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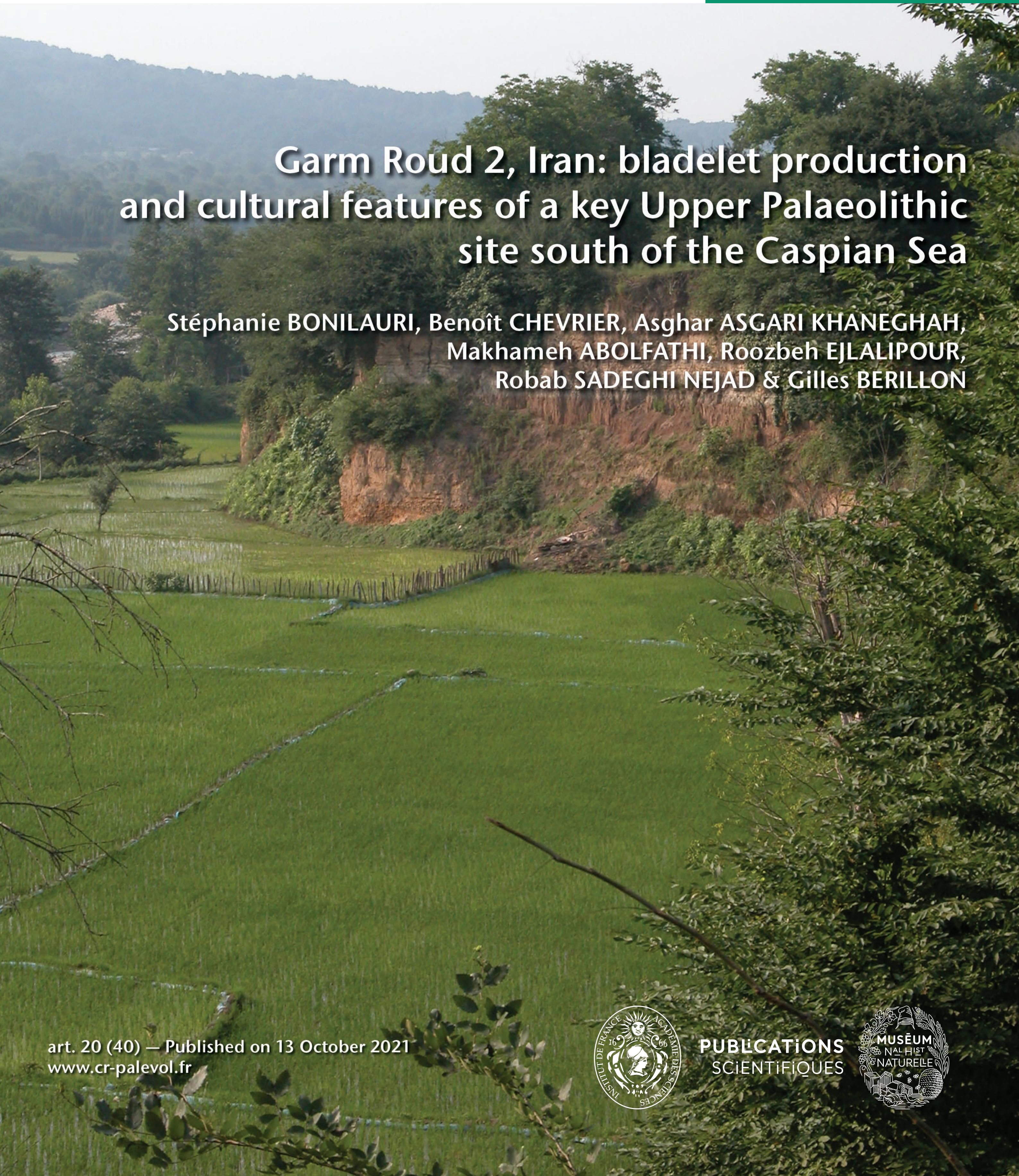

Garm Roud 2, Iran: bladelet production and cultural features of a key Upper Palaeolithic site south of the Caspian Sea

Stéphanie BONILAURI, Benoît CHEVRIER, Asghar ASGARI KHANEGHAH, Makhameh ABOLFATHI, Roozbeh EJLALIPOUR, Robab SADEGHI NEJAD & Gilles BERILLON

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Garm Roud 2, Iran: bladelet production and cultural features of a key Upper Palaeolithic site south of the Caspian Sea

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ABSTRACT

For more than twenty years, Iran has focused a great deal of research on the emergence and development of Upper Palaeolithic industries. South of the Caspian Sea, the site of Garm Roud 2, dated to 33878 ± 3300 Cal BP, is one of the few sites, with Mirak, to have yielded stratified evidence of occupation during this period. This paper presents the results of the typo-technological analysis of the lithic assemblage collected during the 2006 to 2008 excavation campaigns. The focus here is on a production of straight and twisted bladelets. Very few similarities have appeared between this assemblage and those from sites in the Zagros and the rest of Iran, which are generally older (about 35 to 40000 Cal BP). Garm Roud 2 yields original evidence and may be seen as a key site for understanding Upper Palaeolithic technocomplexes and the development of bladelet production in this area.

KEY WORDS
Upper Palaeolithic,
Garm Roud,
Northern Iran,
bladelet production,
bladelets,
lithic industries.

RÉSUMÉ
Garm Roud 2, Iran : production de lamelles et caractéristiques culturelles d'un site clé du Paléolithique supérieur au sud de la mer Caspienne.
Depuis plus d'une vingtaine d'années, l'Iran a concentré de nombreux travaux sur l'émergence et le développement des industries du Paléolithique supérieur. Au sud de la mer Caspienne, le site de Garm Roud 2, daté de 33878 ± 3300 Cal BP, fait partie des rares gisements avec celui de Mirak à avoir livré une occupation stratifiée de cette période. Nous présentons ici les résultats de l'analyse typo-technologique de l'assemblage lithique collecté lors des campagnes de fouille de 2006 à 2008. Il apparaît une diversité des chaînes opératoires axées sur une production de lamelles, rectilignes et torses. Cet assemblage montre très peu de ressemblances avec les sites du Zagros et du reste de l'Iran, généralement plus anciens (environ 35 à 40 000 Cal BP). Garm Roud 2 constitue un témoignage original et peut être considéré comme un site-clé pour la compréhension des techno-complexes du Paléolithique supérieur, ainsi que pour la compréhension du développement de la production lamellaire dans cette région.

MOTS CLÉS
Paléolithique supérieur,
Garm Roud,
Iran du Nord,
production lamellaire,
mamelles,
industries lithiques.

INTRODUCTION

Due to their location between the Caspian Sea and the Persian Gulf, at a crossroads between the Middle East and East Asia, the Iranian Central Plateau and the neighbouring Zagros and Alborz mountains are of particular importance to issues relating to Palaeolithic settlement and mobility. This large region of Central Asia was probably occupied very early, as far back as the Lower Palaeolithic (e.g. Coon 1951; Hole & Flannery 1968; Smith 1986; Olszewski & Dibble 1993; Biglari *et al.* 2004; Biglari & Shidrang 2006). Many sites are located in the Zagros Mountains date from the Middle and Upper Palaeolithic (e.g. Coon 1951; Hole & Flannery 1968; Smith 1986; Olszewski & Dibble 1993; Otte *et al.* 2009; Conard *et al.* 2013), but the quality of the archaeological information is highly variable.

