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Lithic raw material exploitation and circulation in Préhistory. A comparative perspective in diverse palaeoenvironments
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2.4. Small opportunities and big needs: Mira Early Upper Paleolithic case of raw materials exploitation (Dnieper basin, Ukraine)

Résumé

La transition du Paléolithique moyen au Paléolithique supérieur en Europe de l'Est se caractérise par la coexistence d'industries du Paléolithique moyen, du Paléolithique supérieur authentique et du Paléolithique supérieur de transition (ou archaïque ou symbiotique). Ce dernier type d'industrie montre quelques rudiments typologiques et technologiques du Paléolithique moyen d'une part et quelques éléments du Paléolithique supérieur d'autre part. Le site de Mira représente un exemple plutôt rare de Paléolithique supérieur ancien archaïque en Ukraine, recouvert par le Paléolithique supérieur authentique et il est donc à ce titre un exemple intéressant. Le site de Mira se situe dans la vallée de la rivière Dniepr, près de la ville de Zaporozhiye, en Ukraine, en Europe de l'Est. Ce site présente deux occupations paléolithiques distinctes ; deux couches (II/2 et I) séparées par une couche II/I qui est caractérisée par un aspect brûlé naturel. D'après les aspects géologiques essentiels et la taphonomie archéologique nous pouvons considérer les couches I et II/2 de ce site comme de bons exemples de sols d'habitat bien conservés, ces couches nettes et homogènes témoignent de séjours très courts de l'homme préhistorique. Les analyses lithologiques, géomorphologiques, palynologiques, antracologiques, micro et macrofauniques, ainsi que les analyses radiométriques (AMS et C14 conventionnels) permettent d'attribuer les sédiments avec vestiges culturels à l'interstade de Denekamp/Vitachiv tardif/Bryansk de l'avant-dernier pléniglaciaire et de dater les deux occupations paléolithiques entre 28-27 milles ans B.P., C14 non calibré. Il n'y avait pas beaucoup d'artefacts en silex dans la couche II/2. Le site de Mira fournit beaucoup d'informations importantes. En particulier nous trouvons des matières premières d'origine lointaine dans la couche I de ce site. Dans cette couche il y a un certain nombre de types de matières premières utilisées, siliceuses et non siliceuses. Ces collections montrent des modifications importantes par rapport à la forme initiale des pièces dues à des reprises multiples de taille en raison de la pénurie de matière première. Il est probable que le manque de matière première a favorisé la microlithisation des échantillons, la transformation de la forme morphotypologique et même l'invention de nouveaux objets en silex. Cet article fait le point sur les caractéristiques de l'assemblage des objets de la couche I du site de Mira faisant particulièrement référence à sa variabilité et à l'utilisation de la matière première en relation avec sa pénurie.

Abstract

Middle to Upper Paleolithic transition on the territory of Eastern Europe is characterized by coexistence of Middle Paleolithic, true (or full-fledged, or authentic) Upper Paleolithic and transitional (archaic or symbiotic) UP industries. These latter industries exhibit some typological and technological rudiments of Middle Paleolithic, at the same time being quite Upper Paleolithic in other aspects. The site of Mira represents rather rare in the Ukraine instance of archaic EUP industry overlaid – that makes the case even more interesting – with full-fledged or authentic UP. Mira is located in the valley of the river Dnieper, Eastern Europe, Ukraine, next to Zaporozhiye city. The site yields two distinct Palaeolithic occupations, i.e. II/2 and I separated with likely natural burning event II/1. Essential aspects of geological and archaeological taphonomy allows to define Mira layers I and II/2 as representing good example of well-preserved living floors being remains of separate and homogeneous short term occupations. Lithologic, geomorphologic, palynologic, antrocologic, micro- and megafaunistic analyses and radiometric (AMS and conventional 14C) data unanimously correlate culture-bearing sediments with Denekamp /late Vitachiv /Bryansk interstadial of Middle Pleniglacial and put both Palaeolithic occupations between 28-27 uncal C14 ky BP. Layer II/2 yields only not numerous flint artefacts. Mira records provide wide spectrum of evidence. In particular, specific case of remote raw materials exploitation might be described for the Mira layer I assemblage. Lithic series of Mira layer I is highly variable in respect of used raw materials, both siliceous and not siliceous. This assemblage demonstrates signs of serious deformation of its initial habitus by multiple re-workings of limited number of initially available lithics. Raw materials shortage clearly impacted on intensive microlithisation of the inventory, stimulated the transformation of typo-morphological pattern, and likely promoted the independent invention of original flint implements. Proposed paper is mainly focused on characteristic of Mira layer I assemblage with special reference to the aspects of variability, exploitation and use of lithic raw materials under the terms of their shortage.

