Butterfly Beads in the Neolithic Near East: Evolution, Technology and Socio-cultural Implications

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The study of butterfly beads, which first appeared during the tenth millennium cal. BC, covers an important span of the Neolithization process and gives new insights on the symbolic and socio-economic systems of the first farming communities in the Near East. By the end of the Pre-pottery Neolithic, butterfly beads acquired sophisticated shapes and became appreciably larger. Simultaneously, the choice of raw materials changed towards brighter and more colourful allochthonous rocks. These changes reflect a desire to make the butterfly beads more conspicuous as well as an increased demand for 'prestige' materials. The technological mastery required to shape and perforate these beads suggests craft specialization and changes in social organization. The morphological and technological complexity of these items, the aesthetic quality of their raw materials, the variability in the degrees of use-wear, along with the particularity of the archaeological contexts, imply a polysemantic reading of their symbolic functions. Butterfly beads were likely related to motherhood and fecundity. Objects of memory and valuable items of 'prestige', they comprised part of family or group heirlooms and were worn for special ceremonies. They undoubtedly represented the cultural identity of the first farming societies in upper Mesopotamia and the Levant.

In the early 1960s, at the prehistoric sites of Judaidah and Dhahab, in south central Anatolia, Robert and Linda Braidwood found what they called 'double-axe' beads (Braidwood & Braidwood 1960, 62), better known today as 'butterfly' beads, and one of the most typical personal adornments of the Pre-pottery and Pottery Neolithic cultures in the Near East. However, despite their importance, their recurrence in different regions of the Near East and their very attractive aspects, few studies have been devoted to them. This paper presents an integrative analysis of these so-called 'butterfly beads' discovered at several Pre-Pottery Neolithic B (PPNB) sites in Upper Mesopotamia and in central Levant and assesses their role in a context of important socio-cultural and economic changes.

The emergence of the first farming societies: economic and socio-cultural background

It is clearly established today that the emergence of Neolithic farming livelihood in the Near East occurred through series of deep and complex economic, socio-cultural and ideological transformations (e.g. Aurenche & Kozłowski 1999; Cauvin 1997; Hodder 2001; Hole 2000; Kozłowski & Aurenche 2005; Kuijt & Goring-Morris 2002; Verhoeven 2002). Plant domestication during the PPNA (*c.* 10,000–8700 cal. BC), followed by animal domestication during the PPNB (*c.* 8700–7000 cal. BC), were determinant and have triggered the emergence of farming communities. Their development during the PPNB is reflected by the increased size of permanent

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settlements, the population growth, the spread and development of agriculture and husbandry activities, the emergence of specialized industries (e.g. lithic), the technological means made available to serve ideological and ritual issues (collective building, megaliths, plaster floors, plastered human skulls, etc.), the increased complexity of funerary practices, and by the dense cross-culturality expressed through the intensification of long-distance networks of circulation of materials, products, ideologies and humans. It is during this economic and socio-cultural process that the butterfly beads appeared, evolved and became the most characteristic items of the Neolithic stone body ornaments in northern Mesopotamia and the Levant.

The butterfly beads: morphology and terminology

Neolithic body ornaments in these areas were made from a wide range of materials: shell, bone, teeth, clay, stone and native copper (Alarashi 2014), to mention only the preserved and non-organic materials. They display a great morphological and typological diversity as well, however, with dominance of disc-beads, beads and pendants (Alarashi 2014, fig. 14.5; Bar-Yosef Mayer 2013, table 1). Beads are defined as objects with long (or short for the disc-beads) centred and axial perforation, whereas pendants, occasionally mentioned here, are defined as objects with short off-centred and transversal perforation (Alarashi 2014, fig. 4.8).

Although reported in several regions of the Near East (Fig. 1), such as central Anatolia (e.g. Özbaşaran 2012, 157, fig. 20), western Zagros (e.g. Kozłowski & Aurenche 2005, 189, annex 5.1.5), central (e.g. Contenson 2000, 119) and southern Levant (e.g. Bar-Yosef Mayer 2013, 137, fig. 7; Groman-Yaroslavski & Bar-Yosef Mayer 2015, 85), and Cyprus (Peltenburg *et al*. 2001, fig. 2–24; Simmons 2012), the largest number of the most characteristic butterfly beads was discovered in the PPN sites of the middle Euphrates. Almost all the butterfly beads were manufactured from allochthonous stones. A few examples made from clay were found in Early PPNB sites like Nevalı Çori (Morsch 2002, 157, pl. 5:7–9) and Dja'de el-Mughara (Alarashi 2014, fig. 9.2-k, i). Bone and shell were not employed in the manufacture of this kind of object; yet, in the preceramic levels of Mehrgarh (Balochistan, Pakistan), flat beads with lengthened 'eyelets' made from shells are recorded (Barthélémy de Saizieu 2003, 22).

The butterfly beads are fairly large, flat, symmetrical beads (mean length 14.19 mm; mean width 12.56 mm). The most obvious morphological characteristic is their flatness; of the three dimensions, length, width and thickness, the latter is the smallest when measured (Fig. 2). When the bead is observed facing the perforation, the transverse cross-section, which has either a lenticular or a diamond shape, appears very thin and the extremities form two highly acute symmetrical angles. These angles correspond to the thin, delicate edges[1] (Fig. 2a) that separate the two identical profiles of the bead. The profile is a large surface divided into two symmetrical parts by the path of the perforation. This path is sometimes emphasized by a central edge (Fig. 2b). Another important feature observed on some butterfly beads concerns the ends of the perforation channel. These are sometimes thicker and well defined, suggesting a 'collar' that can either be short or extend beyond the volume of the bead (Fig. 2b). These features have generated the terms of 'flaring collared bead' (Braidwood & Braidwood 1960, 62) or 'collared butterfly beads' (Bains *et al*. 2013, 340). Finally, the proportions of butterfly beads may be configured in two ways: the width larger than the length (Fig. 2a) or the length larger than the width (Fig. 2b).

To provide a term for the beads discovered in the Neolithic levels of Abu Hureyra, those with a 'longitudinal perforation separating the bead into two symmetrical wings', Moore first employed the term 'winged beads' (1973, 22) and then 'butterfly beads' (1975a, 118; 1975b, 61; Moore & Molleson 2000, 279). There is no explanation concerning the choice of the term 'butterfly' to be found in the available literature. The shape of some wide-patterned beads, especially those with extended collars, suggests the outspread wings of a butterfly. However, these features could also suggest other entities (e.g. birds, human torso, axe or double axe, etc.). Many other terms have been employed: 'double-axe' beads (Braidwood & Braidwood 1960, 62); the French terms '*perles plates*' (flat beads) (Cauvin 1972, 88) and '*perles à ailettes*' (beads with fins) (Contenson 1977, 15, fig. 10; 2000, 119), etc. Despite the confusion that it could induce, of all these terms 'butterfly beads' remains the best known and the most commonly used so far (e.g. Bains *et al*. 2013, 340; Bar-Yosef Mayer 2013, 139; Kozłowski & Aurenche 2005, 26). Adding a new term will lead to more confusion whereas using a generic term such as 'flat bead' could be reductive. Therefore, the term 'butterfly bead' will be used here to designate every collared or non-collared bead with lenticular or diamond cross-section. When necessary, the term 'collared butterfly bead' will be specified. The term 'flat beads' is used to designate items of elliptical cross-section that are probably the predecessors of the butterfly beads (cf. *infra*).

