Northernmost kites?

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Abstract

The desert-kites have seen their spatial distribution considerably expanded in recent years, thanks to new discoveries. This spatial distribution shows some areas of high density, while the presence of hiatuses exists. Therefore, among these new discoveries, the Aragats kites in Armenia form an isolated aggregate. The comparison of their morphology and their integration in the landscape with other kites, and in particular with those of the Ustyurt Plateau, shows similarities between these two sets. They can clearly be discriminated from those of the whole area of distribution, which, besides, presents a high variability of their morphological characters. From this evidence, the question which arises is that of the existence of a cultural diffusion phenomenon.

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1. Introduction

“Desert kites” were first identified in the Near East in the 1920s. In spite of relatively widespread archaeological research, many fundamental questions surrounding these structures have still not been satisfactorily resolved. The age of kites remains uncertain, as the only rare chronological evidence is centered on the Bronze Age (Échallier and Braemer, 1995; Van Berg et al., 2004; Nadel et al., 2010; Brochier et al., 2014). However, certain authors claim that some of these structures are Neolithic (Helms and Betts, 1987; Akkermans et al., 2014; Iamoni, 2014; Morandi Bonacossi, 2014), while petroglyphs depicting kites point towards a classical age (Harding, 1953; Kennedy and Henderson, 2012), and historical evidence of collective hunting could implicate the use of kites (Burckhardt, 1835; Barker, 1876; Mitford, 1884; Wright, 1895; Musil, 1928a,b), although correlations between the described kites and those observed here still have to be confirmed (Brochier et al., 2014). The long-term use of these structures thus appears likely.

Many authors ascribe a hunting role to kites (Helms and Betts, 1987; Holzer et al., 2010; Nadel et al., 2010, 2013; Zeder et al., 2013), and the hypothesis of pastoral use (Échallier and Braemer, 1995) has not yet been demonstrated. The exact function of these constructions remains to be established and the populations involved have not been identified. Therefore, we still know relatively little about desert kites. These structures are generally devoid of archaeological material and thus cannot be investigated with standard methods.

In 2009, one of us (AK) came across structures similar to kites by chance on the southern foothills of Mount Aragats. This discovery was confirmed by the examination of high resolution satellite images and by a field mission in spring 2011, followed by two additional missions in autumn 2012 and spring 2013, for more in-depth investigations. The discovery was surprising in so far as the kites identified until then were all further south in the Levantine zone, and the structures in the Aralo-Caspian zone, as far removed from Armenia, were not considered by the scientific community to be part of the same complex, in spite of several exceptions (Betts and Yagodin, 2000). Subsequently, authors chose to reveal the existence of kites in Armenia, without citing the discoverer, and to employ the term “northernmost” to qualify them (Gasparyan et al., 2013).

The discovery of the Armenian kites coincided with the period when online satellite image access platforms (Google Earth, Microsoft Bing) began providing high resolution images, representing a new tool for the efficient and reliable identification of kites. Many new discoveries were published (Kennedy, 2012; Barge et al., 2013; Kempe and Al-Malabeh, 2013) and the number of listed kites soared from several hundred to several thousand, considerably widening their distribution range (the inventory piloted by the Globalkites project includes over 4,500 kites (summer 2014)).
list is accessible online: www.globalkites.fr. Consequently, new questions are currently being raised as regards the scale of these structures, as it is now clear that the extent of kites is much more widespread than previously thought and that their scope was probably hitherto underestimated. The few cases studied up until now no longer appear to be representative of a single schema, as was formerly believed. In the future, generalizations must be backed up by appropriate arguments as these structures appear to belong to a long-term context, marked by the strong variability of morphological characteristics and by significant spatial extension. The “Globalkites” project (Crassard et al., 2014) was set up in the light of these findings and is based on several different approaches, including new methods developed during work on the Armenian “laboratory”, which we hope will resolve the technical problems raised by kites. In Armenia, this program took over from the LIA program in 2013 and is currently focusing on new domains (Jordan, Kazakhstan, Saudi Arabia).

A detailed account of the investigations on the slopes of Mount Aragats has just been published (Brochier et al., 2014). However, the latter does not include the results from the last season. The first part of this article will thus recall the main findings, supplemented by the most recent data. After that, the Aragats kites will be compared to the kites of Ustyurt and then considered as part of a representative sample of the whole distribution zone. It will then be possible to broach the significance of the isolation of the Armenian kites in relation to Near Eastern kites.