Keywords: Eastern Europe, Ukraine, Mira, Early Upper Paleolithic, raw materials, technology, morphology, innovations

1 – Introduction

A lot of new data concerning one of the most debated issues of home Paleolithic studies, namely the beginning of anatomically modern human dispersals at Eastern Europe, were accumulated in course of last few years (Anikovich, *et al.,* 2007; Vishnyatsky, 2008; Derevyanko, 2005; 2010). Certain important new evidence on above topic were obtained recently in Ukraine, as well. In particular, one can say about the new multilayered site of Mira in Sub-Ridge area of Dnieper basin.

The results of geological and paleontological studies, and absolute chronology data unanimously put both Paleolithic occupations of Mira into the interstadial of the Middle Pleniglacial. Paleolithic occupations associate with Denekamp (Late Vitachev-Bryansk episode) and are dated back to ca. 28 ky BP (conventional ^{14}C date).

Mira provides clear pattern of overlapping of typologically and technologically more advanced UP industry of layer II/2 by the more archaic industry of the uppermost UP layer I, exhibiting some kind of mixture of Upper and Middle Paleolithic features and accompanied by remains of AMH.

The lack of any other "Aurignacian signs" in the lithic assemblage of Mira layer I except for rather atypical micro-tools (and, probably, large blades and isolated high scrapers), and presence of unique non-geometric microliths provide good perspectives for the study of terms of probable independent invention of microlithic inventory.

Anthropological finds of Mira layer I once again reaffirm the affiliation of Szeletoide (or Post-Micoquian) industries of Eastern Europe with Anatomically Modern Humans.

Despite the rather well recognizable archaic component, Mira layer I represents completely Upper Paleolithic pattern of behavior, including personal ornaments, developed bone technology, dwelling construction, and also the evidence of remote migration. Economic profile Mira layer I might be defined as a seasonal (fall-winter) base camp near the place of successful horse hunt.

Though statistically insufficient, typically UP assemblage of Mira: II/2 provides an example of sharply different technology and typology. Broad analogy of this material might be seen in the Early Gravettian of Central and Eastern Europe. There is a surprisingly close morphological and technological resemblance of blunted bladelets from Mira: II/2 with artifacts recovered in horizon 24A1 of Paglicci in Southern Italy. Worthy to note, that this, though basically Aurignacian, Italian assemblage demonstrates – as its investigators emphasizes – the features of evolutionary shift towards the Gravettian. High mobility of layer II/2 inhabitants is confirmed by the fact of remote location of sources of lithics for their tools, at least 300-350 km away from the site.

2 – The site of Mira: localisation, environment, specific features

Open-air site of Mira locates in the valley of the river Dnieper, Eastern Europe, Ukraine, actually about 15 km South from the city of Zaporozhiye, 47°40' of N latitude and 34°50' of E longitude (Fig. 1). Should be specially stressed, that the area of localisation of the site includes no primary outcrops of knapable lithic raw materials, and only flints redeposited by river flow might be collected in the vicinity of the site. The nearest available outcrops of flints and cherts are reported no closer than 100 km from the site. The nearest outcrops of petrified wood, sometimes used for knapping, are separated by several tens km. This environmental feature is specific for the whole Quaternary period of this area in general. Nevertheless the area was highly attractive for prehistoric hunter-gatherers. Raw materials shortages were compensated by very dense and rich bioresources typical for landscapes of valleys of large rivers. In the case of the Mira layer I even afore weak opportunities to renew the stocks of raw materials by the searching flints in river deposits were denied by cold season of occupation.