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Table 1. *Radiocarbon dates from Abu Hureyra and their calibrations (cf. Alarashi 2014, 70).*

Abu Hureyra	Dates BP	Calibration BC	Dates BP	Calibration BC	Cultural period
Phase 2A	9374±72	9088–8424	8330±100	7138–7086	Early to late PPNB
Phase 2B	8300±100	7082	7310±120	5989	Late PPNB/PPNC
Phase 2C	7310±120	5989	?	?	Pottery Neolithic

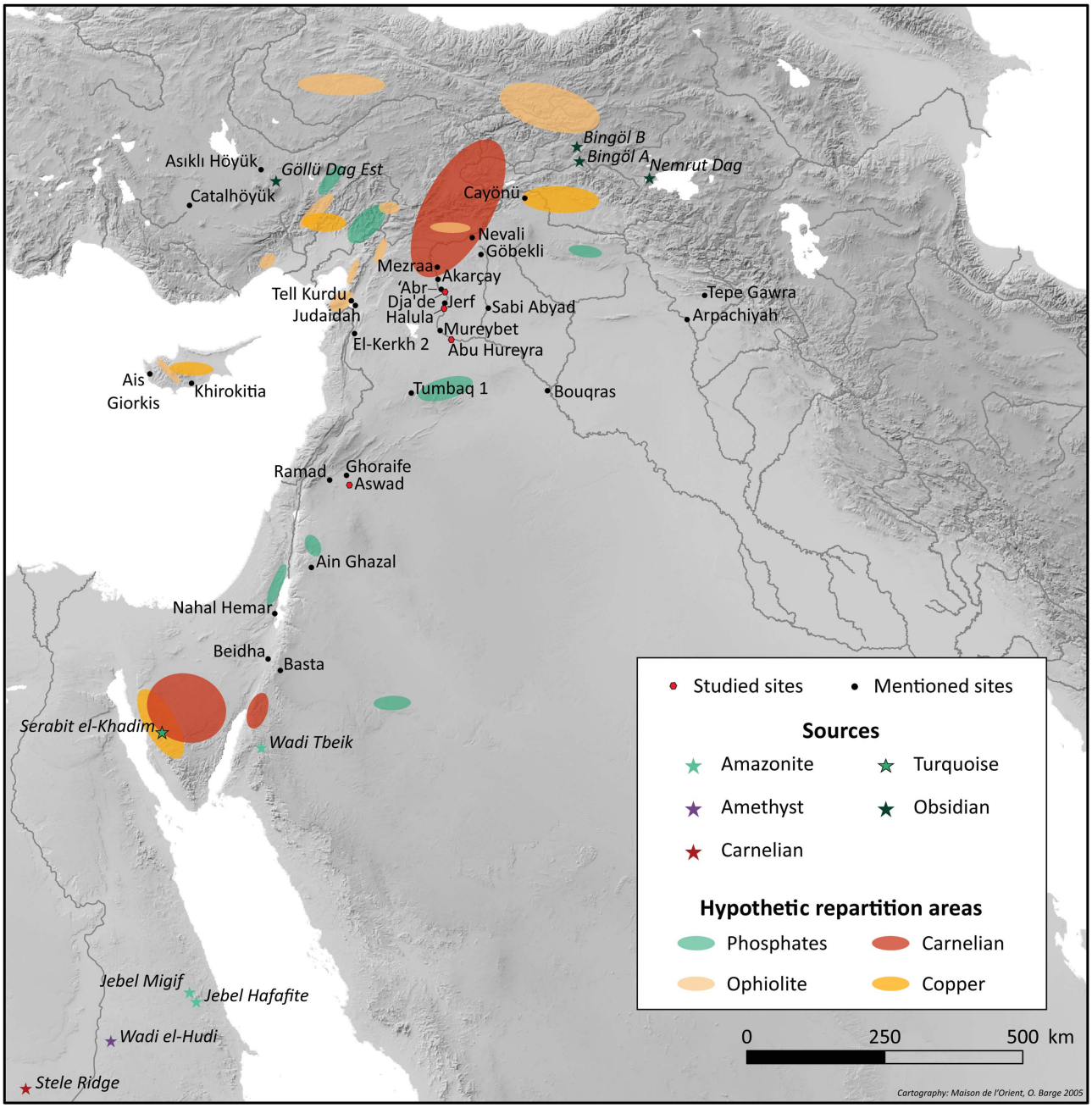


Figure 1. *Map showing the location of studied sites, mentioned sites and possible sources of raw materials.*

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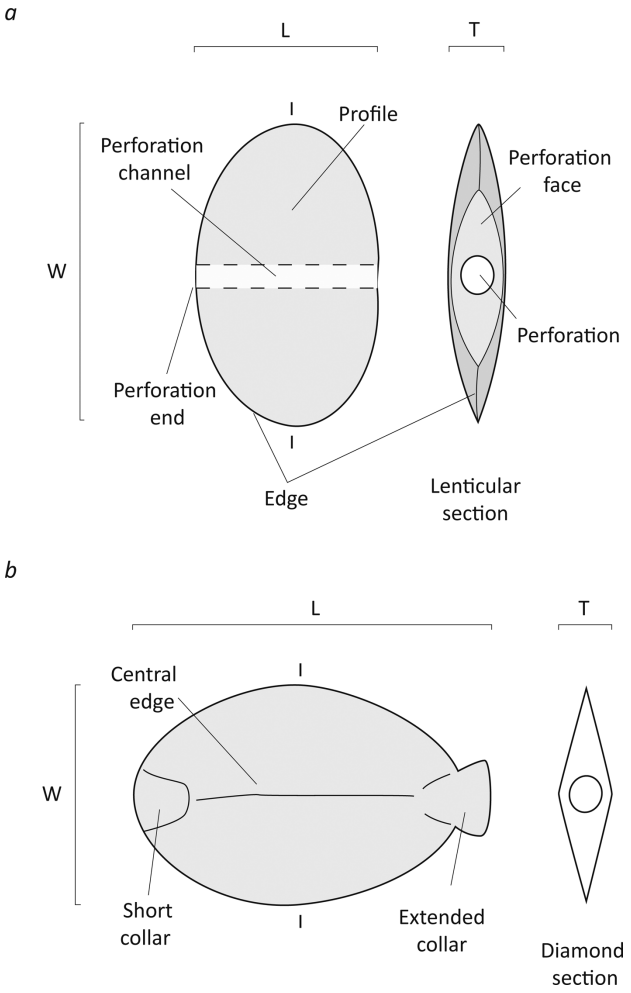


Figure 2. *Morphological characteristics of butterfly beads: (a) non-collared butterfly bead, wide pattern; (b) collared butterfly bead, long pattern. W=Width, L=Length, T=Thickness.*

Material and methods

Material

The majority of the beads studied were discovered at Tell Halula and Tell Abu Hureyra, two important PPNB villages located in the middle Euphrates valley (Fig. 1). A total of 39 occupation phases covering more than 2500 years have been identified during the excavations of Tell Halula (Molist & Vicente 2013, 64). According to the radiocarbon dates (Fig. 3; Borrell & Molist 2014, fig. 3), the earliest phase is dated to 7700–7600 cal. BC and the latest to 5500–5300 cal. BC. From a chrono-cultural point of view, the village was established at the end of the Middle PPNB period, occupied during the Late PPNB, the Pottery Neolithic and the transition period between the Pottery Neolithic and the Chalcolithic. Here, only the occupations between 7700 and 7300 cal. BC are concerned (Molist *et al.* 2013, 91, table 1). They correspond to the end of the Middle PPNB (phases 7–10) and the beginning of the Late PPNB periods (phases 11–13).

Some cereals (Molist & Faura 1999, 31) and animals (Helmer & Saña 1996, 145) were already domesticated in the earliest phases of occupation. At the end of the Middle PPNB, the subsistence economy was based on both wild and domestic resources. In the Late PPNB, herding became the main economic activity, with a focus towards the exploitation of specific products (milk, hides, etc.).

One of the most striking features at Tell Halula is the high regularity of the house plans and the spatial organization of the village during the PPNB occupations. Burials are deposited inside the houses and consist of vertical pits sealed with very compact clods of earth. The dead were buried inside in a seated position, with their upper and lower limbs hyper-flexed (Ortiz *et al.* 2013, 4153, fig. 2). Personal adornments were discovered within a large number of burials and were associated with adults of both sexes and children (Ortiz 2014, fig. 3). A total of 173 butterfly beads were found in these contexts, composing diadems, necklaces and bracelets. Interestingly, at Tell Halula, the collared butterfly beads were always associated with children under 11 years old. Turquoise (Fig. 4a & e), carnelian (Fig. 4d, f, g, & i), serpentine (Fig. 4h), and in rare cases amethyst (Fig. 4b) and obsidian (Fig. 4c), are some of the raw materials exploited for manufacturing these beads.