New international programs have been running in the country for more than two decades. As well as new surface discoveries, previously known sites have been revisited and several new stratified settlements identified and excavated (e.g. Roustaei *et al.* 2004; Jaubert *et al.* 2005, 2009; Asgari Khaneghah *et al.* 2006; Conard *et al.* 2006; Berillon *et al.* 2007, 2009; Otte *et al.* 2007, 2009; Biglari *et al.* 2009; Ghasidian *et al.* 2009; Vahdati Nasab 2011; Vahdati Nasab & Clark 2014; Bazgir *et al.* 2014; Vahdati Nasab *et al.* 2019). Much more reliable archaeological assemblages and chronological data have thus been obtained, bringing new insights into the Palaeolithic in Iran and Central Asia.

As regards the Upper Palaeolithic, reconsideration of the Zagros sites began in the 2000s after a reassessment of the Warwasi collections (Olszewski & Dibble 1993, 1994, 2006; Olszewski 1999; Otte & Kozłowski 2004, 2007; Otte *et al.* 2009, 2012). This raised the question of the origin and cultural area of the Aurignacian: some authors suggest that the Aurignacian originated in Iran, from a local Mousterian, and then spread to the Near East and Europe (Otte & Kozłowski 2004, 2007, 2009), while others maintain that it is clearly distinct from the Middle Palaeolithic and/or hypothesise that Upper Palaeolithic cultures in Iran are very diverse and not only Aurignacian (Olszewski 2009; Bordes & Shidrang 2009, 2012; Conard & Ghasidian 2011; Tsanova 2013; Ghasidian *et al.* 2017). But the discussion has mostly been limited to caves and rock shelters in the Zagros mountains, including Warwasi (Otte & Kozłowski 2007; Tsanova 2013), Yafteh (Hole & Flannery 1968; Bordes & Shidrang 2009; Otte *et al.* 2011, 2012), Gar Arjeneh (Hole & Flannery 1968; Otte & Biglari 2004; Bazgir *et al.* 2014), Ghār-e Boof (Conard *et al.* 2006; Conard & Ghasidian 2011; Ghasidian *et al.* 2017), Guilvaran and Kaldar (Bazgir *et al.* 2014, 2017; Becerra-Valdivia *et al.* 2017) and Ghār-e Khar (Young & Smith 1966; Shidrang *et al.* 2016). Outside the Zagros, Upper Palaeolithic sites are almost absent and the debate is therefore limited. Only three open-air sites are currently known in the morthern zone of the Iranian Central Plateau: Sefid-ab (Shidrang 2009), Delazian (Vahdati Nasab & Clark 2014; Abolfathi *et al.* 2018) and Mirak. The latter was originally described as a Middle Palaeolithic surface site (Rezvani 1990; Rezvani & Vahdati Nasab 2010); recent excavations by the joint French-Iranian Palaeoanthropological Program have uncovered *in situ* archaeological assemblages including one upper and one intermediate assemblage with Upper Palaeolithic affinities (Vahdati Nasab *et al.* 2019). Garm Roud 2 appears to be the only one known in Central Alborz (Asgari Khaneghah *et al.* 2006; Berillon *et al.* 2007, 2009; Berillon & Asgari Khaneghah 2016).

The site of Garm Roud 2 was discovered in 2005 and excavated from 2006 to 2008 by the French-Iranian Palaeoanthropological Program (FIPP). The digs yielded a rich assemblage, from an *in situ* and stratigraphically clear archaeological level relating to the end of OIS 3, and corresponding to a short occupation as a hunting camp (Berillon *et al.* 2007, 2009; Berillon & Asgari Khaneghah 2016). Preliminary studies revealed a large lithic assemblage focused on bladelet production, with evident Upper Palaeolithic affinities (Chevrier *et al.* 2006; ; Berillon *et al.* 2009; Chevrier 2016; Abolfathi

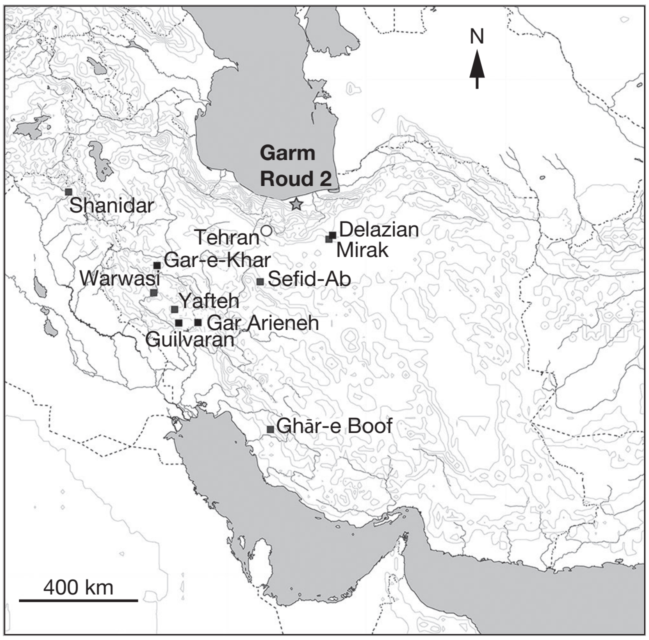

FIG. 1. — Location of Garm Roud 2 and the main sites listed in the paper.

TABLE 1. — Number and composition of the coordinated and uncoordinated artefacts at Garm Roud 2 during the 2005 survey and the 2006-2008 excavations.

	N 2006-2008	N 2005 (from survey: Berillon *et al.* 2007)	Total
Uncoordinated artefacts	8418	–	8418
Coordinated artefacts	2516	214	2730
Flake cores	14	–	14
Bladelet cores	29	2	31
Bladelets	505	27	532
Blades	49	2	51
Flakes, fragments, chips	1491	68	1559
Waste	362	114	476
Undetermined	66	1	67
Total	10934	214	11148

TABLE 2. — Composition of the lithic assemblage at Garm Roud 2 after sorting (2006-2008 sample).

Coordinated artefacts	N 2006-2008 sample
Flakes cores	14
Bladelet cores	29
Bladelets	435
Blades	49
Flakes	372
Total	899

TABLE 3. — Raw materials composition of the Garm Roud 2 lithic assemblage.

Limestone	Chert/flint	Quartz	Siltstone	Rhyolite	Total
451	75	67	16	4	613
73.57%	12.23%	10.93%	2.61%	0.65%	100%

et al. 2018). Thanks to its location outside the Zagros, in central Alborz, and to the quality and dating of its context, the lithic assemblage of Garm Roud 2 as a whole, expanded with the material collected from the excavations, appeared to be informative and able to contribute material to the debate. Given this context, it was necessary to reconsider the entire lithic assemblage through a systematic and extensive examination of the typo-technological lithic diversity and the reduction sequences, and to compare it to available assemblages from the Iranian Central Plateau and the Zagros to the Middle Eastern and Central Asian regions.

BACKGROUND OF GARM ROUD 2

Garm Roud 2 is an open-air site in a clear stratigraphic context located in the province of Mazandaran, 20 km south of the Caspian Sea, near the city of Amol (Berillon *et al.* 2007; Berillon & Asgari Khaneghah 2016) (Fig. 1). The single 5 cm-thick archaeological deposit (unit 8) is preserved in a valley-bottom palaeosol. It appears in the Baliran fluvial sedimentary sequence, which is about 15 m thick at the location of the site (Antoine *et al.* 2006, 2016). The weighted average of three radiocarbon dates obtained from *in situ* charcoal situates the archaeological level at 33 878 ± 3300 Cal BP (Antoine *et al.* 2016) (Fig. 2). The 18m^2 excavation yielded a significant concentration of nearly 50 000 archaeological remains, including 11 148 lithic artefacts. The minor vertical dispersion and the good state of preservation of the archaeological remains indicate minor post-depositional disturbance (Berillon & Asgari Khaneghah 2016). Technical homogeneity of the lithic assemblage was expected and addressed in the two first analyses of a selection from this assemblage (Chevrier 2016; Abolfathi *et al.* 2018).