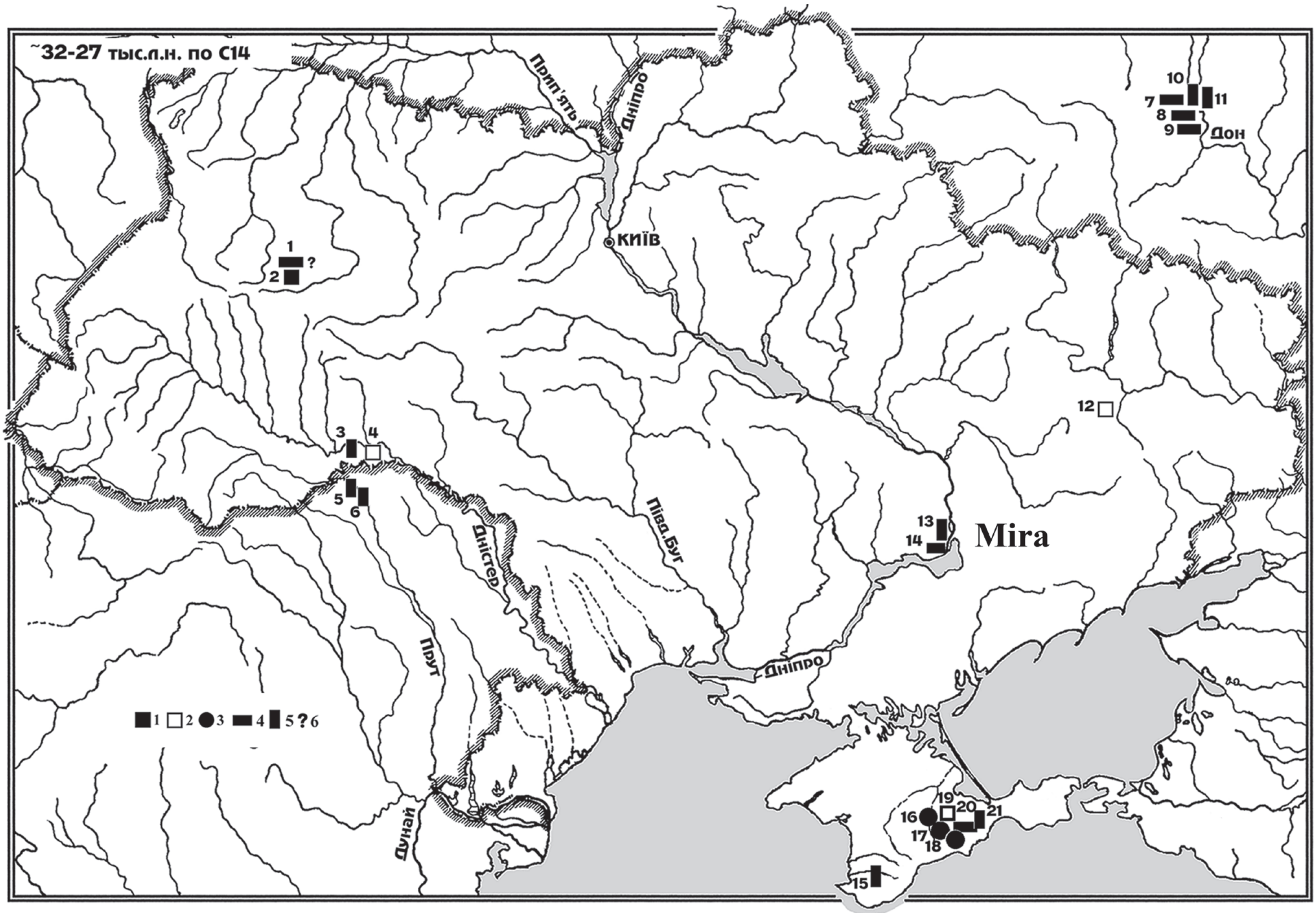

Figure 1 – The site of Mira (No. 13,14) in the context of the main Eastern European Middle and Upper Palaeolithic sites aged between 32-27 uncal ^{14}C ky BP