The second site, Tell Abu Hureyra, was located about 100 km south of Tell Halula. Excavated during three campaigns (1971–73), the site yielded two major periods of occupation (Moore *et al.* 2000): late Natufian (Abu Hureyra 1) and Neolithic (Abu Hureyra 2). The latter is subdivided into three phases (Table 1): Phases 2A and 2B are considered to be PPNB occupations, phase 2C to be Pottery Neolithic (Moore *et al.* 2000, 259). Domesticated cereals (Moulins 2000, fig. 12.28) and animals (Legge & Rowley-Conwy 2000, 425) are present in the earlier levels of phase 2A. During phase 2B, Abu Hureyra became a village of farmers practising agriculture, herding and hunting. The rectangular multi-cellular houses show standardized dimensions and orientations, with the dead buried beneath the floors in varied positions. The 22 butterfly beads studied were discovered in PPNB funerary context and often associated with adult females and sometimes with adolescents or children (Moore & Molleson 2000, 291). Very attractive stones were used for making these items, most of them presenting nuances of colour ranging from green to grey, like those made

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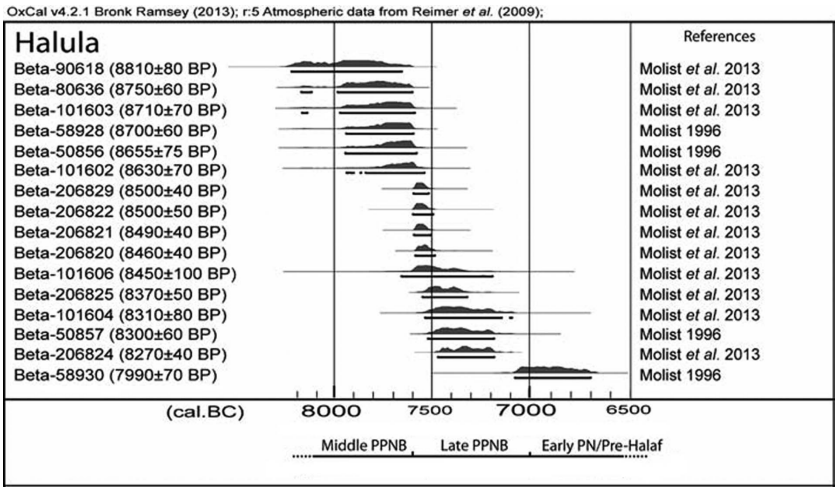


Figure 3. *Tell Halula radiocarbon dates and their calibrations according to Borrell & Molist (2014, fig. 3).*

from serpentine and talc varieties (Fig. 4j, k & p). Orange to red agate was also employed (Fig. 4m & o) along with light blue amazonite (Fig. 4q).

In addition to the beads from Tell Halula and Abu Hureyra, six specimens from Dja'de el-Mughara (Early PPNB, 8800–8290 cal. BC) in the middle Euphrates valley (Coqueugniot 2014) and 19 from Tell Aswad (late Early PPNB, 8620–8280 cal. BC and Middle PPNB, 8169–7725 cal. BC) in the Damascus oasis (Stordeur *et al.* 2010, table 1) have been studied (Fig. 2). The total number of the butterfly beads presented in this paper is 220 items, covering the entire PPNB period.

Methods

Several methods were applied for the study of the butterfly beads in order to question: 1) the variety of stones used, their origins and modalities of procurement (raw materials); 2) morphometric changes over time and aesthetic and cultural choices (typology); 3) the skills and know-how that have enabled the emergence of specialized artcraft (technology); 4) functionalities such as stringing systems and ornament composition (use-wear analysis); and 5) sociocultural functions and meanings (combination of all the previous aspects as well as analyses of the archaeological contexts).

Mineralogical identification was carried out through the recognition of particular physical criteria such as hardness (based on Mohs scale test), density, colour, surface appearance, transparency/translucency or opacity. For difficult cases, identification was made using X-ray diffraction techniques (Alarashi 2014, 112–13). The length, width and thickness of the artifacts were measured as well as the diameter of the perforations, in order to perform morphometric analyses. Finally, studies of the technological processes and use-wear were conducted according to the nature of the raw materials. For this purpose, the surface of every bead was systematically examined using a stereomicroscope (magnifications from 20× to 80×). In some cases, observations were made by metallographic microscope (100×, 200× and 300×) and Scanning Electronic Microscope (SEM) (up to 800×).

Results

All the studied beads are in a good state of preservation allowing technological and use-wear studies as well as identification of the raw materials.

Raw materials

Raw materials employed belong to the quartz family, to the carbonate, phosphate and ophiolite groups, to the feldspar family and to clay (Table 2). The earliest PPNB butterfly beads are from Dja'de el-Mughara and Tell Aswad. At the first site, the specimens are made from clay, talc and chlorite, all soft materials, whereas at Tell Aswad, amazonite, turquoise and other phosphate varieties (e.g. crandallite), which are relatively hard stones, were used along with calcite and malachite. Tell Halula yielded the largest number of butterfly beads. They are mostly made from carnelian and turquoise. Other varieties like agate, obsidian and amethyst were also employed, but in very small amounts. Likewise, soft stones such as talc and serpentine were rarely used. At Abu Hureyra, the majority of the butterfly beads are made from relatively soft stones belonging to the ophiolite group and a few from

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Figure 4. *Examples of non-collared and collared butterfly beads from Tell Halula (a–i) and Abu Hureyra (j–q): (a & e) turquoise; (b) amethyst; (c) obsidian; (d, f, g & i) carnelian; (h) serpentine; (j & k) talc; (l) jadeite (?) (© Ashmolean Museum, University of Oxford); (m & o) agate; (n) phosphates; (p) serpentine-lizardite; (q) amazonite.*

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Table 2. *Raw material families and varieties. Distribution by chronological period and by site. (Ah=Abu Hureyra; Aw=Tell Aswad; Dj=Dja'de el-Mughara; Hl=Tell Halula.)*

Mineral raw materials		Chrono-cultural periods							Total
Groups	Varieties	PPNA/EPPNB	EPPNB		MPPNB		LPPNB		
		Dj	Dj	Aw	Aw	Hl	Hl	Ah	
Quartz	carnelian					17	63		**80**
	agate					1	1	3	**5**
	quartz							1	**1**
	amethyst						1		**1**
	obsidian					1			**1**
Ophiolitic	talc		1		2	3	2	10	**18**
	chlorite		1		4				**5**
	serpentine					1	1	1	**3**
	amphibole?							1	**1**
Phosphates	turquoise			2	5	11	70		**88**
	phosphates	1		2				1	**4**
Carbonates	malachite			1		1			**2**
	calcite				1				**1**
	marble?				1				**1**
Feldspars	amazonite			1				1	**2**
Clay	clay		3						**3**
Undetermined	?							3	**3**
	Total	**1**	**5**	**6**	**13**	**35**	**138**	**22**	**220**

hard stones such as quartz, agate, and amazonite. Finally, it should be stressed that, except for clay and calcite, which could be found locally, the identified raw materials came from distant allochthonous sources, at least 200 km away from the sites studied (Alarashi 2014, 557).

The locations of some specific sources of minerals in the Levant and Upper Mesopotamia are illustrated in Fig. 1. Hypothetical areas of procurement of varieties of chalcedony, copper, ophiolites and phosphates are also designated. Amazonite sources are mentioned for the areas of Wadi Barqa and Wadi Arabah in southern Jordan (Hauptmann 2004, 174). Some PPNB sites in this region yielded amazonite workshops (Fabiano *et al*. 2004; Wright *et al*. 2008, 157). Sources of amethyst are located quite far from the studied area, in the Egyptian desert in southeastern Aswan (Bloxam 2006, 278), but some authors do not exclude their procurement from Anatolia (Zöldföldi 2011, 236). Major obsidian sources are located in northern Mesopotamia near Lake Van and in Central Anatolia (Cappadocia). Based on the dark green colour and its opacity (Delerue 2007, 40), the obsidian used for a single butterfly bead could originate from one of the oriental sources. Turquoise sources are unknown in Anatolia and northern Mesopotamia. In southern Levant, they are identified in the Sinai Peninsula (Bloxam 2006, 278; Hauptmann 2004, 173). Carnelian sources are mentioned for the upper Euphrates Valley region (Inizan 1999, fig. 1, 137), the Sinai Peninsula (Astruc 2002, 123; Quenet 2008) and Wadi Rum in southern Jordan (Rollefson *et al*. 1991, 103). Rocks belonging to the ophiolitic group (chlorite, serpentine, talc) are only available in Anatolian and Upper Tigris areas (Alarashi & Chambrade 2010; Santallier *et al*. 1997). Varieties of phosphates such as fluorapatite, woodhouseite and crandallite, identified at some Neolithic sites in northern Levant and in the middle Euphrates (e.g. Tumbak 1 and 2, Tell Mureybet, Cheikh Hassan, Abu Hureyra), come from the northern Near East sources. These latter are chemically different from the southern Levantine phosphates (Santallier *et al*. 1997, 64).

