



Rock Art and Archaeoastronomy in Morocco: Preliminary Observations

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Abstract

The purpose of this paper is to make public the exceptional discovery in the province of Essaouira (Morocco) of three petroglyphs engraved with an original subject in Moroccan rock art. By incision, astronomical, anthropomorphic, zoomorphic figures with Tifinagh inscriptions are engraved. The distribution and the nature of the engraved subjects evoke, most probably, a testimony with a material document on a natural disaster caused most likely by the fall of a great meteorite contributing, thus; to the understanding of the Ancient History of natural disasters in Morocco.

Keywords: Petroglyphs, Meteor, Bolide, Archaeoastronomy, Tifinagh inscriptions, Morocco.

Introduction

Regardless of the cultures involved, observation of the sky and astronomical bodies has been of worldwide interest since prehistoric times. Petroglyphs have been found around the world and have been interpreted by researchers as signs of the Sun (Davis-Kimball, Martynov, 1993, pp. 207-221; Coimbra, 2009, pp. 99-104), of Moon (Olivera, Silva, 2010, pp. 83-90; Poikalainen, 2005) and of supernovae (Iqbal et al., 2009, pp. 61-65). However, very few of them have been interpreted as bolides (Coimbra, 2007, pp. 250-256), comets (Coimbra, 2010, pp. 635- 646) and meteors or meteorites (Barreto, 2009, pp. 12-22; Iqbal et al., 2010, pp. 469-475; Figueiredo et al., 2017, 127-140). It is not difficult to admit that these events could have been interpreted by early societies as bad or good manifestations of the gods and; therefore, carved on rocky surfaces to be admired by future generations (Sagan, Druyan, 1986, pp. 25-45). In fact, Bailey (Bailey,

1995, pp. 647-671) argues that phenomena related to meteors and comets seem to have played an important role in the beliefs and social habits of most civilizations.

The purpose of this article is to announce the recent discovery of exceptional petroglyphs in Morocco in the rural commune of Ida Ou kazou (Essaouira province) and to try to interpret them. It is about three pebbles engraved with figures of astronomical character (meteors), anthropomorphic, zoomorphic and inscriptions Tifinaghés. This collection is currently preserved at the University Museum of Meteorites of Agadir. Our preliminary investigations expect that a meteor has occurred in Morocco in ancient times. The petroglyphs we studied seem to present a new perspective on Amazigh archaeoastronomy in Morocco that contributes to the understanding of the region's ancient history.

Geographical location

The petroglyphs studied were found in the Tiwrae region (rural commune of Ida Ou kazou, coordinates: $30^{\circ} 59' 49.7''$ N, $9^{\circ} 32' 10.9''$ W) approximately 100 km north of Agadir (fig. 1). The municipality Ida Ou kazou is situated on the western hillside of the High Atlas in the Essaouira province on a mountainous ground bumped with heights varying from 800 to 1500 meters (fig. 2).

