of the shadow line on each following day continues until about 10 days prior to the equinox (~ Sept. 12), when the shadow line touches the circles and the cross during the primary shadow movement for the last time.

The only marker then left in sun light above the shadow line is the "foot"!

The shadow line continues to move upward and reaches the "foot" three days later about 7 days before the equinox (~ Sept. 15). In the following five days it crosses the foot until two days before equinox (~ Sept. 20), when also the "foot" is completely in the shadow zone below the shadow line.

Two days before autumnal equinox is the autumnal solar quarter day!

Winter

During "winter", i.e. the time after the autumnal equinox and before the vernal equinox, the petroglyphs stay in shadow all the time once the shadow tip has reached them shortly after sunrise. This holds until the middle of March (~ March 20), when the shadow line approaches the markers from above and the movement of the shadow line before autumnal equinox happens in reverse order (equinox at March 20 assumed).

The events to be observed after spring equinox are:

- the "foot" is touched by the shadow line the first time (~ March 23)
- shadow line below "foot", but above circles and cross (~ March 28)
- shadow line at upper edge of circles and cross (~ March 30)
- shadow line connects center of circles and cross (~ April 3)
- shadow line at lower edge of circles and cross (~ April 7)
- more and more Atlatl Rock petroglyphs are always in sunlight.

This sequence of events is summarized in the graphics shown on page 23. The columns to the left and right of the central description can be used as a timetable for future observations.

Note: Due to the equation of time, local noon and all derived times are different in March and September. Times in March are later by almost 10 minutes as compared to the times in September.

What is Marked

It is obvious that the petroglyphs that mark the upper boundary of the area that contain the other figures that constitute the Atlatl Rock site have a specific function. The interplay of the shadow edge with the markers is such that it is clear that the three markers are intentionally placed.

The interaction of the upper shadow line with the markers starts in spring shortly (two to three days) after the spring equinox around the Solar Quarter Day, when the shadow edge, first time since winter, touches the upper end of the foot. The following days the shadow moves down across the foot, and reaches the upper end of the concentric circles and the outlined cross.

The inclination of the shadow edge is such, that it exactly matches the inclination between the top of the two markers.

When the shadow continues to move downward it connects the centers of the circles and the cross again at the same time and finally, when the shadow reaches the lower end of circles and cross, again the connecting line is identical to the shadow edge. (In fall, this sequence is just reverse.)

The whole time from first contact with the foot to the last contact with the lower end of the circles and the cross takes about 16 days.

It seems, that this two times during a year played a significant role in ancient times. In the literature, this dates around the equinoxes and/or Solar Quarter Days are known to have a significant meaning: In many ancient (and present) cultures this weeks were celebrated as the start of the planting season in spring and as the time to harvest in fall.

The offset of the first contact of the shadow with the markers from the equinoxes or Solar Quarter Days is not due to the fact that the petroglyphs are estimated to be about 4000 years old. It can not be used to derive an age of the petroglyphs as the shadow cast does not change due to astronomical reasons in that "short" period.

Independent of the knowledge of the reason for the markings:
it is fascinating to watch the shadow cross the markers and see the alignment in spring and fall.