Typology and size variations

The typological system developed recently (Alarashi 2014, 170–72) attributes the butterfly beads to the class of 'objects with long centred axial perforation' (i.e. beads) and to the family of 'flat beads'. The discrimination of these types is based on their geometric shapes, the presence/absence of collars on the perforation ends and on the extension of collars. Table 3 lists the types recorded from the studied sites according to chrono-cultural horizons. The non-collared butterfly beads represent the majority at 90 per cent, while the collared flat beads make up only 10 per cent. The rounded beads, especially the oval shapes, are

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Table 3. *Recorded types of butterfly beads. Distribution by chronological period and by site. (Ah=Abu Hureyra; Aw=Tell Aswad; Dj=Dja'de el-Mughara; Hl=Tell Halula.)*

Types			PPNA/EPPNB	EPPNB		MPPNB		LPPNB		Total
			Dj	Dj	Aw	Aw	Hl	Hl	Ah	
Butterfly beads		Elliptical	1	5	6	9	17	101	1	**140**
		Circular					2	4	6	**12**
		Diamond					5	12		**17**
		Trapezoidal					6	7	1	**14**
		Rectangular				2	2	8		**12**
		Square						1		**1**
		Triangular						1		**1**
Collared butterfly beads	Non-extended collars	Elliptical							3	**3**
		Circular							1	**1**
		Diamond						1		**1**
		Trapezoidal							1	**1**
		Rectangular							1	**1**
	Extended collars	Elliptical				1	3	3	1	**8**
		Trapezoidal							5	5
		Circular							2	2
Total			**1**	**5**	**6**	**12**	**35**	**138**	**22**	**219**

dominant among both the simple and the collared flat beads. Among the polygonal shapes, diamond, trapezoidal and rectangular are the most frequent. The extended or short collars are associated with the most frequent shapes (oval, circular and trapezoidal).

To present the size variability of butterfly beads, the main measurements, width and length, are plotted in Figure 5. Three groups can be distinguished according to size: 'small', 'medium' and 'large'. In terms of proportion, three patterns are observed: 'long', 'broad' and 'equal'. This distribution corresponds to the variability of the assemblages: beads from Abu Hureyra belong to 'large' and 'medium' groups, while those from Tell Halula, Tell Aswad and Dja'de belong to the 'small' and 'medium' groups. This distribution can also be explained by the nature of the raw materials used: 'medium' items correspond to chalcedony beads (carnelian and agate), while most of the 'small' ones are turquoise beads. Most of the beads made from turquoise come from Tell Halula, but some of them, small in size as well, were found at Tell Aswad.

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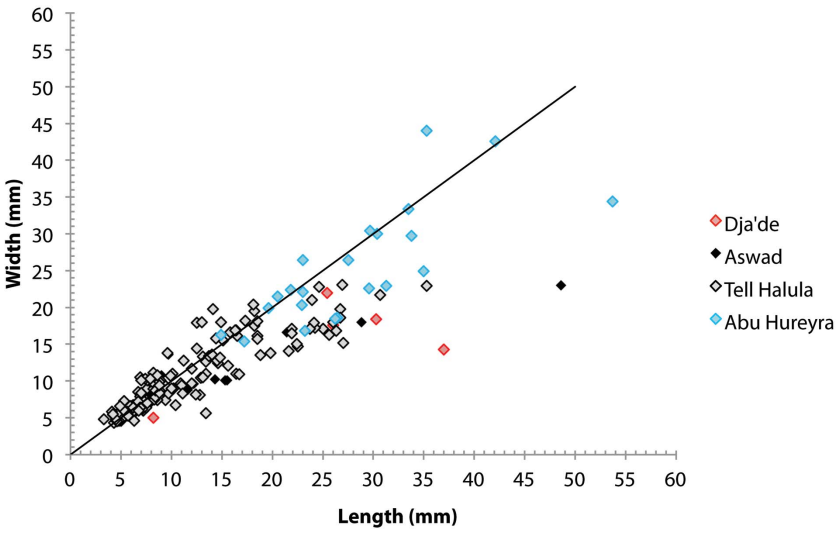


Figure 5. *Scatter plot showing the distribution of collared and non-collared butterfly beads (N=192) according to their length and width.*

Table 4. *Principal metric data of collared and non-collared butterfly beads.*

Metric data	Non-collared butterfly beads		Collared butterfly beads			
			Short collar		Extended collar	
	Length	Width	Length	Width	Length	Width
N	167		7		15	
Maximum	42.1	44.0	35.3	29.7	53.7	34.4
Minimum	3.3	4.3	17.2	15.4	8.2	9.5
Mean	12.5	11.4	25.6	22.1	27.8	21.1
Standard deviation	7.8	6.4	6.7	4.8	11.9	6.6

Based on the main metric data presented in Table 4, the general size seems to be related to the typological group. For the non-collared butterfly beads, the range of variation (average and standard deviation) indicates that they tend to be rather small (mean length 12.5 mm, mean width 11.4 mm). The short-collared butterfly beads appear to be medium on average (mean length 25.6 mm, mean width 22.1 mm), as do the extended-collared butterfly beads (mean length 27.8 mm, mean width 21.1 mm).

In sum, a large number of non-collared butterfly beads belong to the small size group while the collared ones belong to the medium size group. Nevertheless, these tendencies could be influenced by the number of items in each group, the raw materials used or the fact that they come from different sites.

Technological processes

By combining the physical properties of the raw materials (hardness, grain texture and degree of compactness), three groups can be distinguished (A, B and C). Table 5 presents the most representative materials for each group. Based on macroscopic and microscopic observations of the beads and on theoretical considerations, some technical operations have been identified. The manufacture of butterfly beads involves the following stages during which one or more techniques are employed: extraction of the raw material (e.g. removal of the cortex); specific treatments (e.g. heating or humidifying); debitage; shaping; perforation; and finishing (Alarashi 2014, 188). The order and the number of stages of fabrication would have varied according to the nature of the worked material, and some techniques could have been repeated during the manufacturing processes, for example the heating of carnelian (Roux 2000, 40). Table 6 summarizes the techniques applied during the different stages of the *chaîne opératoire* according to the variability of stone groups. The first stages are undocumented, since their evidence is erased by the following stages and by use-wear. The manufacturing processes of beads belonging to groups A and B are similar, except for the

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Table 5. *Groups (A, B & C) of raw materials distinguished by combining physical properties (hardness is estimated according to Mohs scale) and their most representative examples.*

Physical properties	Groups		
	A	B	C
Hardness	≥ 4	≥ 6.5	< 6.5
Grain texture	fine/ medium	fine/ medium	fine/medium
Compactness	compact	medium/compact	compact
Examples	*Talc, serpentine, chlorite, marble, calcite*	*Turquoise, amazonite, phosphates*	*Quartz, obsidian, carnelian, agate*

Table 6. *Techniques employed according to the different stages of the chaîne opératoire and to raw material groups A, B and C (see Table 5).*

Stages	Groups		
	A	B	C
Specific treatments	?	?	heating?
Debitage	sawing, abrasion	sawing, abrasion	direct/indirect percussion?
Shaping	sawing, scraping, grooving, abrasion	sawing, abrasion	indirect percussion? pressure? abrasion
Perforation	mechanical rotary abrasion	mechanical rotary abrasion	mechanical rotary abrasion (abrasive+liquid+fixing devices?)
Finishing	polishing, lustring	polishing, lustring	polishing, lustring (abrasive+liquid+fixing devices?)

shaping stage. Materials belonging to group A such as talc, serpentine, or calcite are shaped by abrasion. The ends of the perforation of the collared beads of this group are emphasized by sawing and scraping (Fig. 6a & b). Materials from group B such as turquoise and amazonite are shaped by abrasion (Fig. 6c). Sawing could have been employed, although this was not observed in the studied assemblages. Neither turquoise nor amazonite was used for making short or extended-collared beads. Heating is documented for all the chalcedony beads (group C) (Alarashi 2014, 444). The debitage and shaping stages of the siliceous rocks from group C could have involved knapping techniques. For chalcedony beads, shaping was carried out by knapping, probably by pressure flaking and then by abrasion (Fig. 6c).

Significant difference is observed in regard to the perforation's cross-section, which is sub-conical for beads of groups A and B (Fig. 6d), whereas it is sub-cylindrical or cylindrical for those of group C (Fig. 6f). The very fine, concentric and parallel striations recorded on the perforation channel (Fig. 6d & e), as well as the regularity of the hole perimeter, indicate that drilling was performed using a mechanical device such as a bow drill. As demonstrated by experimental work (Alarashi 2014, annexe III.1, 195) and ethnographic sources (Sela & Roux 2000), the stage of perforation, especially on hard stones such as carnelian, is extremely delicate and requires stability of the drill as well as constant force. This stage cannot be accomplished without firmly fixing the bead during the drilling and, in the case of hard stones, without continually adding abrasive (e.g. sand) and cooling liquid (e.g. water) to avoid breakage caused by frictional heating.