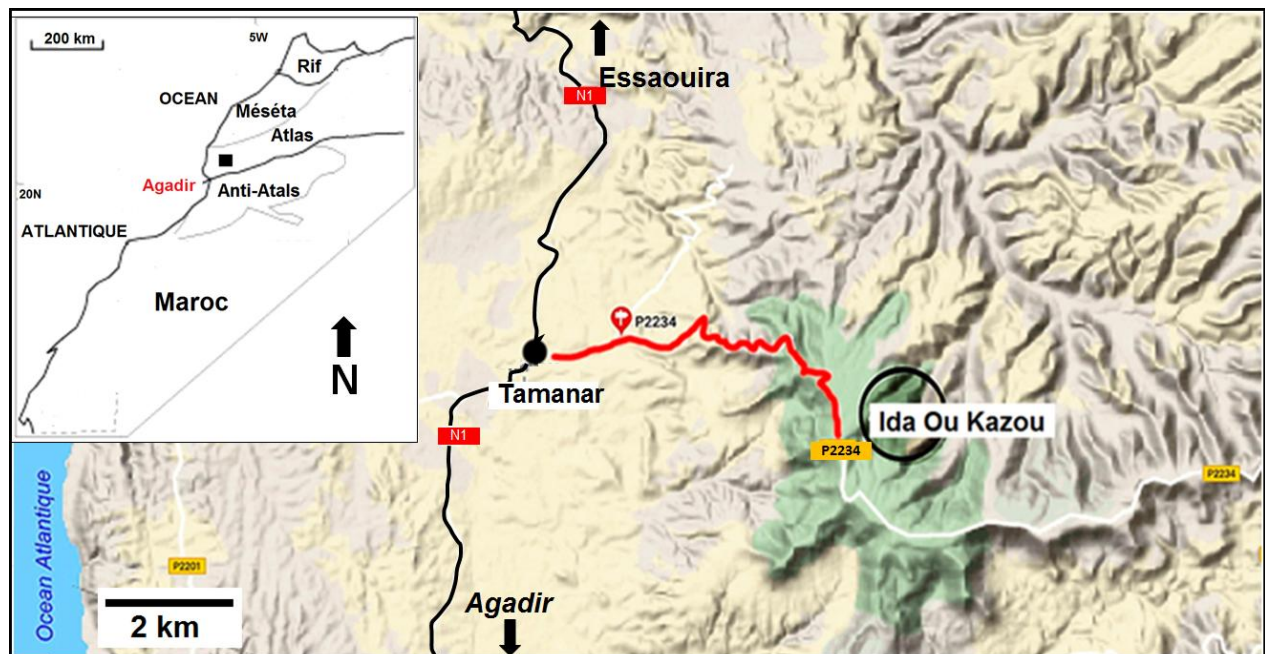


Figure 1. Geographical location of Ida Ou kazou (Essaouira province, Morocco).

Access to this area was recently facilitated by the construction of the P2234 Tamarar-Adrdor road, the petroglyphs were located 10 km south of the main road along the Douar Tiwrae. A canvass was conducted in the neighbouring of the Tiwrae Valley downstream of the site to document the petrographic and morphological variability of the pebbles carried by this stream and to search for rocks like the petroglyphs studied.



Figure 2. Photo of Ida Ou kazou (Essaouira province, Morocco).

Studied materials

The technical analysis carried out with a binocular magnifying glass equipped with an integrated digital camera revealed the mesoscopic characters used to reconstruct the craftsman's approach (engraving technique, direction of tool movement, etc.). The geological materials chosen by the artist are three pebbles of sandstone and quartzite sandstone that we have labelled Ida1, Ida 2 and Ida 3. They are characterized by:

The piece Ida 1 and Ida 2 (length 20 cm, width 17 cm, thickness 5 cm and length 18 cm, width 15 cm, thickness 5 cm respectively) are two pebbles of melanocrate cryptocrystalline quartzitic sandstone of very flat subcircular shape. They show traces of corrosion and dandruffy surface calcification consisting of thin carbonate plates forming a white or beige coating (fig. 3), more or less continuous on the surface of the rock (secondary precipitation of several carbonate dandruffs), this coherent dandruff, quite robust, totally covers the engraved figures, showing well an ageing of this studied work.