1 - Kulychivka; 2 - Zhornov; 3 - Molodova I, layer IX; 4 - Korman', layer 9, 8; 5 - Mitoc Malul Galben, layer 12b-8b (Aurignacian); 6 - Mitoc Malul Galben, layer 7b (Gravettian); 7 - Kostenki 6; - Kostenki 12, layer 1a (Stretskaya Archaeological Culture); 8 - Kostenki 14, layer II, IV (Gorodtsovskaya Archaeological Culture); 9 - Kostenki 16 (Gorodtsovskaya Archaeological Culture); 10 - Kostenki 1, layer 3 (Aurignacian); 11 - Kostenki 8, layer II (Gravettian); 12 - Belokuz'minovka; 13 - Mira, layer II/2 (Gravettian ?); 14 - Mira, layer I; 15 - Siuren' I, layer Fb1, Ga, H; 16 - Zaskal'naya I, layer II and I; 17 - Prolom I, layer I; 18 - Buran-Kaya III, layer B1; 19 - Alioshin Grot, layer I; 20 - Buran-Kaya III, layer C; 21 - Buran-Kaya III, layer 6-2 (Gravettian).

Key: 1 - MP flake industries; 2 – indefinite MP (?) industries without bifacial forms; 3 - MP bifacial industries; 4 - archaic UP industries; 5 - UP industries; 6 - uncertain chronological position.

Three layers including archaeological and natural objects were recognized here. Two of them yield obvious evidence of human activity; these are cultural layers II/2 and I. The lowermost II/2 is separated from the uppermost layer I with remains of burned pines of layer II/1. The nature of remains in layer II/1 is still unclear; as they may present results of either human or natural activity, or probably combined effect of both.

Both Mira I and II/2 associate with the soil-sedimentary processes. Lithological, geomorphological, palynological, antrocological, micro- and megafaunistic analyses and radiometric (AMS and conventional ^{14}C) data allow precisely correlation of layers II/2, II/1 and I with Denekamp /late Vitachiv /Bryansk interstadial of Middle Pleniglacial and put both Paleolithic occupations between 27-28 uncalibrated ^{14}C ky BP (Stepanchuk *et al.,* 2004). As it supposed, human activity remains were likely quickly buried after the occupation, ensuring good surviving of artifacts and site structures. Actually they represents good example of well-preserved archaeological living floors.

Petrographic study of rock composition of lithic series coming from 2000 excavations of the site of Mira was conducted by Dr. V.F. Petrougne by means of studying of immersion samples under polarising microscope. Series of ca. 300 samples of flint and stone artefacts was subjected to analysing.

In archaeological sense assemblage of layer I might be defined as archaic EUP, while underlying Mira: II/2 appears to be authentic UP possessing Aurignacian and Gravettian features.

Lithic series of layers II/2 and I statistically are sharply different. While assemblage of layer II/2 enumerates only about 200 knapped flints, recovered on the same area (ca. 70 square meter) assemblage of layer I enumerates almost 60.000 lithic artifacts. This difference, probably, might be explained in terms of different durability of occupations, more ephemeral in the case of layer II/2. Another likely explanation is that only fringe zones of occupied area II/2 were unearthed till recently. Anyway, only general features of assemblage II/2 might be restored, while lithic series of layer I allow more comprehensive studies and detailed characteristic.