MATERIAL AND METHODS

As the quantity of lithic material is very large (11 148 artefacts), this study relates to the whole lithic assemblage of 2516 pieces that were coordinated *in situ* during the three campaigns (2006-2008); additional observations were made on those without coordinates (8418 artefacts) (Tables 1; 2). The procedure focused on cores, production of blanks (flakes, blades and bladelets), tools and retouched pieces. We discarded waste, undetermined pieces and most damaged fragments, as well as chips and flakes less than 2.5 cm in length. Finally, once whittled down in this way, the lithic series contains 899 pieces (Table 2).

Using a classic technological approach, the aim of this analysis is to understand the overall process of the technical system, from procurement of the raw material to the intended production. This article thus presents a study of the raw material and the different technological classes to produce an overall and dynamic view of lithic production at Garm Roud 2.

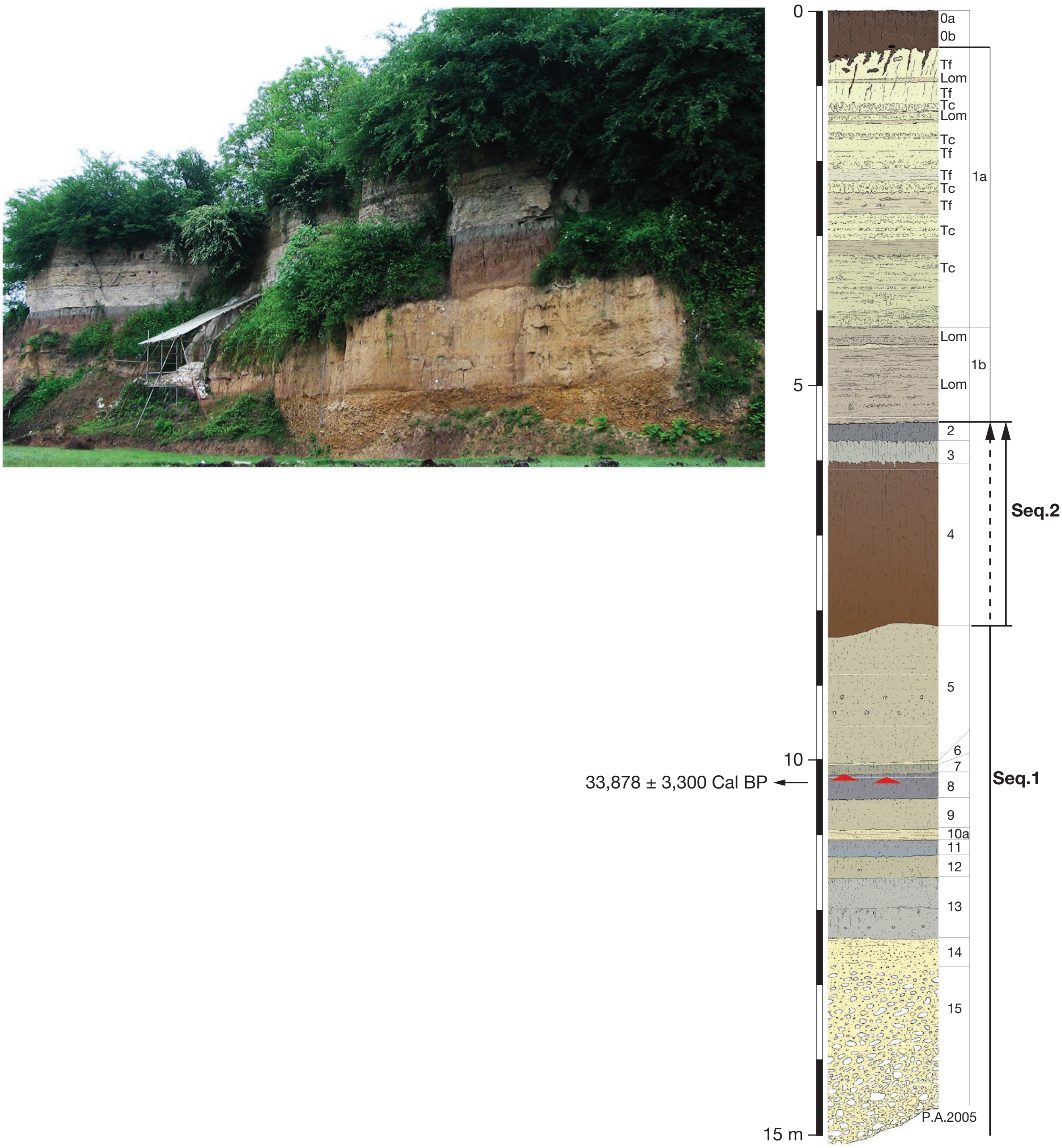

FIG. 2. — View and stratigraphic sequence of Garm Roud 2 in the Baliran formation, and dating of the archaeological occupation (after Berillon & Asgari Khaneghah 2016). Photo: FIPP 2005, Sketch: P. Antoine.

RESULTS

RAW MATERIAL

The raw materials in the Garm Roud 2 assemblage are varied and can be divided into limestone, chert/flint, quartz, siltstone and rhyolite (Table 3). Limestone and chert/flint are broadly dominant (85.8%). These raw materials are locally available as pebbles of various sizes and colours in the channel of coarse gravel located near the site. Knapping quality is generally medium to good. Some excellent and probably exogenous chert/flints of various colours also seem have been used. This is an important argument in discussing the mobility of Garm Roud 2 group(s). However, the small number of these pieces precludes any discussion about the original morphology of the blocks, which would require a more detailed petrographic study and identification of raw material outcrops. In the typo-technological study that follows, we specify the nature of the raw materials only when they do not seem to be local or when they are of superior quality.

Production of blanks

The lithic assemblage includes 899 artefacts and is composed of two main categories of blanks, mainly bladelets and flakes. A few blades are also present.

Flakes

Flakes represent more than 40% of the selected assemblage (n = 372). Two broad categories can be distinguished: products from flake cores and waste from bladelet reduction. In the first category are thick flakes ranging from 25 mm to 80 mm in length and removed by hard stone percussion. These products present frequent cortical surfaces and various morphologies: short, wide, elongated and *débordant*. They are linked to the unidirectional, bidirectional and multidirectional flake cores present in the assemblage (n = 14) and mainly made from pebbles (Fig. 3). Some of them can be considered as blanks for bladelet cores. We therefore have to consider two purposes for these flakes, as both core blanks and blank tools.

The second category relates to waste from bladelet production, as the assemblage also comprises some core microtablets and flakes with one or several straight and/or twisted bladelet scars (Fig. 8).

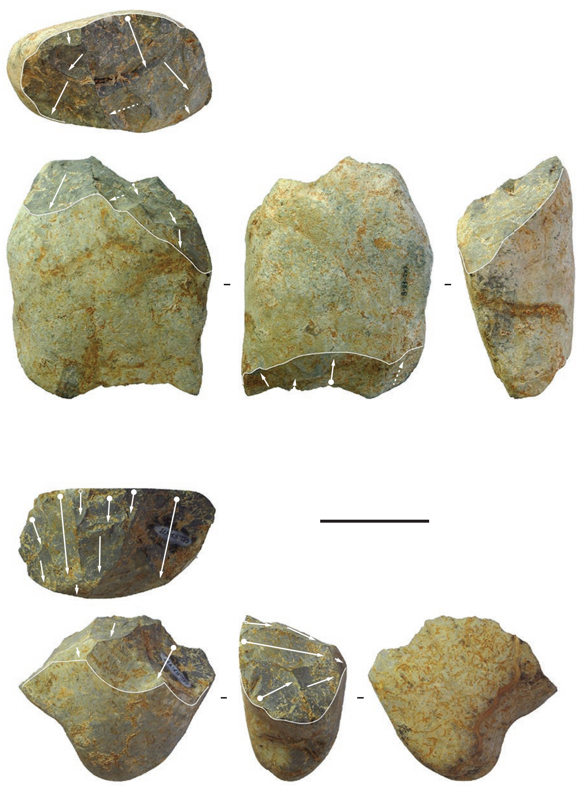

Fig. 3. — Flake cores on pebble. Scale bar: 3 cm. Photo: B. Chevrier.