2. The Mount Aragats kites

2.1. Localization and integration in the landscape

On the western fringes of Ararat Plain, 179 kites have been identified over an area of approximately a thousand square kilometres. They preferentially run along basalt flow fronts issued from Mount Aragats, bestowing linear shapes on their spatial distribution (Fig. 1). Given the regional context, they are at a low altitude. The antennae are generally constructed on the chaotic slight slope surface of the lava flows, whereas the enclosures are on the slope formed by the front of the flow, marking a break in slope at the entrance. The orientation of the Aragats kites, with the antennae...
Fig. 2. a: Aragats, kite AM4. b: Aragats, kite AM10. c: Aragats, kites AM14 and AM15. d: Aragats, kite AM59.
facing uphill, does not point towards a single direction, as is the case in some regions, but reflects lava flow orientation. This general schema is true for most kites, although we have observed several cases of inverted orientation (with the enclosure towards the top), clustered in the northwest part of the zone. The latter often only contain a single antenna or even none at all, whereas most structures follow the general pattern of two antennae.

2.2. Morphology

Average antenna length is 324 m [IQR 170–493 m], but they can exceed a kilometre (Lmax: 1.592 m) and are not very high (only one or two courses of stone). They were often aligned to take advantage of the rocky snags dispersed along the surface of the flows and break off when they come into contact with them (AM10, AM59, AM14 for example). On the other hand, the delineation of the enclosure walls carefully encompasses the rocky snags, at times involving obvious construction efforts (Fig. 2b and c). The enclosures thus always present a chaotic topography, so that the whole surface cannot be observed from any point. The enclosure is relatively far-reaching, as the median surface attains 1.8 ha [IQR 1.4–2.5 ha]. Only 13 out of the 154 measurable enclosures measure less than one hectare (the values indicated here may differ slightly from those published in Brochier et al., 2014, without greatly modifying the general characteristics, as they have been updated to include the whole corpus). This surface can be partitioned (17% of cases).

Blocks of basalt were used for the construction of walls. The walls of the enclosure are built with single facing and are much higher than the antenna walls, with an average of 76 cm and a maximum height of 2 m. The cell walls are higher still, with an average of 1.5 m and are always built with double facing. These small circular or rectangular-shaped constructions (about 25 m² on average) are always present, but generally in limited numbers (2.9 on average and 10 at the most). Most of the cells (72%) are built at the end of pointed-shaped appendages (Fig. 2a, c and d) and are preferentially positioned near the entrance (79% of the kites have at least one proximal cell), often on either side of the entrance.

The entrance is on average about 30 m wide and in the majority of cases (60%) is delimited by two retaining walls converging towards the interior of the enclosure. These are not extensions of the antennae and do not present the same orientation. We refer to these as “funnel-shaped entrances” (Fig. 2a and d).

The shape of the enclosures is generally simple: one or several pointed cells adjoin the roughly circular (AM59, Fig. 2d for example) or triangular base (AM10, Fig. 2b, for example), which can result in an overall star shape (AM4, Fig. 2a). The application of multiple correspondence analysis (MCA) to all the attributes does not show any recurring associations apart from the unexplained decrease in enclosure surface and antenna length with altitude. The attributes of these constructions thus appear to be very consistent.

The cells are clearly an important element of kites in that they are omnipresent and particular care was visibly taken with their construction. For this reason, several test pits were made inside them but no archaeological material was found. However, these test pits led to a better understanding of the architecture of these features. First of all, they confirmed that they were always built with double-faced walls with a slight internal overhang in the upper part. No entrance was identified, either towards the exterior of the kite, or in the interior of the enclosure.

The base of the cells is always lower than that of the enclosure and the difference in level often exceeds a metre. This recurring characteristic was undoubtedly essential, and was obtained in two different ways:

- when the local topography is level, the inside of the cell was carved into the basaltic substratum,
- when the local topography presents a break in slope towards the exterior of the enclosure, the joint enclosure/cell wall was built at this difference in altitude so that the cell base is naturally lower than the enclosure. In this case, it is not necessary to dig out the floor and it appears that these specific zones were sought out for their construction.

2.3. Chronology and function

Out of the 38 kites visited, very few architectural modifications were observed. Unlike in other regions, these are also very rare on the satellite images. This tends to imply that the kites were used for a relatively short period of time. The observed morphological consistency also points to short-term use. The chronological elements collected up until now, consisting of superposition and radiocarbon dating, place the construction of these edifices in a wide interval spanning the Early Bronze Age and the change of era, thereby eliminating the Neolithic and recent periods after the Iron Age.