Timetable for Future Observations

Timetable for Future Observations of Primary Shadow Interactions at Atlatl Rock in the 18 Days After Vernal (Spring) Equinox and in the 18 Days Before Autumnal (Fall) Equinox										
date in spring 2024	date in spring 2025	date in spring 2026	days from equinox	spring	between 9:30 am and 11:00 am	days to equinox	fall	date in fall 2024	date in fall 2025	date in fall 2026
Apr. 06	Apr. 07	Apr. 07	18	contact of shadow with lower edge of the markers	18	fall	contact of shadow with lower edge of the markers	Sept. 04	Sept. 04	Sept. 04
Apr. 05	Apr. 06	Apr. 06	17	first time coming from above	17	fall	first time coming from below	Sept. 05	Sept. 05	Sept. 05
Apr. 04	Apr. 05	Apr. 05	16		16	fall		Sept. 06	Sept. 06	Sept. 06
Apr. 03	Apr. 04	Apr. 04	15		15	fall		Sept. 07	Sept. 07	Sept. 07
Apr. 02	Apr. 03	Apr. 03	14	shadow edge connects centers of the markers	14	fall	shadow edge connects centers of the markers	Sept. 08	Sept. 08	Sept. 08
Apr. 01	Apr. 02	Apr. 02	13		13	fall		Sept. 09	Sept. 09	Sept. 09
Mar. 31	Apr. 01	Apr. 01	12		12	fall		Sept. 10	Sept. 10	Sept. 10
Mar. 30	Mar. 31	Mar. 31	11		11	fall		Sept. 11	Sept. 11	Sept. 11
Mar. 29	Mar. 30	Mar. 30	10	contact of shadow with upper edge of the markers	10	fall	contact of shadow with upper edge of the markers	Sept. 12	Sept. 12	Sept. 12
Mar. 28	Mar. 29	Mar. 29	9	first time coming from above	9	fall	first time coming from below	Sept. 13	Sept. 13	Sept. 13
Mar. 27	Mar. 28	Mar. 28	8	markers and petroglyphs in shadow	8	fall	markers and petroglyphs in shadow	Sept. 14	Sept. 14	Sept. 14
Mar. 26	Mar. 27	Mar. 27	7		7	fall		Sept. 15	Sept. 15	Sept. 15
Mar. 25	Mar. 26	Mar. 26	6	shadow edge crosses "foot"	6	fall	shadow edge crosses "foot"	Sept. 16	Sept. 16	Sept. 16
Mar. 24	Mar. 25	Mar. 25	5	markers and petroglyphs in shadow	5	fall	markers and petroglyphs in shadow	Sept. 17	Sept. 17	Sept. 17
Mar. 23	Mar. 24	Mar. 24	4		4	fall		Sept. 18	Sept. 18	Sept. 18
Mar. 22	Mar. 23	Mar. 23	3		3	fall		Sept. 19	Sept. 19	Sept. 19
Mar. 21	Mar. 22	Mar. 22	2	markers and petroglyphs in shadow	2	fall	markers and petroglyphs in shadow	Sept. 20	Sept. 20	Sept. 20
Mar. 20	Mar. 21	Mar. 21	1		1	fall		Sept. 21	Sept. 21	Sept. 21
Mar. 19 08:06 pm PDT	Mar. 20 02:01 am PDT	Mar. 20 07:4 am PDT		astronomical equinox		fall	astronomical equinox	Sept. 22 05:43 am PDT	Sept. 22 11:19 am PDT	Sept. 22 05:05 pm PDT
date in spring 2024	date in spring 2025	date in spring 2026	days to equinox	spring	between 9:30 am and 11:00 am	days from equinox	fall	date in fall 2024	date in fall 2025	date in fall 2026

In spring: take pictures every 15 minutes
- starting latest 9:15 am PDT, ending 12:30 pm PDT

In fall: take pictures every 15 minutes
- starting latest 9:00 am PDT, ending 12:15 pm PDT

Appendix

Comparison of the Shadow at Atlatl Rock at Corresponding Times in Spring and Fall

The position of the shadow edge at Atlatl Rock with respect to the markers should be almost identical at corresponding times in spring and fall. If the distance in time from (spring) or to (fall) the equinox is the same in days, then the shadow should be at the same position relative to the markers.

All observations so far had been made in fall and the conclusions derived from those observations have been used to “predict” the behavior of the shadow in spring, which should be in reverse order.

To prove this assumption, the site was visited in March/April 2023 and pictures were taken every 15 minutes in the morning until noon from 4 to 17 days after spring equinox.

The complete symmetry of the events
in spring and fall
has been demonstrated successfully!