The following aspects are important in respect of better comprehension of situation with raw materials, namely: economic status of occupations, seasonality, and availability of raw materials in the vicinity of the site. Occupation of layer I was comparatively long-term, and was in function for several months. There are different indications pointing to the Autumn-Winter season of this habitation. Coming from the whole corpus of data in hands, it is possible to describe economic specificity of layer I occupation as seasonal settlement raised next to the place of successful single episode of hunting on harem group of wild horses. Evidence is far less representative in the case of layer II/2. It only possible to state now, that this occupation was likely ephemeral, and that accompanied faunal remains belong mainly to bison and horse. No data concerning seasonality of II/2 are in hands. Both assemblages were based upon flints, though not siliceous rocks are widely represented in assemblage of Mira I, as well. Interesting that Mira layer I assemblage includes few small-dimensioned pieces of flint which likely were found in alluvial context nearby the site. Additional difficulties in raw materials supply in the case of Mira I were added by natural constrains of season of habitation. These evidence obviously witness for objectively very strict conditions of raw materials supply at the site.

3 – Mira layer I industry: Variability of lithic raw materials

Nevertheless more than 20 varieties of used lithic rocks were recognized in materials of layer I (Petrougne 2002-2003; Stepanchuk & Petrougne 2008), of which 13 are different varieties of flints. Composition of industry of the lowermost layer is obviously more poor, besides the fact the non-siliceous rocks products are completely absent among lithic artifacts. Petrographic study of lithic artifacts recovered in 2000 was conducted by V.F. Petrougne (Petrougne, 2002-2003; Stepanchuk, *et al.,* 2004; Stepanchuk & Petrougne, 2005) by the mean of studying of immersion preparations under a polarizing microscope. The total number of petrographically examined flint and stone artifacts enumerates about 300 specimens (Tabl. 1).

Should be empasized that the total number of finds of the upper layer constitutes ca. 54,000 artifacts, while the layer II/2 yields only 200. The major portion of both series is represented by micro-flakes and tiny chips, enumerating up to 97% of assemblage. Larger artifacts were mostly subjected to the petrographic analysing, of course (Tabl.

Name of rock	Conditional code	Presence in layer I	Presence in layer II/2
Flint	Ia^1, Ia^2, Ia^3, Ia^4, Ia^5, Ia-b(A), Ia-b(B), Ia-b(V), Ia-b(G-1), Ia-b(G-2)	all except for Ia^5	Ia^5
Fossilized wood	Ib	+	-
Local sandstone	IIa	+	-
Quartzite sandstone	IIb	+	-
Zeolitised tuff	III	+	-
Effusive rock	V	+	-
Quartz-diabase	V	+	-
Quartz milonite-ultramilonite	VIa	+	-
Quartzite	VIb	+	-
Actinolitite	VIIa	+	-
Amphibolite	VIIb	+	-
Migmatite or gneiss	VIII	+	-
Tektite-Moldavite (?)	IX	+	-

Table 1 – Mira. The list of rocks, represented in materials of layer I and II/2

2). Each fifth large-sized flint artifact was analyzed, as well as each seven of ten non-siliceous lithic find. Below proposed brief description and definition of raw materials composition is belonging to late prof. V.F. Petrougne. These data are available in more detail in several special papers (Petrougne, 2002-2003; Stepanchuk, Petrougne 2005; and at http://www.ace.hu/ametry/meghive_2005_3.html).

UNIT Ia: Siliceous, mainly diagenetic and partially infiltratic rocks of basically chalcedoneous content

Subunit Ia^1

Mainly tabular laminated light grey to almost black flint with thin grey grainy mono-mineral chalcedony coarse cortex.
After V.F. Petrougne conclusion, flints of this subunit should be considered as delivered from the territory of modern Romania.

Subunit Ia^2

Subunit of flints that are similar by structure and microfauna to previous type, but in various extent red-coloured. There is no data on primary outcrops of such kind of raw materials on the territory of Ukraine. To judge by series of signs, firstly by the content of microfauna, flints of this subunit are also originated from currently not precisely localised Romanian geo-locale.