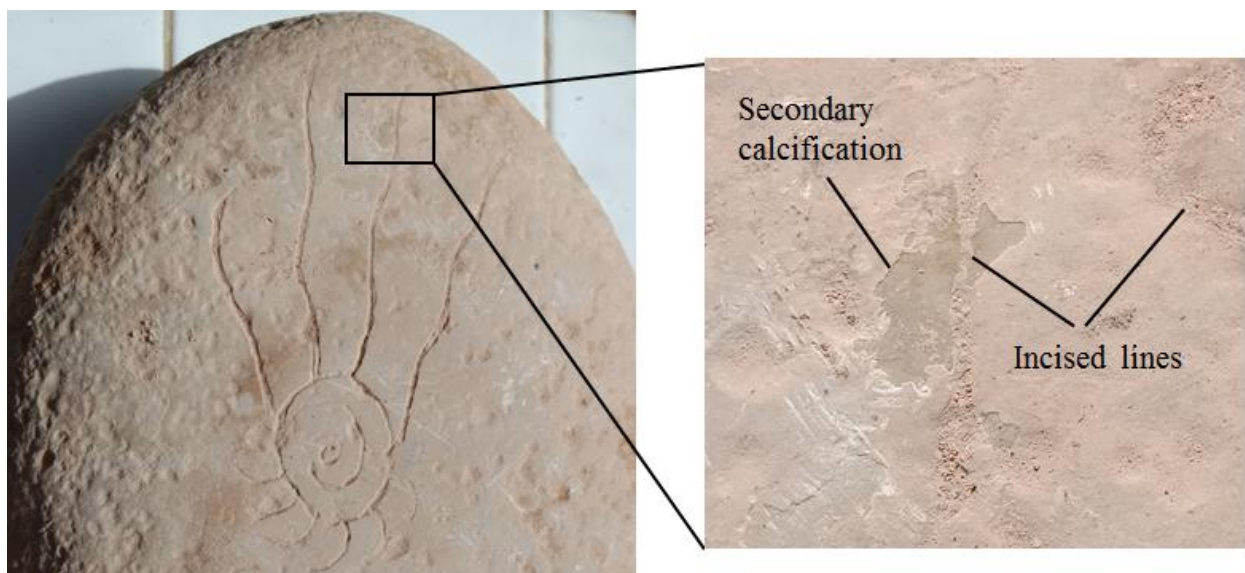


Figure 3. Incised lines and secondary calcification on Ida 2.

According to Millot et al. (Millot et autr., 1977, pp. 129-152) all the surface geochemistry indicates that the rocks of the region sufficiently yielded to meteorological agents, over a more or less long period, are frequently altered by precipitates of secondary carbonates.

After carefully cleaning Ida 1 (brushing and vinegar), the only engraved side of this piece features a spectacular scene of a man and woman apparently panicked by the fall of a meteor (fig. 4).



Figure 4. Overall view of the petroglyph Ida 2, before and after cleaning.

Identically on Ida 2, not yet cleaned of its clay and sand gangue and under the secondary precipitates of carbonate drandruffs, we can identify a scene that includes a fleeing anthropomorph and a large car (fig. 5).



Figure 5. Overall view of the petroglyph Ida 2.

Ida 3 (length 35 cm, width 27 cm, thickness 12 cm) is a thin, leucocratic sandstone pebble, rather flat and more or less square in shape. The mesoscopic analysis reveals that all the features engraved on this pebble are the work of the same point and the same engraver. After cleaning, Ida 3 symbolizes a scene that includes an anthropomorphic, two cattle of different sizes, a meteor and a figurine of the sun with concentric circles in the center. To complete his ideogram, the artist has arranged two lines of inscriptions with Tifinagh characters with blunt incised lines on the sides (fig. 6), showing, thus, an image-inscription association that is arranged in the interval that remains free, where it blends harmoniously. These Tifinagh inscriptions, which are difficult to translate, are quite old, it is impossible to date them precisely. A later note will be devoted to this.



Figure 6. Overall view, before and after cleaning.

Interpretation attempt and discussion

The countless astronomical representations painted or engraved on rocks around the world, with different chronologies, seem to confirm that one of the first concerns was to observe the sky. Indeed, the representation of astronomical bodies such as the sun, the moon and, less occasionally, the meteor phenomenon, constitutes an idea of the intellectual processes of these early societies and allows us to debate their ways of thinking about these astronomical concerns. The three petroglyphs studied, expose concentric circles (in the center hollowed out for Ida 1) attached to a group of three wavy lines (four for Ida 2) that extend backwards and that look like nothing, more than one round thing flying in the air and leaving behind a trail (fig. 7C and 8D, E and F).