In the absence of material in the test pits, the role of the Armenian kites is probably the most difficult question to resolve. Although the cells are undoubtedly the key to understanding how kites were used, the study of these elements is inconclusive and leaves room for diverse hypotheses. A hide role is rather unlikely, given that a smaller and less sophisticated structure would have sufficed. Moreover, if they were hides, they appear to be few and far between in relation to the size of the enclosure, and inappropriately distributed. If we envisage a pit function, the question of access must be considered as it is blocked off by a wall at least as high as the enclosure walls on either side of the cell. The function of selective stocking is even more improbable, for the same access reasons, and given the absence of remains in the test pits, a domestic function is very unlikely. Leaving aside the cells, the pastoral role of kites is improbable due the size of the enclosure and also on account of the frequent and apparently deliberate inclusion of rocky snags within the enclosure. Finally, only the frequent presence of a break in slope at the enclosure entrance points towards a hunting role. Orientation reflects slope topography, and generally points towards the northwest, which is compatible with the interception of migrating troops. However, no elements provide information on the species hunted.

3. Parallels between Aragats and Ustyurt?

A kite study mission was carried out in September 2013 on the south-western edge of the Ustyurt Plateau, in Kazakhstan (Barge et al., in this volume), following the same protocol as in Armenia, including excavations in the cells. Unlike the Aragats kites, two rather different types of morphology are present. Broadly speaking (for more details on the Ustyurt kites, see Barge et al., in this volume), they can be distinguished as follows:

- kites located near the cliff which bounds the plateau. These kites sometimes use cliff edges here to delimit the enclosures. In some cases only the entrance is built, outlining a convex indentation of the plateau: when the cliff presents jagged forms, the use of spurs limits construction work to the strict minimum.
- very large kites with very original shapes, the “arrow-shaped structures” of Yagodin (1998), “double-arrowed” kites, with a triangular partition on either side of the entrance and a cell at each angle. These kites are located within the plateau.

These two types of kites can be compared, but as the latter require further study, we will only compare the classical shapes.
that do not include cliffs in their outline to the Aragats kites. This comparison concerns both the general plan and the architectural details.

The overall shape of the enclosure is often triangular, with a truncated or rounded distal end. It frequently comprises a funnel entrance, made up of two pointed cells in proximal position (Fig. 3a and b). A few other cells are spread over the outer edge of the enclosure. They are clearly external and are connected to the enclosure by two small walls forming an angle with that of the enclosure, marking out a sort of nascent point.

These characteristics evoke those of the Armenian kites. The general shape of the enclosure is similar, although it is less regular in Armenia and the double proximal point forming the funnel-shaped entrance is less systematic. In the same way, pointed cells are frequent in Armenia and quasi-systematic on the Ustyurt Plateau (Fig. 4b), and nascent points have also been observed in Armenia.

As in Armenia, the cells seem to be the part of the kite requiring the most work and care. The walls are higher than the enclosure walls, and although the materials used are lithologically very different, two features are identical:

- the base of the cell is always lower than that of the enclosure (Fig. 4b and c). The loose substratum, and locally even the bedrock, were carved out in sub-horizontal parts of the ground (Fig. 4b). Breaks in slope are less frequent and less marked than

![Fig. 3.](image)

**Fig. 3.** a: Ustyurt, enclosure of kite KZ1. Hillshade of a Digital Surface Model. On this document, we distinguish clearly the plan of the structure in the local topography, the relative heights of the walls and the base of the cells, lower than that of the enclosure. b: Ustyurt, enclosure of kite KZ2 (hillshade of a Digital Surface Model).

![Fig. 4.](image)

**Fig. 4.** Ustyurt, cells. a) KZ28, cells are completely closed; b) KZ52, an example of pointed cell viewed from the exterior of the kite; c) KZ152, the base of the cell, built at the slope break, is lower than that of the enclosure (upper right part of the photo); d) KZ152, the same cell viewed from above: note the wall corbelling.
in Armenia, but intermittently we observe cells using natural declivity so that their base is lower than that of the enclosure (Fig. 4c).
- the cells also seem to be completely closed, including the part adjacent to the enclosure. The walls are corbelled; built by the horizontal stacking of slabs, gradually offset towards the interior of the cell (Fig. 4d).