Blades

Ranging from 30 to 40 mm long, blades represent less than 6% of the selected lithic series (n = 49). This group includes two blade categories produced by soft percussion: main-intended blades and preparation/maintenance blades for bladelet or blade production (Fig. 4Q-T, Z, B'). The main-intended blades are characterized by various morphologies (with convergent or parallel edges) and various side faces, mainly straight and in some cases curved or twisted. The direction of removal on their dorsal face is unidirectional, providing evidence of production on prismatic cores. All blades are made from exogenous raw material (flint – or high-quality chert – is over-represented). The absence of blade cores and blade preparation/maintenance indicates that they were produced at another site and imported into Garm Roud 2.

Some blades (7 or 8 pieces) relate to preparation and maintenance phases but especially to bladelet production. These display the remains of crest hinged scars on their ventral face. Among these, some pieces clearly reflect perfectly controlled production of twisted bladelets, usually carried out with excellent exogenous raw materials (Fig. 4T).

Bladelets

Bladelets represent more than 45% of the selected lithic production (n = 435) and can be classified into two main categories: main-intended bladelets (n = 327) and preparation/maintenance bladelets (n = 108). The raw materials are the same for all bladelets, and soft percussion was used as confirmed by several "bulb spallings" on the proximal part of the products (Pelegrin 2000). Among the main-intended bladelets, and despite the high percentage of broken bladelets (n = 301, 69.2%), it is possible to distinguish two subgroups: straight and twisted bladelets resulting from several reduction strategies: primary *in situ* production and secondary outside production.

Straight bladelets. Straight bladelets represent 54.7% of the main-intended bladelet production (n = 179/327). Ranging from 12 to 38 mm in length and from 3.5 to 7 mm in width with an average width of 5.5 mm, these pieces have various morphologies and are more or less regular (Fig. 4A-I, U, W). Two sub-categories can be distinguished: bladelets with convergent edges and points and parallel bladelets. Most of them were produced *in situ* and result from different *débitage* methods.

The bladelets with convergent edges were mainly produced from convergent bladelet cores on flakes (around 17 pieces) (Fig. 5). Unidirectional bladelet reduction was done along a narrow dihedral face of the flake (Figs 5A right view; 6) or along a wide or a flat surface. In this case, the removals are located on the ridges of the wide or flat surface (Figs 5A left view, D, E; 7). In both cases, the series of narrow and convergent removals are short (10 to 41 mm long) and followed by numerous hinged scars. Convergent bladelet cores show few preparation stigmas and only one or two cores show unilateral cresting. The striking platforms could be flat (large scar, cortical or fracture surface) or prepared.

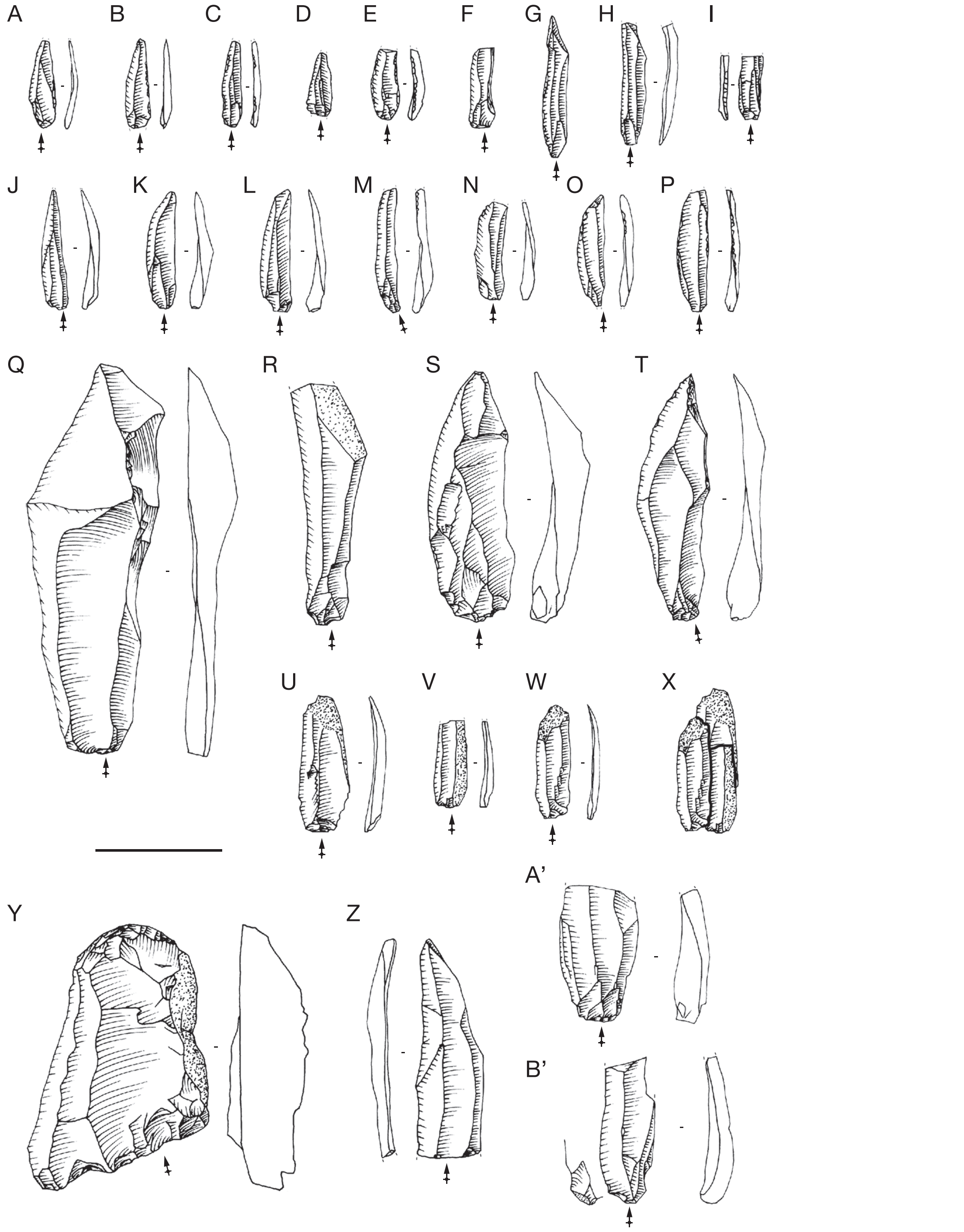

Fig. 4. — Bladelets, blades and tools: **A**-**I**, **U**-**W**, straight bladelets (A-C, E, G, I, retouched bladelets); **J**-**P**, twisted bladelets (M-P, retouched bladelets); **Q**-**T**, **Z**-**B'**, blades (Z, burin; B', retouched blade on the proximal part); **X**, refitting of bladelets U to W; **Y**, endscraper on flake. Scale bar: 3 cm. Drawing: B. Chevrier.

Parallel bladelets and some bladelets with convergent edges were produced from parallel bladelet cores on flakes (around 8 pieces) (Figs 5B, C; 7). The bladelets were removed from a wide, flat surface, on an edge. *Débitage* is unidirectional but one core shows scars in two opposite directions (possibly indicating maintenance of the flaking surface). The series of removals are often short but we cannot exclude the hypothesis of longer series. Again, hinged scars are frequent due to consumption of the carina (Fig. 5B). The striking platform is always flat and is either a natural surface, a large removal or part of a lower face. In only one or two cases, it has been maintained by means of one or more scars.