Subunit Ia^3

This subunit includes mainly grey with slight greenish tincture and grey-smoky spots, little transparent flints of alternately clayey-chalcedony content.

Table 2 – Mira. Provenience of raw materials used for production of flint artefacts from the uppermost layer I

Provenance of raw materials		**Eastern Carpathians**				**Eastern Carpathians?**	**Prut**	**Dniester**	**Southern Bug**		**Dnieper (Krivoj Rog)**	**Dnieper (Cherkassy)**	**Volhyno-Podolian ?**
Code of raw materials		Ia^1	Ia^2	Ia^3	Ia^4	IIb	Ia-b (A)	Ia-b (B)	Ia-b (V)	Ia-b (V) ?	Ia-b (G-1)	Ia-b (G-2)	Ia^5 ?
Category of artefact	flakes	1						1					
	blades	1											
	biface waste-flakes	10	1										
	waste-flakes of flake tool rejuvenation	5											
	tools on flake	49	5	3	1	1	4	1	1	1	1	1	1
	tools on bladey-flake	17		1									
	tools on blade	36	2	4	3	2	1	1	1				
	tools on bladelets	5											
	tools on biface waste-flakes	25			1								
	tools on waste-flakes of rejuvenation of edges of flake tool	14											
	tools on waste-flake of thinning of flake tool	8											
	core on flake tool	2											
	bifacial tool	3		3									2
	partially bifacial tool	2											
Total for varieties of raw materials		178	8	11	5	3	5	3	2	1	1	1	3
Total areas of origins of raw materials		Eastern Carpathians: 205					Prut: 5	Dniester:3	Southern Bug: 3		Dnieper: 2		Volhynia ?:3
Total areas of origins of raw materials, % (221=100%)		92.7					2.3	1.4	1.4		0.9		1.4

Localisation of primary outcrops of this kind of flints is still unknown, and this kind of rock is definitely absent on the territory of Right Bank Ukraine, Sub- and Transcarpathia, and in Carpathians itself.

Subunit Ia⁴

Subunit consists of hlauconised and partly patined flint raw materials. It might be paragenetically connected with area of primary outcrops of tabular smoky flints of subunit Ia^1.

Subunit Ia^5

Transparent smoky chalcedony thin grain raw materials. Flints are similar to those of so called Volhynian (Podolian) type in its smoky variety.

Subunit Ia-b

This subunit is rather provisional and includes quantitatively subordinate series of samples of unusual mineral raw materials.

Ia-b (A)

These lithics with an apospiculae structure are analogous to flints associated with Lower Cenomanian deposits known in middle flow of Dniester and Prut rivers.

Ia-b (B)

A black smoky flint with white softy cortex. The raw material is originated from primary deposits of an Upper Cenomanian age exposed along the Dniester valley between mouth of River Kalus and Resina town.

Ia-b (V)

Almost not transparent, bold lustred, multicoloured, with blue-black, red-brown, smoky grey-whitish, secondary greenish-gray tints. Nodular cortex is white and soft. This rock is analogous to Sarmatian clayey-chalcedony flints of Bakshala type, e.g. known on the cortex of erosion of Ukrainian crystal shield in the mouth of River Bakshala in the basin of Lower Bug.

Ia-b (G-1)

Light grey not transparent almost dim fine-grained flints. Similar flints are known in the cortex of erosion of Proterozoic rocks of upper suite of Krivoj Rog series on the territory of Krivoj Rog town.

Ia-b (G-2)

Three-coloured, well transparent, mainly muddy-smoky, bold lustred and fine-grained flints. This kind of raw materials is known in the cortex of erosion of Ukrainian crystal shield in Middle Dnieper are and elsewhere in Right Bank Ukraine, e.g. in Cherkassy region (Petrougne, 2000).