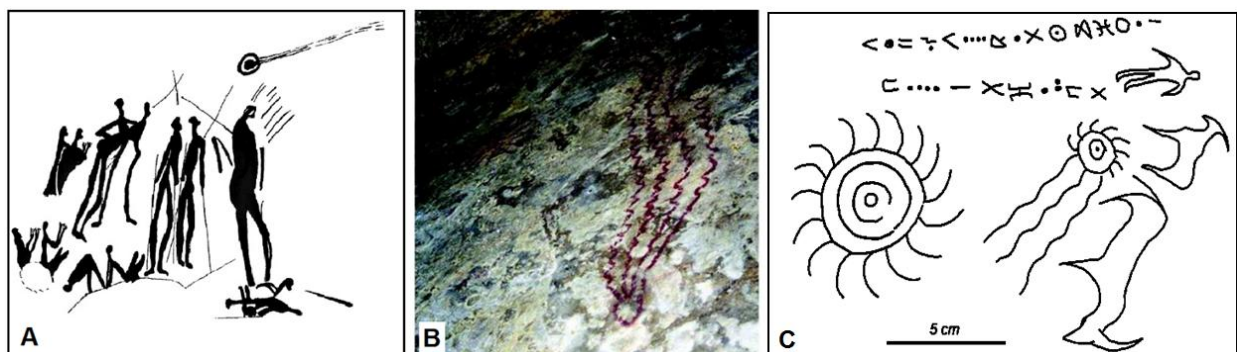


Figure 7. **A** - Meteor of Toca do Cosmos (Bahia, Brazil) (Coimbra, 2009). **B** - Fouriesbourg Meteor (South Africa) (Woodhouse, 1986). **C** - Reading of the petroglyph Ida 3.

These are the objects we propose as meteors. The typology of these objects is very similar to the meteor of the engraving of Toca do Cosmos (Bahia, Brazil) (Coimbra, 2009, pp. 99-104) and that of the rock painting of the Fouriesbourg district (South Africa) (Woodhouse, 1986, pp. 33-35) (fig. 7). The lines engraved on the petroglyphs studied show long, wavy tails giving a bright and very dynamic aspect of a flying object. Eyewitnesses to the fall of the Tissint meteorite in 2011 in the Tata region of Morocco reported that the fireball appeared in the sky with a continuous trail of smoke and dust (Ibhi, Nachit, Abia, 2013, pp. 293-298). Therefore, the wavy lines engraved on the petroglyphs can be interpreted as the smoke left behind by the meteor.

Astronomical observations reveal that these sculptures are those of a meteor, the three petroglyphs seem to represent the impact of a great meteorite that frightened the inhabitants and that the artist certainly lived and found this astronomical event spectacular to record it on the rock. However, mesoscopic observations show that the three petroglyphs, even if they represent the same scene, are technically and artistically different (fig. 8). It seems excessive to assume that these three similar works would be of the same hand or time. The ostentatious impact of the event justifies the presence of these ideograms on rocks and there are probably other representations in the region.