The results are shown in the following series of picture pairs that show the shadow edge with respect to the markers at corresponding times:

One day after equinox in spring at 11:00 am PDT

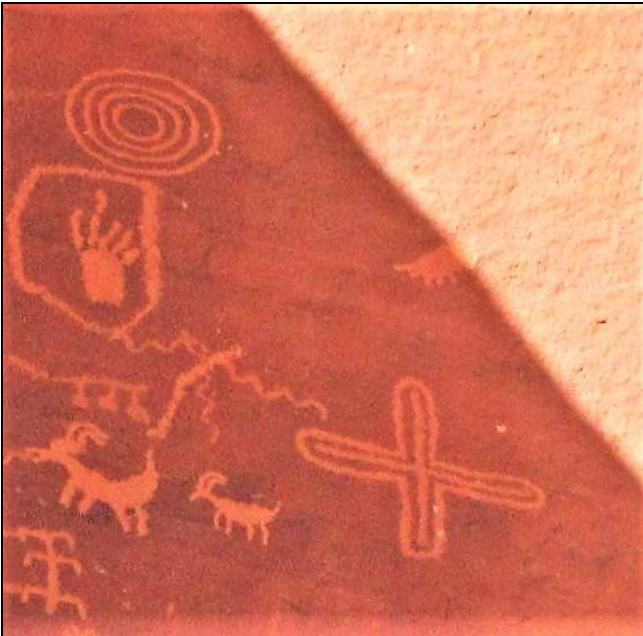
corresponds to

one day before equinox in fall at 10:45 am PDT

and so on

<p>no picture</p>	
<p>Equinox in spring</p>	<p>0.5 days before equinox in fall 2023-09-22 10:46 am PDT</p>
<p>no picture</p>	
<p>1 day after Equinox in spring</p>	<p>1.1 day before equinox in fall 2017-09-21 10:46 am PDT</p>

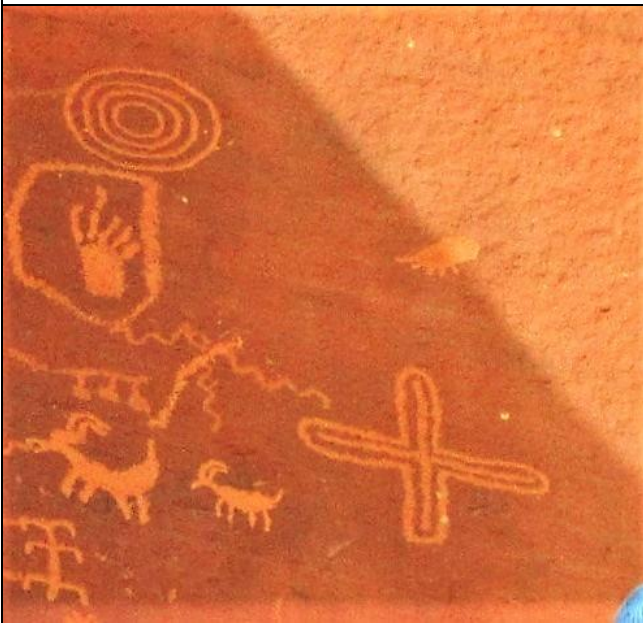
<p>no picture</p>	
<p>2 days after Equinox in spring (Solar Quarter Day)</p>	<p>2.1 days before Equinox in fall (Solar Quarter Day) 2017-09-20 10:46 am PDT</p>
<p>no picture</p>	
<p>3 days after Equinox in spring</p>	<p>3.1 days before Equinox in fall 2017-09-19 10:46 am PDT</p>