UNIT Ib: **Siliceous rock of infiltratic-metasomatic origin**

This unit is represented by two varieties. The first – more frequent – is identical to chalcedonised petrified wood known in Paleogene deposits nearby town of Marganets, and might be provisionally identified as swamp cypress.

The second variety is represented by the isolated large size sample, the origin of which is not defined.

UNIT II: **Clastic(detrital) sedimentary rocks**

Subunit IIa

Predominantly grey sandstone with massive texture, basically analogous to Tertiary sandstones (from Buchak to Upper Pliocene) which were formed due to the destruction of crystalline formations of Ukrainian shield. This sandstone has most likely a regionally local genesis.

Subunit IIb

It is light grey, with glass lustre, quartzite-like sandstone. Romanian origin of this rock is cannot be excluded though outcrops of likely sandstone are known in Southern Bug valley, on the right bank of Mertvovod River, eastward of Voznesensk town.

UNIT III: **Sedimentary-volcanogenic, pyroclastic rocks**

Subunit IIIa

By the sum of signs, rock represents a practically completely zeolitised originally vitroclastic cemented (welded?) ashen tuff of silt structure and dacite (?) content. Most reasonably this rock is cognate with ante-Sarmatian formations of East-Carpathian region. Zeolitised tuffs and below characterized amphibolites – products of different stages of the process of zeolitisation - are represented in Mira layer I assemblage jointly. It is good ground to consider their origin from the area in which both formations are known. Therefore, we should say about the exterior zone of Carpathian arc, ranging between Ukrainian Transcarpathia and Northern part of Romanian Eastern Carpathians, up to latitude of Tirgu-Mures town (Onchescu 1960).

UNIT IV: **Effusive (volcanic, lava) rocks**

It is a greenish-grey in colour rock of microoligofire structure with an extra fine-grained basis. By the association with zeolitised pyroclastes has most likely regional-Carpathian origin.

UNIT V: **Intrusive (Plutonic) and dike and sill formations**

Dark grey quartz-diabase. The local origin seems to be most likely. The nearest outcrops of quartz-diabase are known, for instance, in the mouth of Samara River.

UNIT VI: **Rocks of dynamometamorphic genesis**

Subunit VIa

Quartz milonite-ultramilonite of most likely local origin, somewhere from the local crust decay of Ukrainian crystal shield localized not far from the site.

Subunit VIb

This, formed by quartz rock, is either of local (and moraine of Dnieper glacial), or more western (basin of Southern Bug, north to Pervomaisk town), and even Carpathian (alluvium of local rivers) might equally be supposed.

Unit VII: **Rocks of middle stages of regional metamorphism**

Subunit VII:

Almost mono-mineral aggregate composed of sub-prismatic crystals of actinolitite, isolated flakes of chlorite, silt dimensioned grains of quartz and magnetite.
To judge by pebble appearance, crystal-optic constants and paragenetic associations differing from actinolitite rocks known in area of Krivoj Rog (Petrougne 1967a), Dnieper area, and in Eastern Asov sea region (Danilevich 1970), actinolitites from Mira - as well as genetically close hornblende amphibolites - might originate from Carpathians, even maybe from the Rakhov massive in Transcarpathian Ukraine.

Subunit VIIb

This rock, black or dark grey on surface, with massive texture and heteronematoblastic structure, is determined as amphibolite.
Amphibolites are widely known among crystalline formations of southern edge of Ukrainian shield. But territorially the closest rocks known in various localities in Dnieper basin are different by row of macro- and micro-signs.
Till the definition of absolute age of the Mira samples by Ka/Ar, it is possible to consider them as belonging to the Carpathian area (Matkovskij, 1967) and area of crystalline shales (Onchescu, 1960).

Unit VIII: **Rocks of high stages of regional metamorphism**

These rocks are represented by isolated samples and have local origin. Among these are likely specimens of migmatite or gneiss from neighbouring areas of Ukrainian shield.