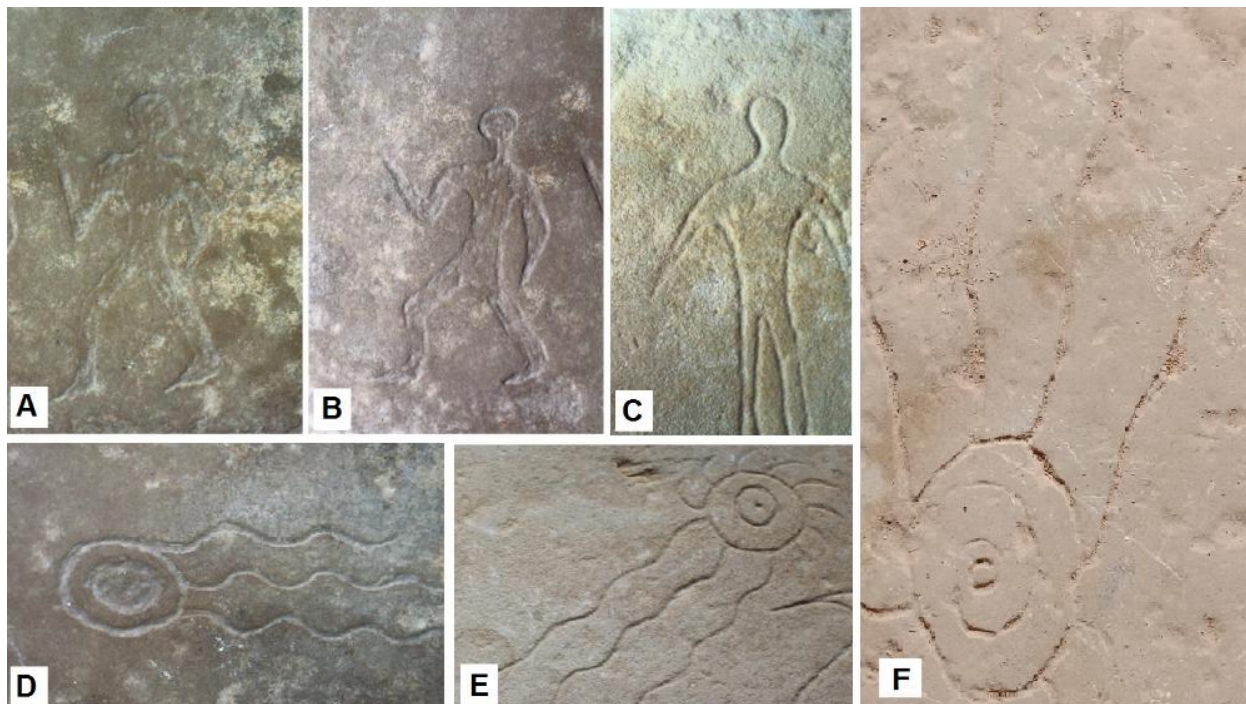


Figure 8. Ida 1: two human figures (probably a woman (A) and a man (B) and a meteor with a hollow centre (D). Ida 2: a human figure (C) and a meteor (E). Ida 3: meteor with four wavy lines (F).

The dating of the petroglyphs studied encounters a basic problem, which is the impossibility of connecting these artistic works to a specific engraving location in the region. To try to launch a chronology, we use other elements: the subjects represented, style, technique, patina and Tifinagh inscriptions. For the moment, and in the absence of additional studies, the dating is subtle, because we are faced with an archaeological discovery unpublished in Morocco and hence we have no means of relative dating by extrapolation. Conversely, chemical dating, which is based on the abundance of certain elements in the coatings of calcifications and micromorphological examinations of thin slides of these dandruffs, may help to limit the range of dates in which petroglyphs were created.

In desert areas around the world, carbonates form the layers over any petroglyph formation. Numerous attempts have been made to determine the age of rock art by radiocarbon analysis of carbonate (Bednarik, 2008, pp. 61-100; Rowe, Steelman, 2003, pp. 1349-1351; Russ et al., 1995, pp. 43-63).

A schematic representation depicting the process of carbonate formation is shown in fig. 9. Such a process would mean that the carbon that is incorporated in the carbonate (CaCO_3) can be used to provide information on the age of associated rock art. Before petroglyph production, natural weathering of the surface of petroglyph results in the formation of a carbonate crust. In our case, the SEM analysis of the Ibn Zohr University, shows that the carbonates are mixed with more abundant dolomite (double carbonate of calcium and magnesium, of formula $(\text{Ca}, \text{Mg})(\text{CO}_3)_2$ (fig. 9A). This carbonate film has been crystallized on the quartzitic sandstone substratum of the petroglyph Ida 2 (fig. 9B). The effect of carving into the surface results in the carbonate crust being removed (fig. 9C). A renewed layer of carbonate crust is deposited onto the exposed surfaces from natural weathering. Thus, at the time in which a sample is taken for radiocarbon dating, the newly formed crust over the carved surface would give an indication when approximately the new carbonate layer was deposited, presumably starting soon after the petroglyph was made (fig. 9D). In other words, the deposition of carbonate may occur continuously on an archaeological time scale of hundreds of years (Hassiba et al., 2012, pp. 2-16).