Some cores (about 4 pieces) have several flaking surfaces in association (convergent and/or parallel). The production may be similar or different on the same core, but never occurs over the entire block (Fig. 5A, B).

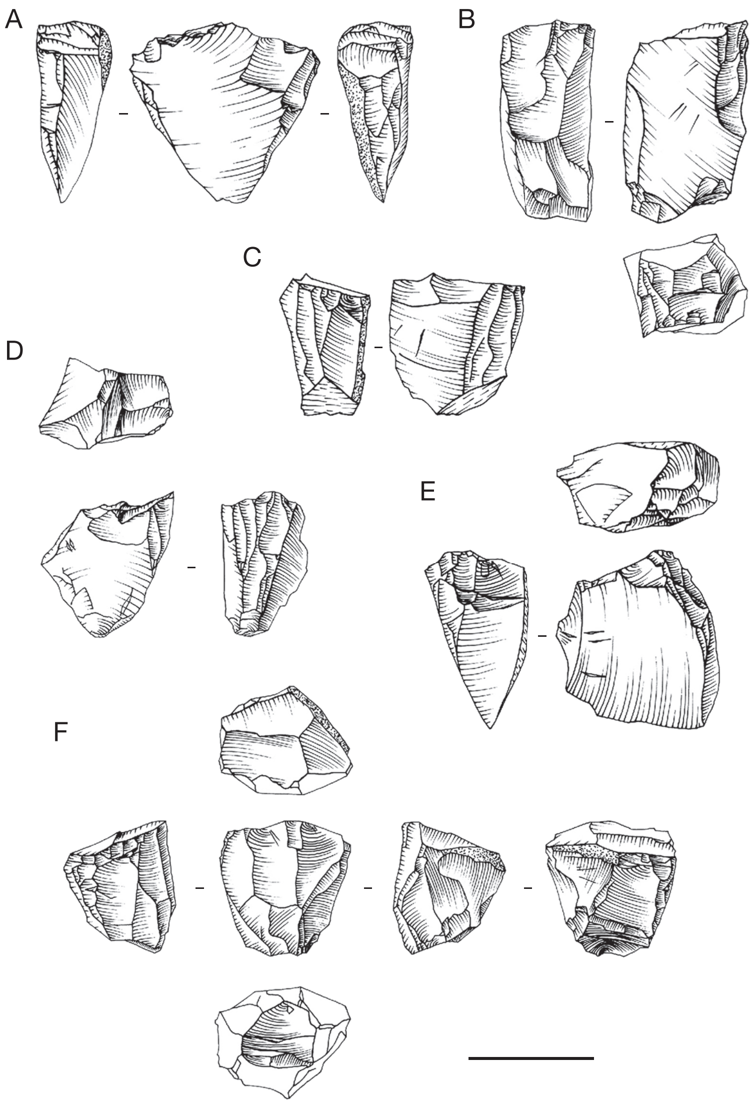

Fig. 5. — Bladelet cores: **A**-**E**, convergent and parallel bladelet cores; **F**, complex bladelet core. Scale bar: 3 cm. Drawings: B. Chevrier.

Besides these main types of cores, more complex prismatic bladelet cores are also present (about 4 pieces) (Fig. 5F). Limestone and chert/flint were used, both local and exogenous. The cores display a relatively long series of convergent and/or parallel removals on a wide and slightly convex flaking surface. Preparation of the cores would have been an important phase during which crests, especially posterior ones, were probably made. Maintenance focused on the striking platforms, with the removal of core microtablets from the flaking surface on at least one piece (Fig. 5F).

Twisted bladelets. Twisted bladelets represent 45.3% of the main-intended bladelets (n = 148/327) and are characterized by a marked (n = 61) or moderate twist (n = 87) (Fig. 4J-P). They mainly range from 14 and 38 mm in length and from 4.5 to 7 mm in width (with an average width of 5.5 mm). Apart from a few pieces in which fortuitous torsion occurred during production, the bladelets with a marked twist indicate high-quality and perfectly controlled production. For example, some of these bladelets have short proximal scars: these were needed to shift the guide ridge and the required impact point to twist the removals (Fig. 4M-O). The direction of the twist is overwhelmingly counter-clockwise (n = 55, 90.2%). As regards the moderately twisted bladelets (Fig. 4M-P), it is difficult, without a matching core, to demonstrate intentional production. Several assumptions need to be considered, including intentional production and opportunistic production mixed in with other bladelets and unintended by-products. Although some pieces are probably in the latter category, the majority of these bladelets support the first two hypotheses. A brief review of the direction of the twists shows that it is mostly counter-clockwise, as in the bladelets with a marked twist.

Given the cores studied, the presence of twisted bladelets is surprising as they do not relate to any identified core in Garm Roud 2. It seems that some of the twisted bladelets were imported into the site. However, some maintenance flakes

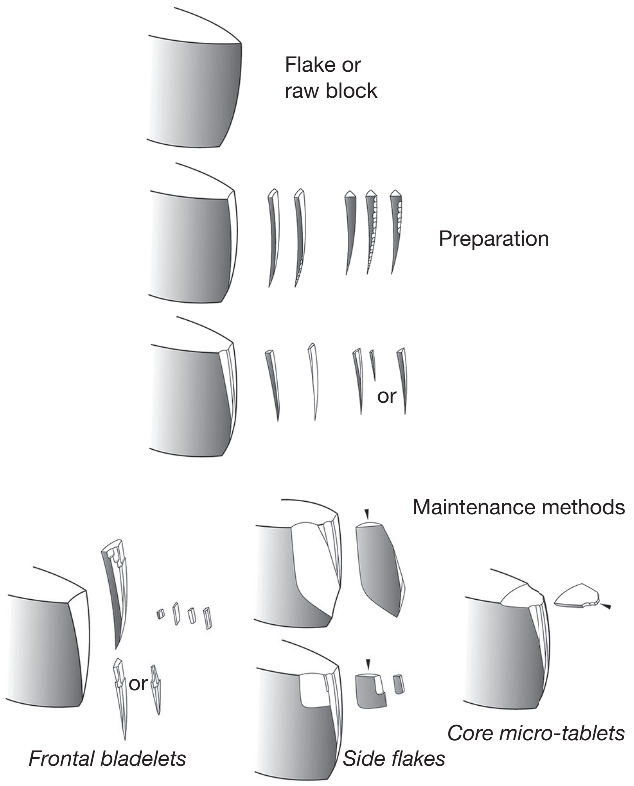

Fig. 6. — Diagrams summarising the preparation, intended volumes, production and maintenance of convergent bladelet cores.

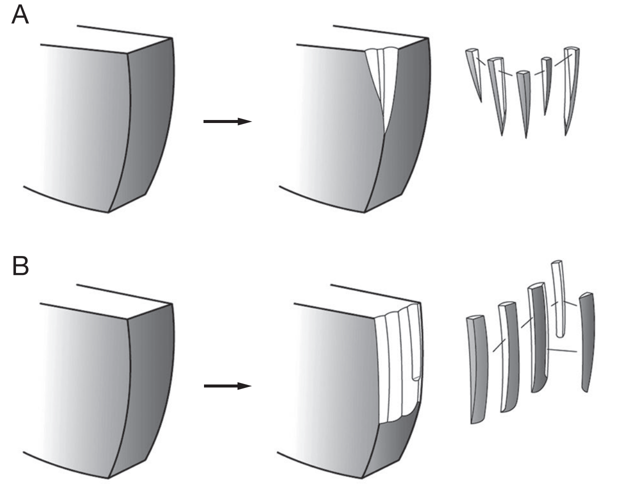

Fig. 7. — Diagrams summarising the production and intended volumes of convergent bladelet cores (**A**) and parallel bladelet cores (**B**). Diagrams: B. Chevrier.

and blades present at Garm Roud 2 show twisted bladelet scars suggesting that twisted bladelets were also produced on the site. Moreover, given that some waste flakes display both straight and twisted bladelet scars, the hypothesis of opportunistic twisted bladelet *débitage* is also possible.