In this way, the Ustyurt kites, or at least the classical-shaped structures, seem to present strong similarities with the Aragats kites. These shared features show that similarities exist between very distant constructions. It is now necessary to test whether the resemblances observed by comparing field data also emerge from the analysis of other data. It is also appropriate to evaluate to what extent the attributes of kites from this vast northern zone differ from the other kites. To this end, they will be compared to a representative sample from the whole distribution area.

4. Kites in Aragats, Ustyurt and the Near East

Using satellite images and fieldwork, we collected, observed, or measured 22 descriptive features for each kite (Barge and Brochier, 2011; Crassard et al., 2014). This information was recorded for 179 kites from Aragats and 143 kites in a delimited region in Ustyurt, studied in the field. In both regions, the data were tested in the field, thereby ensuring their reliability. Moreover, the same 22 characteristics were recorded in a random sample of 500 kites extracted from the 4,500 kites currently known in the Near East (or 11% of the total). The comparison of the features from these three complexes resulted in the following observations:

- number of cells: the distributions of the number of cells in the Aragats and Ustyurt kites are not statistically different ($p_{(\text{Chi}^2)} = 0.69$). In both cases, they are not very frequent: respectively IQR $[2\,\text{–}\,4]$ and $[2\,\text{–}\,3]$. They are, on the other hand, very significantly different from the kites in the Near East on the whole, where they are much more frequent: IQR $[4\,\text{–}\,10]$ (Fig. 5a).
- surface of the enclosures: the Aragats (Md 1.75 ha) and Ustyurt (Md 1.44 ha) kite enclosures are much larger than their Near Eastern counterparts (Md 0.65 ha). This appears to be a tenuous observation as the resemblance between Aragats and Ustyurt from this point of view is only significant if we include two exceptionally vast enclosures from Ustyurt in the sample (KZ 282 and 283; 172 ha and 77 ha respectively). In Ustyurt, the surface of the enclosure is well calibrated in classical cases, but this is not the case where kites are shaped like barred spurs, making comparisons difficult (Fig. 5b).
- frequency of proximal cells: the kites from Aragats and Ustyurt are characterized by high frequencies of cells in proximal position. This differs clearly from Near Eastern kites where proximal cell proportions of more than 60% are exceptional (Fig. 5c).
- frequency of pointed cells: the kites from Aragats and Ustyurt have very high relative frequencies of cells at the acute-angled extremities of the enclosure. For 50% of the Aragats kites, the

![Fig. 5. a: Distribution of cell numbers of Aragats, Ustyurt and the whole Near East kites. b: Tukey box-plots of the area of the kite's enclosures. c: Distribution of the relative frequencies of the proximal cells of Aragats, Ustyurt and the whole Near East kites. d: Distribution of the relative frequencies of the pointed cells of Aragats, Ustyurt and the whole Near East kites.](http://dx.doi.org/10.1016/j.quaint.2015.03.051)
cells are pointed and this proportion reaches 90% for Ustyurt. They stand out clearly from the other kites in the Near East, where pointed cells are sometimes absent or rare and never attain such high proportions (Fig. 5d).

These four main morphological criteria are the only features considered here and highlight the originality and similarity of kites in Aragats and Ustyurt, apart from the double-arrowed kites, compared to the corpus of kites from the Near East, with in particular, the recurring combination of a small number of generally proximal and often pointed cells on the periphery of large enclosures. Naturally, this does not imply that similar kites to the northern specimens do not exist elsewhere, but simply that the Aragats and Ustyurt complex offers a relatively invariable combination of features that are present in much lower proportions in the more extensive geographic area of the Near East.

5. Spatial heterogeneity of features

The random sample used includes 500 kites out of the 4,500 listed kites in the whole of the Near East. Based on selected criteria other than geographic elements, we mapped the dispersal of kites with similar features to those in Armenia (Fig. 6).