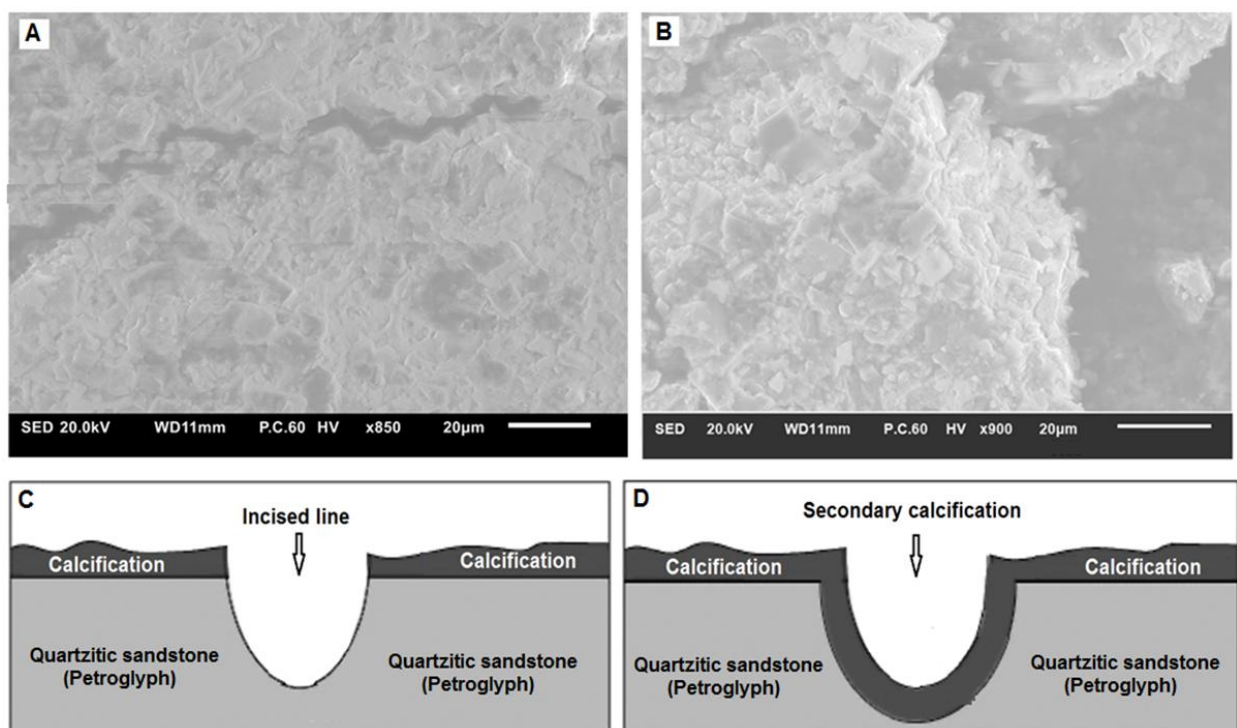


Figure 9. The carbonate film mixed with dolomite (A). The quartzitic sandstone substratum of the petroglyph Ida 2 (B). The schematic diagram is shown depicting the process of carbonate deposit on Ida 2 petroglyph (C). The carbonate that forms over the newly exposed surfaces of removed rock material collects over time and provides a sample for radiocarbon dating (D).

There will certainly be future scientific investigations that will confirm or refute our hypothesis of meteorite impact, including (a) the presence in the field of meteorite fragments and impacts (terrestrial rocks modified by the impact); (b) the presence of metamorphic shock effects in the surrounding regions. Plans are on track to conduct further geological, magnetic and gravity

prospecting studies to confirm this hypothesis. Proving this meteorite impact will be of great importance not only for Moroccan archaeoastronomy, but also for meteorites as a section of modern astronomy.

We underline the preliminary nature of this survey and one of our objectives is to encourage debate among colleagues interested in Moroccan archaeoastronomy, in order to participate in the development of scientific research in this field.

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