Preparation and maintenance bladelets. Some bladelets are clearly linked to the preparation or maintenance of bladelet cores. Among these are bladelets with a thick triangular or trapezoidal section and crested and sub-crested bladelets relating to the early stages of production (Fig. 8A-E, I). Regarding maintenance phases, some bladelets were used to restore lateral and distal convexities. It is thus possible to recognise thick, narrow bladelets with convergent or parallel edges, on which hinged removals can be observed on the proximal part, and sometimes one or two abrupt side edges (Fig. 8F).

Tools

Most of the main-intended bladelets, blades and flakes are not retouched and probably represent the main tools in the lithic assemblage of Garm Roud 2.

Retouched tools are mainly retouched bladelets (n = 64) (Table 4; Fig. 4A-C, E, G, I, M-P, B'). It should be noted that the twisted retouched bladelets are over-represented compared to their percentage in the total number of bladelets (n = 31/64, 48.4%). This could indicate imports of a larger number of finalised twisted bladelets than straight bladelets, which is also suggested by the absence of cores and the very few remains from twisted bladelet *débitage*. The retouches are located on the dorsal face of the blanks, on one or both sides, and are often short and semi-abrupt. None of them can be considered as Dufour bladelets *stricto sensu* (for a review of the different definitions of Dufour bladelets, see Lucas 1997) and only one (uncoordinated) bladelet shows a convergent retouch forming an Arjeneh point. The percentage of broken retouched bladelets (n = 55/64, 85.9%) is much higher than for all bladelets (69.2%). Their condition may partly explain why they were left behind at Garm Roud 2, but a specific intention cannot be excluded, which could be tested through a study of the fractures. The length of the unbroken retouched bladelets ranges from 15.5 to 33.5 mm. Analysis of their mesial width shows a high degree of homogeneity, with 45 retouched bladelets between 4.5 and 6 mm in width (70.3%). Apart from modifications due to wear and tear, the retouches therefore seem to have been made to adjust the morphology of the bladelet, especially in width, rather than to create a cutting edge. It is therefore likely that some unretouched bladelets were also used for similar purposes because they were of a suitable size.

We also note the presence of some common tools: two endscrapers on flakes (Fig. 4Y), a dihedral burin on a blade produced with an excellent and probably exogenous raw material (Fig. 4Z), five retouched blades, two burins on small flakes (although they could be accidental removals) and four retouched flakes with a marginal retouch.

DISCUSSION

Main contributions

The technological analysis of the Garm Roud 2 lithic assemblage shows a variety of *chaînes opératoires* mainly focused on bladelet production and to some extent on flakes. Representing more than 45% of the blanks, the bladelets, straight

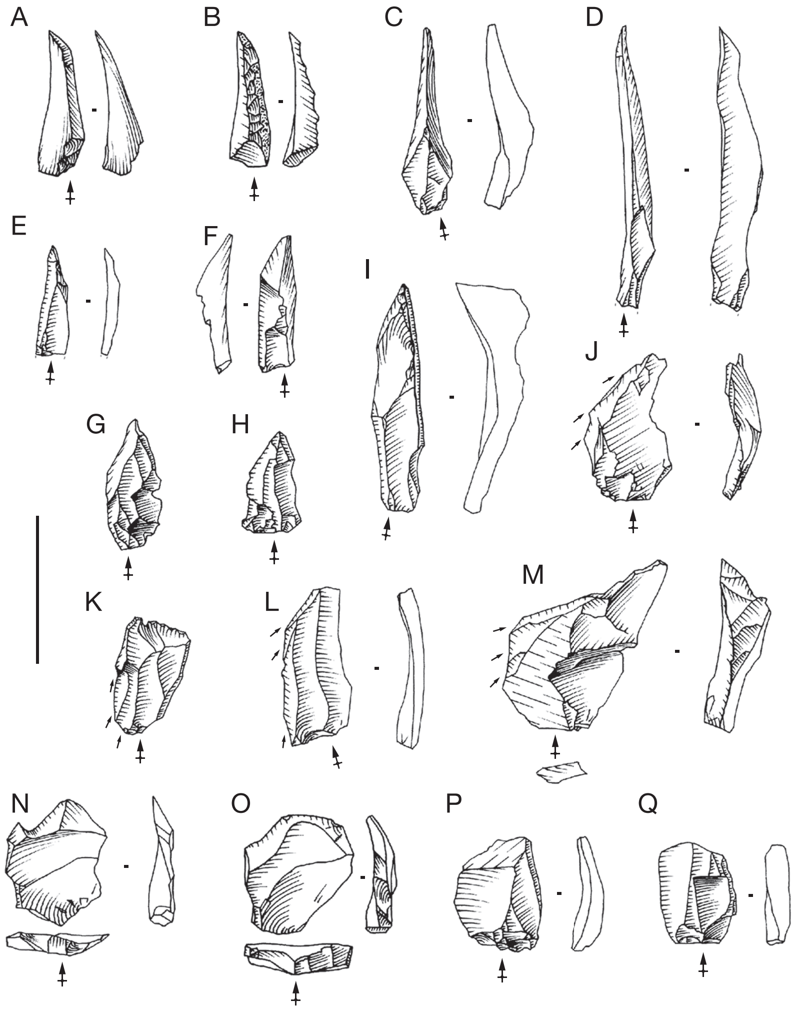

FIG. 8. — Preparation and maintenance bladelets and flakes. The small **arrows** on **J**-**M** indicate bladelet removals. Scale bar: 3 cm. Drawings: B. Chevrier.

TABLE 4. — Number of retouched tools at Garm Roud 2.

Retouched baldelets	Endscrapers	Dihedral burin	Burins	Retouched blades	Retouched flakes	Total
64	2	1	2	5	4	78
82.05%	2.57%	1.28%	2.57%	6.41%	5.12%	100%

or twisted, show a homogeneous and regular mesial width of around 4.5 and 6 mm. The mesial width is controlled either during *débitage* or by a short or very short, direct, semi-abrupt or more rarely abrupt retouch. As regards straight bladelets, parallel or with convergent edges, all stages of production are represented at Garm Roud 2, from acquisition of the raw material through the production of blanks and tools. For the flake cores and some bladelet cores, the raw materials were collected locally. These blocks are flaked or broken, and while the flakes may have been retouched to make tools (e.g. endscrapers), they were mainly used as blanks for simple convergent and parallel bladelet cores. As regards twisted bladelets, no twisted bladelet cores have been identified: it seems that some of the twisted bladelets were imported into Garm Roud 2, but it is likely that *débitage* of such bladelets occured on the site. The presence of a large number of these bladelets and of some maintenance flakes and blades points to several production patterns: very well controlled *débitage* of bladelets and probably opportunistic production in combination with other kinds of bladelets. A small number of cores relate to prismatic or pyramidal designs and also to produced bladelets. These points to more complex technical intentions requiring more preparation and maintenance. It is possible that these cores were prepared and partially used elsewhere, then imported into Garm Roud 2 and subsequently left on the site. Apart from bladelets and flakes, some blades mainly made from exogenous raw material are also present at Garm Roud 2. There is no evidence to support the idea of a continuity in the blade and bladelet reduction strategy: the absence of blade cores and preparation / maintenance blades therefore indicates that production was done elsewhere, with exogenous raw materials of excellent quality.