The finishing stage consists of smoothing the surface and giving the bead its final shape. Two techniques are generally applied during this stage: polishing and lustring (fine polishing). The first is employed to erase irregularities and visible technical marks on the surface (Fig. 6f), while the second provides a shiny and brilliant aspect to the surface (e.g. Fig. 4p). All the studied beads were polished; however, lustring is documented for only few items. At Tell Halula, it was observed on very restricted areas on some carnelian beads. Showing erased striations and a very smoothed surface (Fig. 6g), these small areas could be part of more extended lustre that has disappeared due to use-wear. For the Abu Hureyra beads, lustring was identified for at least four specimens, although all of them were made from soft stone, either talc or serpentine (e.g. Fig. 4p). The very high degree of shine suggests the use of lustring supports containing grease, such as leather (Alarashi 2014, 474). The sharpness of the bead edges and the very good preservation of the shape exclude the possibility that the shiny aspect of the surface was produced by intensive and continual friction during use.

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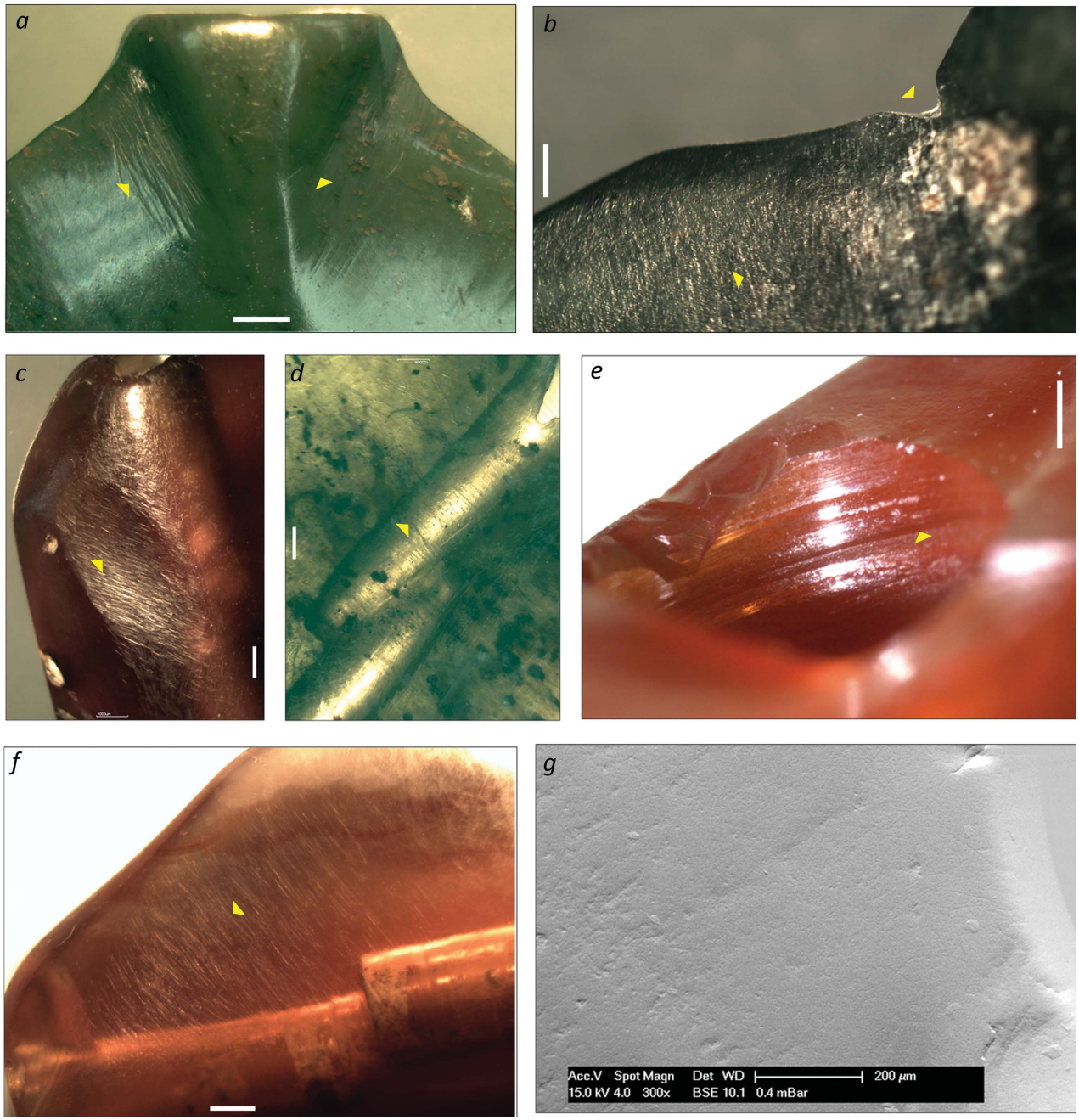


Figure 6. *Technical marks: (a) scraping traces near the perforation ends, serpentine (scale 1 mm); (b) sawing groove delimiting the perforation end and abrasion striation on the bead profile, talc (scale 0.5 mm); (c) knapping negatives (by pressure?) covered with abrasion striations on the bead profile, carnelian (scale 1 mm); (d) rotary striations on the walls of the sub-conical perforation, talc (scale 1 mm); (e) rotary striations on the walls of the cylindrical perforation, carnelian (scale 0.5 mm); (f) fine striation of polishing on the profile of the bead, carnelian (scale 1 mm): see also the sub-cylindrical cross-section of the perforation tube; (g) 'empty' zones indicating intentional lustre, carnelian.*

Use-wear

Two categories of use-wear are distinguished: superficial and volume use-wear (Alarashi 2014, 238). The majority of beads (93 per cent) present superficial use-wear characterized by the occurrence of one or various markings such as a general smoothing, random strips (Fig. 7a), or partial erasure of previous technical traces (Fig. 7b). A few beads (5.6 per cent) show a high degree of use-wear characterized by peripheral chips (Fig. 7c) and deformation of the hole perimeter

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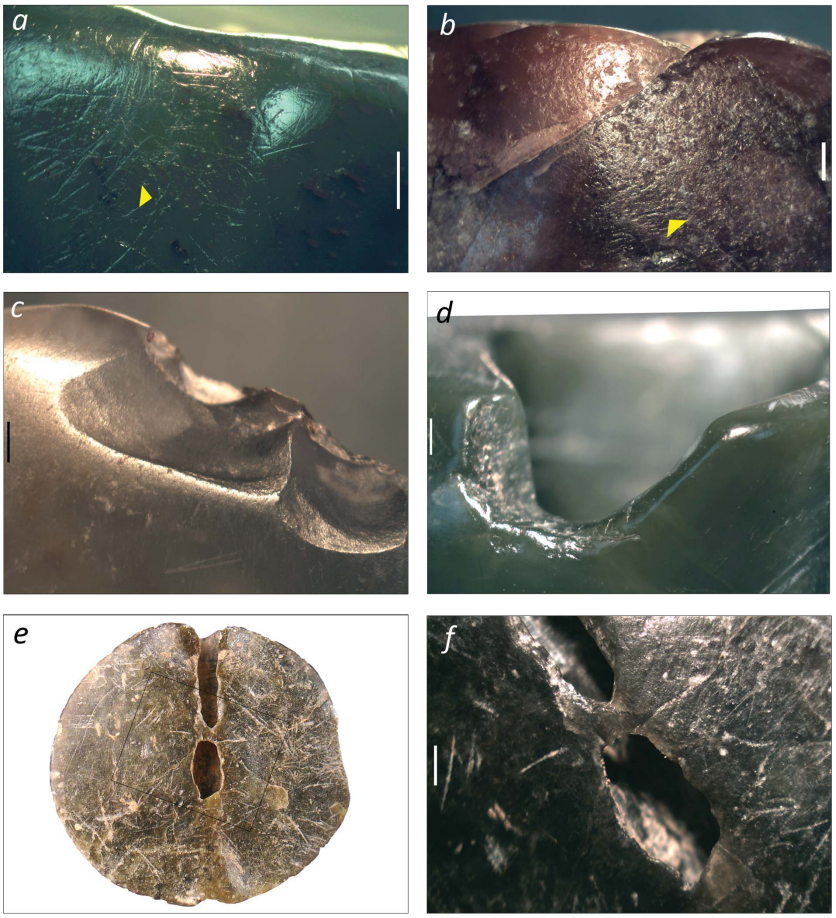


Figure 7. *Use-wear marks: (a) smoothing and random strips, serpentine (scale 0.5 mm); (b) erasure of technical traces, agate (scale 1 mm); (c) peripheral chips, quartz (scale 1 mm); (d) notched perforation in the circumference, talc (scale 0.5 mm); (e) pierced perforation tube, talc; (f) detail of the pierced tube (scale 1 mm).*

indicated by a relatively deep notch (Fig. 7d). In two cases (0.93 per cent), the perforation is damaged: the channel is pierced from the outside due to continuous friction of the bead surface with another surface (Fig. 7e & f).