The 20 Armenian kites from the sample can be selected using a simple query corresponding to kites with an enclosure surface of more than one hectare and with 10 or less cells (Fig. 6). In the other regions, this selection shows that a high proportion of the kites at the foothills of the Taurus and the Jabal Al-Has also present these features. Likewise, they are frequent on the Ustyurt Plateau and in the region of Al-Qaryatayn in Syria, whereas they are rare in Jazirah, in Palmyrene mountain range, in Harrat-al-Shaam and in Saudi Arabia. In order to refine this distribution, we can carry out a more drastic query, selecting the majority, but not all the Aragats kites.
For a high proportion of kites with few cells, the latter were generally in proximal position, enclosures were relatively large and the number of antennae was low. By selecting these criteria (number of cells < 5, proportion of proximal cells > 50, enclosure surface > 1 ha and number of antennae < 3), we only obtain 38 kites, 14 of which are in Armenia. With the exception of two specimens in the region of Al-Qaryatayn and one in Jabal Al-Has, none of these kites is present in Syria or further south. They are only found on the edge of Ustyurt Plateau and in the Taurus foothills, south of Turkey. Therefore, a certain similarity emerges as regards the choices adopted by the kite constructors of these regions.

6. Isolation, convergence and distribution

The Armenian kites seem to make up an isolated entity. They are contained within an area of just over a thousand square kilometres. On average, the distance between two kites is 890 m and does not exceed 7 km. At the same time, the Armenian kites are very remote in relation to the nearest kites: 415 km from those of Jazirah and 850 km from those of Ustyurt. The observation of satellite images did not reveal any such structures in the surrounding areas. We know that certain kites are not visible on satellite images due to their conservation status or lack of contrast with their environment. However, the fact that we did not observe any kites whatsoever around the Armenian group remains surprising and it is unlikely that other kites exist nearby, at least in the same proportions or density, given that the environment is comparable and the region was carefully surveyed. Beyond a zone extending over several tens of kilometers around the Aragats kites, the discovery of new kites is very random (for this reason, an automatic kite search program on satellite images was launched in parallel with the GlobalKites program (Crassard et al., 2014)), especially considering the vast expanse of the hiatus areas on either side of Armenia.
thus seems that the aggregation formed by the Aragats kites can be considered as an isolated entity. While nothing explains the reasons for the existence of this entity, it is difficult to consider that it derives from a phenomenon of convergence; or, in other words, it is unlikely that the Armenian entity represents an isolated occurrence with no relation to the other kites. There are examples of convergence throughout the world, such as the principle of long walls ending in enclosed areas in Scandinavia, in North and South America, but compared to all these cases, the presence of cells is a marked and singular feature of eastern kites and appears to have been an essential working element of these structures, given their omnipresence and the care involved in their construction. Therefore, the presence of cells is a decisive element in linking the Armenian kites to the Near Eastern complex.

It thus appears relevant to examine the existence of a cultural diffusion phenomenon. The distinctive character of the kites implies that the technique was invented and practiced at a given point within the distribution area, and was then diffused; perhaps evolving throughout time, perhaps adapting to different species. However, without well-established elements pertaining to the role of these structures, and with so few available chronological data, nothing enables us to define, or even indicate the direction, of this possible diffusion. The Syrian region is the only zone yielding early data, and dates from the Aragats and Ustyurt entities are relatively recent.

If we take the complex of kites from Aragats and compare their characteristics with those of the other kites from the whole distribution area, specific morphological features clearly emerge, including rather large enclosures, few cells and the high frequency of pointed cells, particularly in proximal position. This observation is consistent with the notion of an isolated entity, even though we are not in a position to explain specific regional traits. However, other kites present similar morphological characteristics, namely the nearest kites to Armenia, even though they are at a considerable distance. The classical Ustyurt kites, and in particular, those near the cliff delimiting the plateau, also comprise few cells and these are generally pointed and in proximal position. This set of characteristics is even almost systematic. Therefore, there appears to be a link between these two complexes, even though enclosure size differs. This observed connection is not limited to Ustyurt as it also applies to the kites from the Taurus foothills, in Turkey (Fig. 6).

The mapping approach shows clear similarities. These features even seem to be present further south, to the Al-Qaryatayn region. The same is true of the funnel-shaped entrances, highlighting the same partition (Fig. 7).

Regional groups have already been recognized in the past. They are beginning to emerge at the scale of the area of distribution, thanks to the cartographic approach based on features of kites (Barge et al., in press). The kite phenomenon appears with a strong geographic variability and a single attribute from one spot cannot be interpreted as representative of all kites. There is no doubt that it will be possible to develop these descriptions once more field data, in particular chronological, are available. For the time being, we can postulate that although Armenian kites present regional characteristics, they are part of a more general complex, as those from Ustyurt. They have features in common with the latter and therefore cannot be considered as the “northernmost” kites.

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