As regards tools, straight and twisted bladelets, unretouched or retouched, are the main components of the toolkit. These are associated with a few tools commonly used for domestic (endscrapers, burins). We note the absence of Dufour bladelets and Arjeneh points, two major components of the Zagros Aurignacian industries.

Based on these observations as well as on all the archaeological data (e.g. fragmented remains of large mammals with percussion and cut marks, burned bone fragments and lithic artefacts in association with numerous charcoal fragments) the assemblage has been interpreted as representing a single and fairly brief occupation most likely linked to butchering activities and to hunting-related trips (Berillon & Asgari Khaneghah 2016). In the future, a micro wear analysis of the tools and of breakages of the retouched bladelets will allow us to discuss whether this industry is linked only to specialized activities (butchery and/or hunting) and short occupation and/or due to the small excavation area and/or to a cultural tradition.

Regional comparisons

The Upper Palaeolithic sites in the Central Iranian Plateau and neighbouring areas are mainly concentrated in the Zagros and its foothills. If we consider only stratified sites that have delivered reliable information (Shanidar, Yafteh, Warwasi, Ghār-e Boof, Kaldar), these are very few in number and because lithostratigraphic methods were seldom used for old excavations, the assemblages from some of these sites (e.g. Yafteh, Warwasi) relate to artificial collections covering different settlements (Braidwood & Howe 1960; Braidwood *et al.* 1961; Solecki 1963; Olszewski & Dibble 1993; Otte & Kozłowski 2007; Otte *et al.* 2007, 2012; Conard & Ghasidian 2011). However, they help to understand evolutionary trends and reflect the presence or absence of some classes in these archaeological sequences.

Yafteh is currently the best known site in the Zagros thanks to new excavation campaigns in the late 2000s (Otte *et al.* 2011, 2012). The whole sequence relates only to the Upper Palaeolithic and the dates from Hole and Flannery's excavations (29 000-38 000 BP) have been reassessed (Otte *et al.* 2011; Zwyns *et al.* 2012), as new samples are now considered to link the entire sequence to a single early phase dated to 33 000 to 35 000 BP, i.e., 37 000 to 39 000 Cal BP. These results may match the earliest Shanidar (Iraq) layer C dates, at 28 000 to 36 000 BP (Solecki 1963). With these new data, we can dismiss the idea of a comparison with the most recent Garm Roud 2 lithic assemblage (33 878 ± 3300 Cal BP) and discard the hypothesis previously suggested of a possible link based on the most recent dates from Hole and Flannery's excavations (Chevrier *et al.* 2006; Berillon *et al.* 2007; Otte *et al.* 2011; Zwyns *et al.* 2012). Moreover, the new results from the Garm Roud 2 reduction sequences confirm the distinction between this site on the one hand and the Zagros Aurignacian (Yafteh, Warwasi, Shanidar C in particular) linked to the Levantine Aurignacian on the other hand (Otte & Kozłowski 2004, 2007; Olszewski 2009). While the large proportion of typological burins is still a constant criterion, the significant number of endscrapers, carinated pieces, pointed bladelets such as Arjeneh points and Dufour bladelets in the Zagros Aurignacian means that Garm Roud 2 must be distinguished from this complex. Furthermore, the technological analysis of the Yafteh industries describes a stratigraphically lower set composed of long, straight or curved bladelets and pointed Dufour bladelets on the one hand, and an upper complex with small twisted bladelets, Dufour bladelets and burins on the other hand (Bordes & Shidrang 2009, 2012), which also suggests clear differences with Garm Roud 2. Otherwise, the recent investigations carried out in the Kaldar and Gilvaran caves and the data relating to the Upper Palaeolithic lithic industries, clearly attributed to the Zagros Aurignacian (Bazgir *et al.* 2014, 2017), also show clear differences with Garm Roud 2.

N. J. Conard and E. Ghasidian (2011) and Ghasidian *et al.* (2017) have put forward the hypothesis of a cultural group that differs from the Zagros Aurignacian: the Rostamian. This is located in the southern Zagros and has been defined from the Ghār-e Boof site in particular, where bladelet *débitage* on blocks using soft stone percussion and wide twisted bladelets with a direct abrupt or semi-abrupt retouch on one or both sides, called Rostamian bladelets, have been recognised. These were found together with small twisted retouched bladelets, a few inverse-retouched bladelets, endscrapers and a very few Arjeneh points. These features clearly distinguish Garm Roud 2 from the Rostamian assemblages, which is also suggested by the early dates of Ghār-e Boof: 31 000-37 000 BP, i.e., 35 000 to 41 000 Cal BP.

Outside the Zagros, on the Iranian Plateau, Sefid-ab has yielded no date because the assemblage was collected on the surface (Otte & Kozłowski 2007; Shidrang 2009). However, based on the presence of Dufour bladelets, carinated burins and endscrapers, it has been linked to a recent phase of the Zagros Aurignacian. The Garm Roud 2 assemblage therefore cannot be linked with the Sefid-Ab collection.

Finally, in the northern fringe of the Iranian Central Plateau, the lithic assemblages of the open-air sites of Delazian and Mirak – the nearest Palaeolithic sites to Garm Roud 2 – bear witness to several occupations by different groups during the Upper Palaeolithic (Vahdati Nasab & Clark 2014; Vahdati Nasab *et al.* 2019). The lithic industry of Delazian, although collected on the surface, is focused on straight bladelet production mainly from prismatic cores and on twisted bladelets knapped from carinated cores. The toolkit is varied and composed of diverse retouched bladelets including Dufour bladelets and numerous endscrapers, carinated endscrapers and burins (Abolfathi *et al.* 2018). While this assemblage has clear affinities with the lower and recent phases of the Zagros Aurignacian (Vahdati Nasab & Clark 2014; Abolfathi *et al.* 2018), its typo-technological features distinguish Delazian from Garm Roud 2. In the same area, the recently excavated open-air site of Mirak has yielded *in situ* archaeological assemblages that include an upper assemblage with Upper Palaeolithic affinities, but disturbed and poorly preserved, and an intermediate assemblage with a mixture of artefacts with Upper and Middle Palaeolithic affinities (Vahdati Nasab *et al.* 2019). This intermediate assemblage, which may be affiliated to an Early Upper Palaeolithic or even an Initial Upper Palaeolithic, is characterized by a production of Levallois flakes (points and flakes), blades and straight, curved and some twisted bladelets knapped from unidirectionnal – prismatic – cores and narrow-face cores on flakes. These two assemblages are dated by OSL in the ranges of 21-28 ky and 26-33 ky respectively (Heydari *et al.* 2020). Although comparison is difficult between the Garm Roud 2 and Mirak assemblages, their composition and a number of common features, as well as ages, highlight the complexity of the Upper and Early Upper Palaeolithic in the area.

How can the presence of such different typo-technological entities in the different Iranian areas be explained? Did connections – expansions of humans and/or ideas – exist between Garm Roud 2 and this part of the Alborz with neighbouring or more distant regions during the Early Upper and Upper Paleolithic? Or do these different entities reflect independent techno-cultural developments during these Palaeolithic periods?