As expected, there is a strong relationship between the degree of use-wear and the nature of the raw material. Beads of groups B and C are less affected by use-wear than those of group A. Moreover, the comparisons between specimens made from the same material (e.g. carnelian, serpentine) but coming from different sites show that the degree of use-wear at Tell Halula is lower than at the other sites where notched or damaged perforations were observed. The beads of Abu Hureyra present several degrees of use-wear: while some of them present damaged perforations and deformed shape, others seem to have been worn only a few times before the death of the persons or benefited from exceptional care during their use as suggested by the very good preservation of the shape, the sharpness of the delicate edges and the shiny surface (e.g. Fig. 4l & p).

Discussion and interpretation

Early evidence and morphometric evolution

The predecessors of the butterfly beads described in this study are the flat beads that appeared at the beginning of and during the PPNA (10,000–8700 cal. BC) at Tell Mureybet (Alarashi 2014, fig. 7.14v–z), Jerf el-Ahmar (Alarashi 2014, fig. 8.10i) and Cheikh Hassan (C. Maréchal pers. comm., 2015). At this time the flat beads have a simple pattern: their shapes are either rectangular or square (Fig. 8a), their profiles are not divided with a central edge, the cross-section is elliptical and the perforation ends exhibit no special treatment.

The first flat beads with a biconvex cross-section belong to the Early PPNB and are attested at Dja'de el-Mughara (six items) and Tell Aswad (five items)

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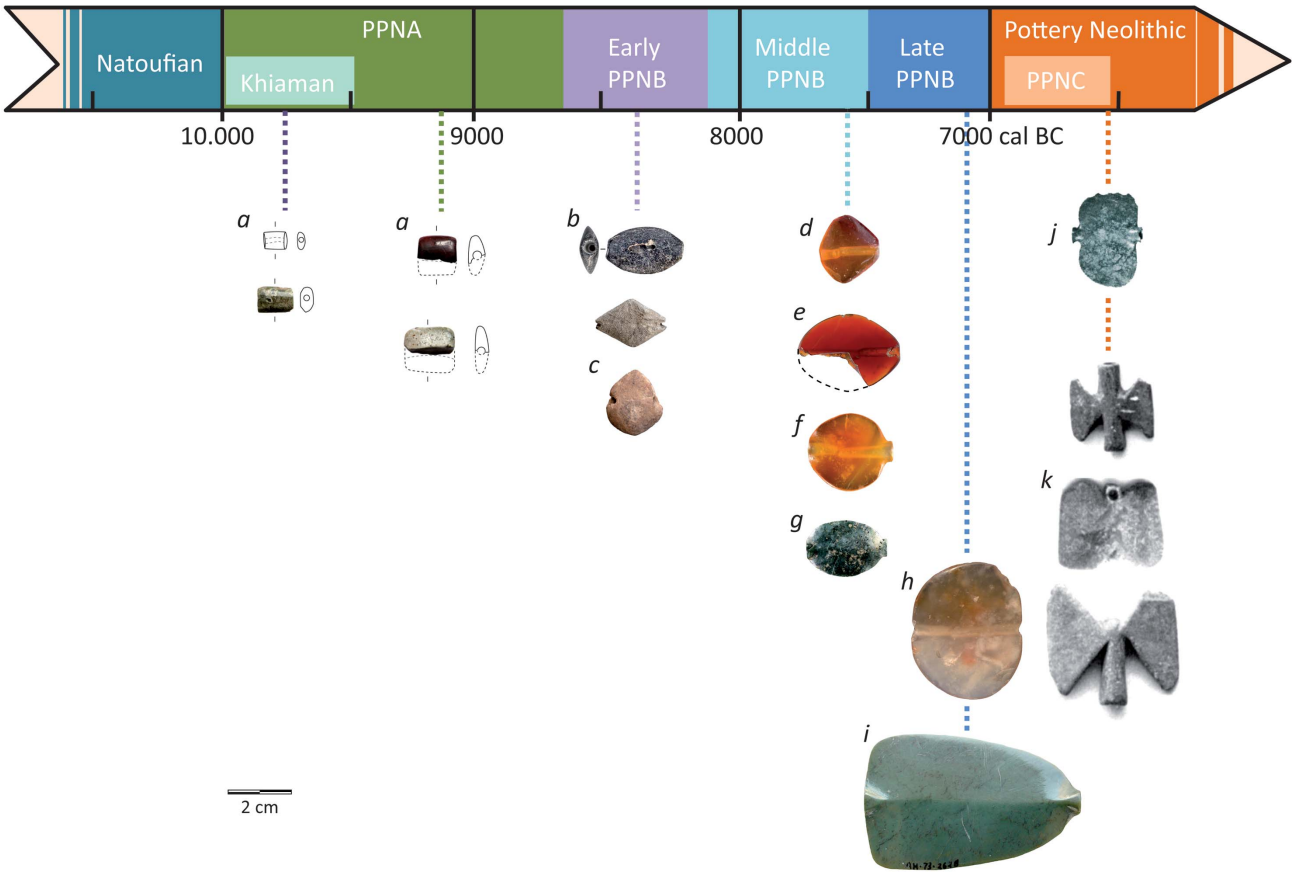


Figure 8. *Morphological evolution of flat and butterfly beads. Hypothesis: (a) simple small stone flat beads (Mureybet), PPNA; (b) stone butterfly bead with biconvex cross-section and elliptical shape (Dja'de), Early PPNB; (c) diamond shape in clay (Dja'de); (d) carnelian diamond shapes (Halula); (e) carnelian diamond shape (Nahal Hemar, cf. Groman-Yaroslavski & Bar-Yosef Mayer 2015, fig. 2), carnelian and serpentine; (f): first examples of carnelian collared butterfly beads (Halula), middle PPNB; (g) first examples of serpentine collared butterfly beads (Halula), middle PPNB; (h) large-sized butterfly bead, agate (Abu Hureyra); (i) large-sized collared butterfly bead, serpentine (Abu Hureyra); (j) butterfly bead with two extended collars (cf. Braidwood & Braidwood 1960, fig. 36); (k) 'butterfly' pendants (Mallowan & Rose 1935, plate VI-b).*

(Fig. 8b). Their shapes are elliptical, except for two from Dja'de that are diamond shaped and made of clay (Fig. 8c). By the mid eighth millennium cal. BC, butterfly beads made from stone present new shapes: diamond (Fig. 8d & e), trapezoidal, circular (Fig. 8f) and triangular. Diamond PPNB flat beads made from soft and hard stones are attested at Çayönü Tepesi (Erim-Özdoğan 2011, fig. 72) as well.

The earliest collared butterfly beads could probably have been made from clay, as attested by a roughly diamond-shaped clay bead found at Nevalı Çori and dated to the late ninth millennium cal. BC (Morsch 2002, pls. 5–8). As for the first collared butterfly beads made from stone, they are dated to the mid eighth millennium; they belong to phases 7 and 9 of Tell Halula (three items) and are made from both hard (Fig. 8f: carnelian) and soft stone (Fig. 8g: talc and serpentine). A contemporaneous parallel comes from Aşıklı Höyük (level 2B/2C, mid eighth millennium cal. BC). It is a pale green collared butterfly bead found in the burial of a woman 47–48 years old (M. Özbaşaran & S. Yelözer pers. comm., 2015).