3.9 days after Equinox in spring
2023-03-24 11:00 am PDT



4.1 days before Equinox in fall
2017-09-18 10:47 am PDT



4.9 days after Equinox in spring
2023-03-25 11:00 am PDT



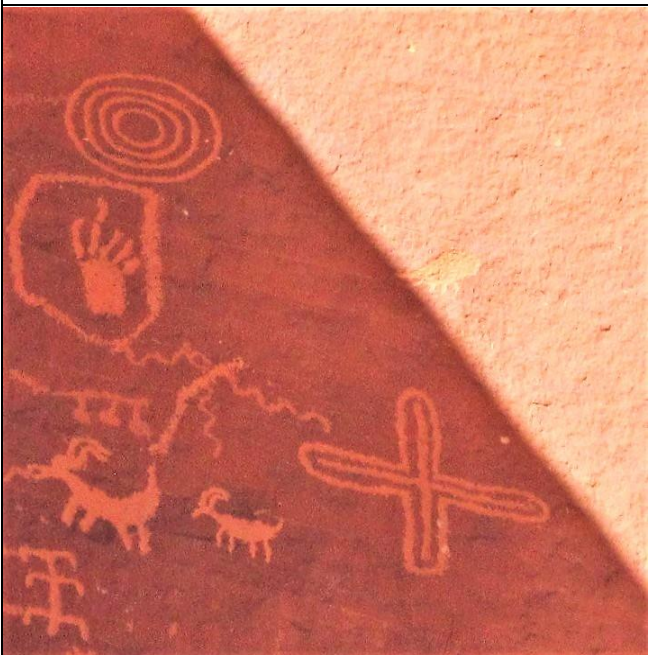
5.1 days before Equinox in fall
2017-09-17 10:46 am PDT



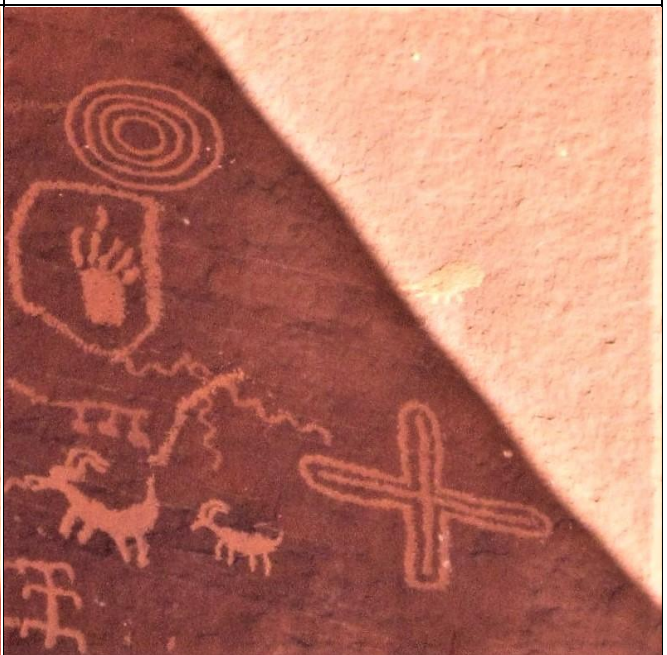
5.9 days after Equinox in spring
2023-03-26 11:00 am PDT



6.3 days before Equinox in fall
2018-09-16 10:44 am PDT



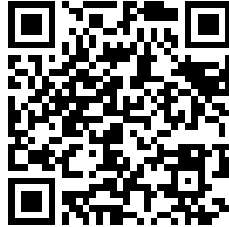
6.9 days after Equinox in spring
2023-03-27 11:00 am PDT



7.3 days before Equinox in fall
2018-09-15 10:45 am PDT

<p>7.9 days after Equinox in spring 2023-03-28 11:00 am PDT</p>	<p>8.3 days before Equinox in fall 2018-09-14 10:45 am PDT</p>
<p>8.9 days after Equinox in spring 2023-03-29 10:59 am PDT</p>	<p>9.3 days before Equinox in fall 2018-09-13 10:45 am PDT</p>

This printout (or an updated version) is also available as a pdf-file in letter format:



<https://www.helmutsteinle.de/AtlAtl-Rock/booklet-letter.pdf>

Much more information on the observations and the analysis of the data is available at:



<https://www.helmutsteinle.de/AtlAtl-Rock/index.html>

Contact:

Dr. Helmut Steinle
Am Eschbichl 21
81929 Munich
Germany

HelmutSteinle@t-online.de

Version 3 – February 2024

© 2024 Helmut Steinle