To the west of the Iranian regions, in the Levant, two main technocomplexes from the Early Upper Palaeolithic are present. The Early Ahmarian is focused on blade/bladelet industries and the Aurignacian on flake industries (Gilead 1981; Marks 1981). The Early Ahmarian seems to be around 43-42 ka BP (Belfer-Cohen & Goring-Morris 2014) with multiple occupations around 34 to 30 ka BP including those, for example, of Qadesh Barnea (Gilead & Bar-Yosef 1993) in the southern Umm el Tlel area 2 (e.g. layer I4'c') (Ploux & Soriano 2003) and Wadi Khara 16R (Kadowaki *et al.* 2015) in the northern inland regions, and Ksar-Akil X-XI (Bergman 1987; Douka *et al.* 2013) and Üçagizli (Kuhn *et al.* 2009) in the Mediterranean zone. Despite regional differences, the Early Ahmarian industries share an emphasis on bladelet production, straight and slightly curved, parallel or with convergent edges. Bladelets are modified into retouched (with fine and semi-steep or steep retouches) and backed bladelets as well as into points including El Wad point types. While the core reduction strategies can involve a bi-directional blade/bladelet knapping method to a single plateform core or on an opposite platform, mainly for the northern assemblages (Goring-Morris & Davidzon 2006), bladelet production for almost all Early Ahmarian assemblages is based on a unidirectional knapping method to a single platform from the narrow face of a core (Belfer-Cohen & Goring-Morris 2014), for example in Nahal Nizza III, an industry from which the concept of a "narrow fronted core with a typical Y-shaped configuration" was proposed (Davidzon & Goring-Morris 2003). In most assemblages, a single core strategy produces blades and bladelets in continuity (Kadowaki *et al.* 2015). Based on these typo-technological elements, the Garm Roud 2 assemblage can be compared to some Early Ahmarian assemblages, such as that of Umm el Tlel area 2 (I4'c'). There are similarities in some reduction schemes (unidirectional knapping method from a narrow face of a core) as well as in the tool kit, based in both cases on lightly retouched bladelets (often broken) and characterized by the absence of El Wad type points (Ploux & Soriano 2003). However, the Garm Roud 2 blade/bladelet production remains quite different and a link with the Early Ahmarian industries seem unlikely. The reduction schemes from cores and flakes are varied and autonomous and a large number of baldelets have a twisted profile. Based on the technological characteristics of the bladelets and despite important typological differences, the assemblage from Garm Roud 2 has some similarities with the early facies of the Levantine Aurignacian formerly known as "A" (Copeland 1975; Goring-Morris & Belfer-Cohen 2006), as represented by the industries of Ksar-Akil XI-XIII (Bergman 1987; Williams & Bergman 2010), probably Kebara I-II (Bar-Yosef *et al.* 1996) and Umm el Tlel area 5 (Ploux & Soriano 2003). The Ksar Akil XI-XIII assemblage, where level XII is dated to around 40-39 ka cal BP (Douka *et al.* 2013), and the Umm el Tlel area 5 industry are based on blades and bladelet production with a large number of twisted bladelets modified into retouched bladelets. The bladelet production patterns are autonomous and diverse – carinated pieces, cores on flakes and unidirectional prismatic cores including the lateral carinated scraper (Bergman 1987). These assemblages are typologically characterized by a large number of burins and then by end-scrapers, notches and retouched bladelets including, except for the Umm el Tlel tool kit, El Wad points. Nevertheless, and despite some technological similarities between the assemblage from Gram Roud 2 and the Early Ahmarian and the Levantine Aurignacian "A" technocomplexes, the differences do not allow this industry to be grouped with the Early Upper Paleolithic traditions of the Levant.

To the east, in Central Asia, recent studies and discoveries at the Upper Palaeolithic sites of Kulbulak, Dodekatym-2 and Shugnou (Kolobova *et al.* 2011, 2013; Ranov *et al.* 2012) highlight a new cultural-technlogical tradition called the Kulbulakian, which shares many features with the Baradostian/Zagros Aurignacian and the Rostamian technocomplexes (Kolobova & Krivoshapkin 2014), as well as some typo-technological similarities with the lithic assemblage of Garm Roud 2. The early/middle stage complexes of the Kulbulak tradition, estimated at around 35-25 ka BP, is characterized by the development of flakes, small straight blades and bladelets from prismatic and narrow-faced cores and by non-straight bladelets mainly knapped from carinated cores (Kolobova & Krivoshapkin 2014; Kolobova *et al.* 2014). The tool kit is made up of many common tools on flakes, numerous retouched blades and bladelets including Dufour bladelets as well as some backed bladelets (Kolobova & Krivoshapkin 2014). Although the lithic assemblage from Garm Roud 2 shares many technological attributes with the early and middle Kulbulakian technocomplex, the significant typological differences prevent us from fully affiliating the Garm Roud 2 assemblage with this techno-cultural tradition.

Finally, it may be with some Early Upper Palaeolithic assemblages from the northern region of the Caucasus that the techno-typological similarities seem most obvious. In 2012, Y. E. Demidenko proposed connections between "Southern Caucasus Early Upper Paleolithic" industries and some assemblages of the Southern Zagros (e.g. Ghār-e Boof Cave AH IV-III) and the Alborz region such as Garm Roud 2 (Demidenko 2014). The majority of the "southern Caucasus EUP" assemblages, including those of the Dzudzuana cave Units D (35-32 ka cal BP) and Ortval Klde rock-shelter layers 4d-4c (40-26 ka cal BP) in the south and Mezmaiskaya cave (35-34 ka BP) in the north, share similar technical traits based on fine or narrow bladelet and microbladelet production mainly from unidirectional – prismatic or pyramidal – cores and narrow-flake bladelet cores on flakes (e.g. Meshveliani *et al.* 2004; Bar-Yosef *et al.* 2006; Adler *et al.* 2008; Golovanova & Doronichev 2012; Demidenko 2014). In all these assemblages, the most distinctive tool types are small finely retouched bladelets (or microliths) about 2-4 mm in width, fine backed bladelets and light points with fine bilateral retouches. In the eastern part of the southern Caucasus, the assemblage of Aghitu 3 cave AH VI-III (36-24 ka cal BP) (Kandel *et al.* 2014, 2017) also has close typo-technological affinities with the assemblages mentioned above (e.g. Dzudzuana cave) and offer perhaps the best comparison to Garm Roud 2. Throughout the sequence, the industry shows an emphasis on small or narrow bladelet production mainly from unidirectional platform cores. The tool types are mainly represented by laterally finely retouched bladelets (on one or both edges) while other tool types, including a variety of backed bladelets, burins and carinated scrapers, are rare, as are cores. Additionally, the presence of narrow and often twisted bladelets can be highlighted here (Kandel *et al.* 2014).

CONCLUSION

The technological analysis presented here of the artefacts collected at Garm Roud 2 has produced a dynamic view of the site's productions and toolkit. Distinctive Upper Palaeolithic features have been identified: straight and twisted bladelets, bladelet cores, retouched bladelets, laminar blanks and some common tools such as burins and endscrapers. While the Garm Roud 2 assemblage appears to differ from the Zagros Aurignacian, it has common features with some Upper Palaeolithic or Early Upper Palaeolithic assemblages from peripheral regions: the diversity of knapping patterns and bladelet production, the balanced combination of straight and twisted bladelets, the *débitage* of numerous flake blanks and the high percentage of bladelets with direct, short, semi-abrupt or even abrupt retouches. Its likely function as a hunting camp (Berillon & Asgari Khaneghah 2016) necessarily influenced the components of the industry and the proportions of cores and tools, but the differences remain significant. One would be tempted to consider Garm Roud 2 as one site within a local techno-complex, which may be peculiar to the Caspian region and later than the Zagros Aurignacian and the Rostamian. However, although a techno-cultural mosaic is usually obvious, it seems premature to define such a complex when few Upper Palaeolithic sites have been surveyed or excavated in the area. A major challenge must now be to find new stratigraphically well-located sites in northern Iran that could yield reliable dates to further our understanding of cultural relationships between Upper Palaeolithic groups in Central Asia.

Although the Garm Roud 2 settlement, given its late chronology, does not provide new information about the emergence of bladelet debitage, this study has produced new data about the development of these industries and the Upper Palaeolithic groups concerned. Thanks to its precise stratigraphic framework, the Garm Roud 2 site has to be considered as a key site for defining and understanding the evolution of Upper Palaeolithic cultural complexes in the Central Iranian Plateau and neighbouring areas, and more widely in Central Asia.

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