Collared butterfly beads became more frequent between the second half of the eighth millennium and the sixth millennium cal. BC. This long time span corresponds to the Late (7500–7000 cal. BC) and Final PPNB (or PPNC) and to the Pottery Neolithic (7000–6000 cal. BC). Their evolution during these periods appears to involve both the size and the shape of the collars. The turquoise butterfly beads from Tell Halula are generally smaller than the specimens made from other materials (e.g. carnelian, serpentine). The same situation

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is observed at Tell Aswad, where the turquoise beads are among the smallest. This might reflect a cultural choice and/or be related to accessibility of turquoise sources and modalities of procurement, which could have affected the size of the cores before their manufacturing.

The butterfly beads of Abu Hureyra are distinguished by their large size in comparison to the other sites (mean length: 29.2 mm). Indeed, the largest specimen in the studied assemblage, a serpentine bead (length up to 53.7 mm), belongs to Abu Hureyra (Fig. 4p & 8i). Similar serpentine examples are recorded for the Late PPNB, in level 5, at Tell Sabi Abyad (Verhoeven 2000, fig. 4.6) and at the Pottery Neolithic site of Mezraa-Teleilat (Özdoğan 2011, figs. 64–65). The significant differences in size observed between the Late PPNB specimens from Tell Halula and those from Abu Hureyra are certainly due to the fact that the horizons at Tell Halula (phases 11–14) are earlier (Fig. 3; Molist *et al.* 2013, table 1.90–91) than the Late PPNB levels of Abu Hureyra (Table 1) and Level 5 of Tell Sabi Abyad (Akkermans & Verhoeven 2000, table 1.1). Thus, it could be assumed that the butterfly beads became larger at the end of the PPNB.

Another morphological change concerns the collars. At the end of the PPNB and during the Pottery Neolithic, the butterfly beads start to show extended collars at both ends of the perforation (Fig. 8j). These beads have been recorded in southern Turkey, in the Amuq plain, at Tell Kurdu (Yener *et al*. 2000, figs. 17–19), Tell Dhahab and Tell Judaidah (Braidwood & Braidwood 1960, fig. 36), in western Syria at Tell Kerkh (Kozłowski & Aurenche 2005, Annex 5.1.5), in eastern Syria at Tell Bouqras and in northern Iraq at Tell Arpachiyah.[2] At the same time in northern Iraq, very similar ornaments occurred from a morphological point of view, although they belong to a completely different functional category—pendants. In place of the long central perforation, a short transverse hole is located laterally on one or two extremities of the bead. These are called 'double-axe pendants' and are attested for the Halaf period at Arpachiyah (Mallowan & Rose 1935, pl. VI-b) and Tepe Gawra,[3] where butterfly beads made from obsidian and carnelian have also been found. In the Pottery Neolithic levels of Çatalhöyük in central Anatolia, these objects are recorded as 'butterfly pendants' (Wright 2010, 7). Some examples of double-axe pendants from Tepe Gawra and Arpachiyah present strong indications that they were recycled from previous extended-collared butterfly beads; after the damage (perhaps caused by intensive use-wear?), the long perforation was eliminated and a new short transverse perforation on the collar zone of the previous perforation was created (Fig. 8k). These recycled butterfly beads were probably inherited from earlier generations and repaired in order to prolong their use.

What purposes do the collars of the butterfly beads serve? Many propositions can be made. Interestingly, collars became more frequent at the end of the PPNB and during the Pottery Neolithic, at the same time that the butterfly beads became larger and more voluminous. Therefore, they likely were made to increase the length of the beads.

Sources, procurement and production

Butterfly beads may have been brought to the PPNB villages as finished objects. Alternatively, raw materials could have been introduced into these sites and manufactured locally.

Crossing the ophiolitic massifs of Anatolia in its upstream section, the Euphrates River could have carried fragments of these materials and deposited them nearby the villages in the middle valley. Being relatively soft, however, these fragments could have offered little resistance during fluvial transportation, unless they were included in much harder rocks (Maréchal & Alarashi 2008, 604). Anthropogenic transportation of these materials into the PPNB villages is therefore a more plausible hypothesis.

Turquoise, amazonite and probably other minerals like copper and malachite could have been procured from southern Levant as raw or final products along with the Red Sea cowrie-shell beads found in large quantities at the PPNB villages in central Levant (Alarashi 2010) and in the middle Euphrates (Alarashi 2014; Ridout-Sharpe 2015). The discovery at Dja'de el-Mughara (Early PPNB) and at Tell Aswad (Early and Middle PPNB) of calcite and talc fragments, preforms of beads and pendants, as well as finished objects including the butterfly beads made from these materials (Alarashi 2014, 353; 479), indicates the implication of the inhabitants in bead-making using both local (calcite) and allochthonous (talc) raw materials. The situation is less clear in the case of Tell Halula, where allochthonous raw materials used for beads are only present as finished products, at least in the excavated area. On the other hand, a few local limestone cores and preforms of cylindrical beads have been discovered, suggesting local manufacture of the cylindrical beads. The available data are insufficient to discuss bead-making at the site using allochthonous materials. However, local manufacture, at least in the region of the middle Euphrates, cannot be rejected if we take into consideration two elements. Firstly, the earliest evidence of butterfly beads (simple flat beads) appears at several PPNA sites in the middle Euphrates (e.g. Tell Mureybet, Jerf el-Ahmar, Cheikh Hassan). It

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is worth mentioning that these beads were shaped in allochthonous materials and that some of them were abandoned during the perforation stage (Maréchal & Alarashi 2008, 596). The morphometric evolution from the Early PPNB onward is well described for this region (*cf. supra*). Secondly, the pressure-flaking technique was first practised by the beginning of the Middle PPNB on obsidian at Tell Mureybet (Abbès 2008, 278) and Çayönü (Altınbilek Algül *et al*. 2012, 159) and then on flint, by the end of the Middle PPNB (Abbès 2014, 6; Arimura *et al*. 2000, 244; Coqueugniot 2004, 298), around 7600 cal. BC. At the same time carnelian, agate, obsidian and other knappable materials began to be exploited for bead-making, as attested at Tell Halula and other contemporaneous sites such as Aşıklı Höyük. In other words, the butterfly beads made from siliceous rocks such as carnelian and quartz were certainly processed within the area of the middle/upper Euphrates and benefited from the skills and know-how of local knappers.

Although few knapping traces remain on the siliceous rock beads, they suggest shaping by pressure flaking, which is the most adequate technique to shape relatively small items with precision. This hypothesis is supported by the strong links between pressure flaking and heating treatment highlighted by several researchers (Binder & Gassin 1988; Inizan & Lechevallier 1996; Inizan & Tixier 2000, 30). Indeed, pressure flaking appears to be more efficient when applied on heated siliceous rocks. Evidenced for Bronze Age chalcedony beads in the Ancient Near East (Inizan & Tixier 2000, 28), this procedure was likely already in use during the Middle and Late PPNB for carnelian and agate beads at Tell Halula and Abu Hureyra. Drilling with mechanical devices (e.g. a bow drill) is known to have been used as early as the Natufian period (twelfth to tenth millennium cal. BC) and was practised on hard animal tissue (Stordeur 1988, 79) and on soft stones (Maréchal & Alarashi 2008, 606). The same technique was maintained for the perforation of siliceous rocks by the late Middle PPNB. Long parallel-sided drills, up to 18 mm, of small diameter (2 to 3 mm), have been found in a workshop associated with unfinished beads at Tumbak 1, an early PPNA site in the Syrian Desert (Abbès 2008, fig. 7). Long cylindrical polished drills were also found at Mezraa Teleilat in the Anatolian Euphrates basin (Coşkunsu 2008), where carnelian and obsidian butterfly beads, some of them broken during drilling, have been found. Coşkunsu has suggested the use of these drills to perforate the beads. Varieties of stone drills, similar to the Neolithic tools from Mezraa, were used to perforate carnelian flat beads at Bronze Age Troy (Ludvik *et al.* 2015, fig. 3). Butterfly beads made from hard stones could be perforated using similar drills. However, according to our experiments (Alarashi 2014, annexe III.1, 195), drilling with long parallel-sided drills, in addition to water and abrasive, requires mechanical devices ensuring the immobility of the objects and the straightness of the drill during motion. Other hypothesis for carnelian drilling is the use of micro-splinters hafted in a wooden stick (Groman-Yaroslavski & Bar-Yosef Mayer 2015, 86).

Technological improvement and specialization

The study of the technological process of butterfly beads gives some insights into the social organization of the first farming communities. Although no new techniques were invented during the PPNB, stone bead technology benefited from important improvements in tools, methods and skills, based on an important technological background inherited from earlier periods. These improvements are probably due to a better understanding of the nature of the raw materials and to the development of mechanical facilities, ensuring more precise gestures and more rapidity during the production (Alarashi 2014, 602). What driving forces were implied in this process by the end of the PPNB period? As stated by some scholars (e.g. Cauvin 1997, 91–2; Ibáñez & Urquijo 2011, 147), the evolution in flint and obsidian technology that occurred during the PPNB cannot be explained by economic and environmental changes but rather by social, symbolic and ideological factors. It is observed, for example, that the Late PPNB bi-polar knapping method reached a high level of complexity resulting in the production of large regular pointed blades for making projectile points. 'Paradoxically, technologies associated with the production of projectile points develop at the same time as hunting becomes less important, even marginal, in the diet' (Ibáñez & Gonzáles Urquijo 2011, 150). This suggests ideological and societal development expressed by an increased demand for 'prestige' goods. Likewise, butterfly beads are a prime example of how ideological and socio-cultural issues were determinant for stimulating technological improvements in lapidary crafts.

Other aspects of the sophistication of the technological system can be discussed through socio-cultural changes observed in bead making over time. For instance, during the early periods (PPNA and the Early PPNB), bead making appears to have been an artisanal activity practised within the household unit. By the end of the Middle PPNB, the introduction of hard stones in bead technology, and especially in the manufacture of butterfly beads, was conditional upon mastery of several groups of techniques: knapping, abrasion, drilling and heating. Each group requires its

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own know-how, tools, gestures, and probably places of work. This means, on the one hand, that bead making using such materials was carried out by highly qualified individuals; and on the other hand, that these qualified individuals certainly specialized in different techniques: flint knappers, persons who abrade or perforate ... In other words, manufacturing butterfly beads required an important organization of work between artisans and therefore an important social organization. Moreover, the transfer of stone-bead technology from household unit to specialized persons certainly contributed to the emergence of new sociocultural status related to bead makers within Neolithic farming communities.

The polysemantic nature of the butterfly beads

The economic and aesthetic values of the raw materials, the important technological investment and the sophisticated morphometrical designs of the butterfly beads place them among the most meaningful artifacts of the PPNB material culture. The powerful symbolic meanings that emanate from these extraordinary objects suggest their polysemantic nature (Pearce 1990; Sciama & Eicher 1998). Indeed, a constellation of meanings and functions were probably attributed to these beads rather than one single function. Some of these functions are proposed here.

Based on anthropological and archaeological analyses, an association could be made between collared butterfly beads and children in the case of Tell Halula, and between both collared and non-collared beads and female adults and children at Abu Hureyra. The unique collared butterfly bead found at Aşıklı Höyük was also discovered in association with an adult woman skeleton. The association between butterfly beads, adult females and children needs to be confirmed by further discoveries. Nevertheless, one plausible interpretation of such relation could be the symbolic value of motherhood, birth or fecundity. These topics largely animated the PPNB ideology and were the subject of intensive ritual activities performed by the farming communities (Cauvin 1997; Verhoeven 2002). Moreover, fecundity is explicitly documented by a number of clay figurines found at PPNB sites representing pregnant females (Morsch 2002, pl.1, 3–6) or women with a child in arms (Morsch 2002, pl.1, 1–2).

According to use-wear analysis, butterfly beads were used during the lifetime of individuals and probably buried with their wearers, except in the case of babies and very young children (?) for whom they would have been provided at the time of death. The low intensity of use-wear, the delicate well-preserved morphology and the fragile nature of some raw materials[4] suggest that some butterfly beads were carefully used in order to avoid damage. They could have been worn at important moments in life such as birth, puberty, death, religious ceremonies or for special meetings.

An opposite scenario from low-intensity use is given by some butterfly beads showing high levels of wear that have caused their damage (broken edges and fractures of the perforation walls). This indicates a long period of use, even after the damage, as demonstrated by the intense polish of the fractures, and probably transmission from one generation to another as a family or group heirloom (Lillios 1999). The butterfly beads recycled into pendants found at the Halaf sites of Arpachiyah and Gawra (cf. Fig. 8) express the desire to prolong the longevity of these beads, probably inherited across generations. Thus, butterfly beads could have been considered as objects of memory which accumulate genealogical values. It hardly needs to be reminded that memory was very important for PPNB ritual life. The best examples of its preservation and prolongation are given by funerary practices, especially by the plastered human skulls.

As revealed earlier, butterfly beads experienced important changes during the late Middle PPNB and the Late PPNB in tandem with the economic and cultural shifts that occurred in the north Mesopotamian and Levantine societies. The growth of farming economies was accompanied with a remarkable expansion of long-distance circulation networks (Alarashi 2014, 566). The PPNB villages of the middle Euphrates and central Levant were located in the heart of these networks that connected the north (Cappadocia, upper Euphrates and upper Tigris) with the southern Levant as far as the Red Sea. Contacts between culturally different communities coexisting in the Near East were therefore regularly sustained. The increased size of the butterfly beads and the use of new attractive and colourful materials are an obvious indication of the desire to make these beads more impressive and more visible. They could have been worn at special meetings of different Neolithic human groups (e.g. farmers, hunter-gatherers and nomadic herders) thus symbolizing the farmer identity that crystallized by the end of the PPNB.

Conclusion

The main purpose of this paper is to shed light on butterfly beads, one of the most meaningful items of PPNB material culture, and to highlight their importance in building our understanding of the social and symbolic behaviour of the first farming communities in the Near East. For this purpose, every aspect of the

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butterfly beads was studied and discussed and can be summarized by the following points.

Firstly, diachronic study has allowed us to trace the morphometric evolution of butterfly beads over time. It was identified that their initial design derived from the simple flat bead pattern which appeared during the PPNA. This pattern evolved and reached a high degree of complexity along with a notable increase in size by the end of the PPNB. The development of collars on the perforation ends could have served the purpose of size enlargement of the butterfly beads.

Secondly, it was shown that, since their first appearance in northern Mesopotamia, butterfly beads were almost always manufactured from attractive exotic stones, with special attention devoted to enhancing these aesthetic qualities. Significant change was produced, however, during the Middle PPNB, when butterfly beads started to be manufactured from knappable rocks, probably chosen for their translucency and transparency, that produce attractive light fluctuations and effects. Sources of the raw materials are hundreds of kilometres distant from the PPNB villages and were introduced either as raw or as finished items. A middle Euphrates manufacturing of the butterfly beads is, however, more plausible, especially when taking into consideration their morphometric evolution traced within this area and the technological adaptations which occurred in parallel with this evolution.

Thirdly, through the technological study of butterfly beads, important aspects of the social organization were explored. It was argued that technological advances in lapidary crafts were not necessarily due to economic purposes, but rather stimulated by cultural and ideological issues. Moreover, it was stressed that the use of knappable rocks for bead making by the mid eighth millennium cal. BC was a new threshold of technological development in lapidary crafts. Manufacturing butterfly beads from these kinds of materials was only possible by specialized persons. Therefore, the evolution of the butterfly beads could have led to important technological advances and changes in social organization. One of these changes is the emergence of a new socio-cultural status dedicated to the stone-bead makers.

Finally, the chrono-cultural and archaeological contexts of the butterfly beads, their evolution and their different degrees of use-wear require a polysemantic reading of their functions: 1) possibly related to motherhood, birth and fertility; 2) objects of memory transmitted from one generation to another as part of the family or group heirloom; 3) items of prestige worn on special occasions of social and ritual lives; 4) symbols of self-affirmation and cultural affiliation to the farming societies in the Near East, especially to those of the middle Euphrates.

In conclusion, it remains to be said that the importance of the butterfly beads was maintained during the Pottery Neolithic and later during the Chalcolithic and the Bronze Age, when they were reinvented using new materials (Rahmstorf 2010, fig. 9), such as silver and gold, or as supports of a new category of artifacts, seals (Ludvik *et al.* 2015, fig. 4). First appearing more than 11,000 years ago, these attractive beads still remain in use even today.

Notes

1. Terminology established by H. Beck (1928) was employed to describe the morphological features of the beads.
2. Exhibited items at the Metropolitan Museum of Art, NYC: http://www.metmuseum.org/collection/the-collection-online/search/327164; http://traveltoeat.com/levant-neolithic-period-metropolitan-museum-of-art-nyc/
3. http://www.penn.museum/collections/object/212861
4. Like glass, cornelian, quartz and obsidian are fragile and can be broken by low impact. However, these materials are resistant to superficial abrasion produced by use-wear. On the contrary, serpentine, chlorite and talc have a low resistance to abrasion and use-wear; simple hand manipulation can leave traces on their surfaces.

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