UNIT IX: Rocks of uncertain genesis

Water (?) eroded fragment of light green glass of gravel dimension, with dim surface but well translucent. Fraction with glass lustre, without admixture of clastic grains or inclusions. It might be either tektite-moldavite or rolled in water modern industrial glass. Sample is more similar to tektites by structural-texture features but index of refraction is more typical for modern glass. Chemical analysis of sample and its gas inclusions would be decisive for final solution.

Therefore, the examination of petrographic content of lithic artifacts of the site of Mira allows – to prof. V.F. Petrougne notion – to conclude the following.

1. Quantitatively predominate flints (subunits Ia^{1-3}) of the uppermost archaic UP layer of the site (Mira: I) are represented by mostly tabular smoky, grey-smoky and grey chalcedonolites which, due to their specific composition of inclusions, have no analogies among the silicilites of Ukrainian Right-Bank area, Ukrainian Carpathians, and Transcarpathia (Petrougne 1995). This flint raw materials (subunits Ia^{1-3} and, probably, Ia^{4}) have an Eastern Carpathian origins and, as well as a part of the non-siliceous stone rocks discovered at the site, were seemingly collected somewhere on the territory of modern Romania. The state of the physical preservation of chalcedonolitic artefacts allows to suppose the exploitation of either fresh primary outcrops or eluvially disintegrated flint-bearing rocks, most likely dated to Upper Cretaceous period. The lithics of subunits Ia-b and Ib quantitatively are less significant. Nevertheless, their peculiarities allow to define their exact origins. The assemblage of the upper layer of Mira includes the following varieties of lithics, i.e.: apospiculae chalcedonolites of Lower Cenomanian age (subunit Ia-b(A)) which were picked up in the area of modern Kosteshti town in the Prut valley; spiculae-inoceramic flints of Upper Cenomanian age (subunit Ia-b(B)) originated from the area of modern Soroki town in the Dniester valley; residual-infiltrated Sarmatian flints and opoka-like rocks (subunit Ia-b(V)) from the area of the mouth of river Bakshala in the Southern Bug valley; local cherts of Krivoy Rog type (subunit Ia-b(G-1)) in River Ingulets valley; fossilised wood (unit Ib) from the area of modern towns of Nikopol and Marganets in Lower Dnieper valley.

   There are both local and remote non-siliceous rocks in the Mira layer I assemblage, as well. The paragenetic association of zeolitised tuffs (subunit IIIa), actinolitites (subunit VIIa), amphibolites (subunit VIIb), and effusives (unit IV) points to Carpathian origins of certain exotic varieties of non-siliceous rocks. Sandstone of subunit IIa, quartz milonite-ultramilonite of subunit VIa, migmatite or gneiss (unit VIII), and probably quartz-diabase (unit V) have local origins.

2. The high quality homogeneous, fine-grained chalcedony flint raw material of the lower occupation Mira: II/2 (subunit Ia^{5}), though also smoky, but including only rare elementary microfauna, provides good macro- and microscopic affinities to chalcedonolites of western, at least Volhynian type. A further study is desirable with the aim of discovery of silicificated remains of fish whitebait. If the results would be positive, preliminary assumption about a Turonian age and Volhynian-Podolian origin of this raw materials should be regarded as proven.

3. In the case of the lowermost Mira: II/2 occupation, the outcrops of the lithic raw materials were remote from the site for at least 300 to 350 km, and might be localised somewhere in Western Ukraine. The typomorphic peculiarities of flints and non-siliceous rocks allow a comparatively precise tracing of the supposed route of a West-to-East movement of the people who left the uppermost Palaeolithic layer of Mira. There are grounds to believe that they started somewhere on the territory of modern Romania and passed almost in longitudinal direction across the valleys of Rivers Prut, Dniester, Southern Bug, Ingulets, and, finally, stopped at the right bank of Dnieper. The initial set of presumably East Carpathian flint and non-siliceous artefacts was added by testing of flint raw materials on the route to the Dnieper and by collecting seemingly local non-siliceous rocks of a Dnieper

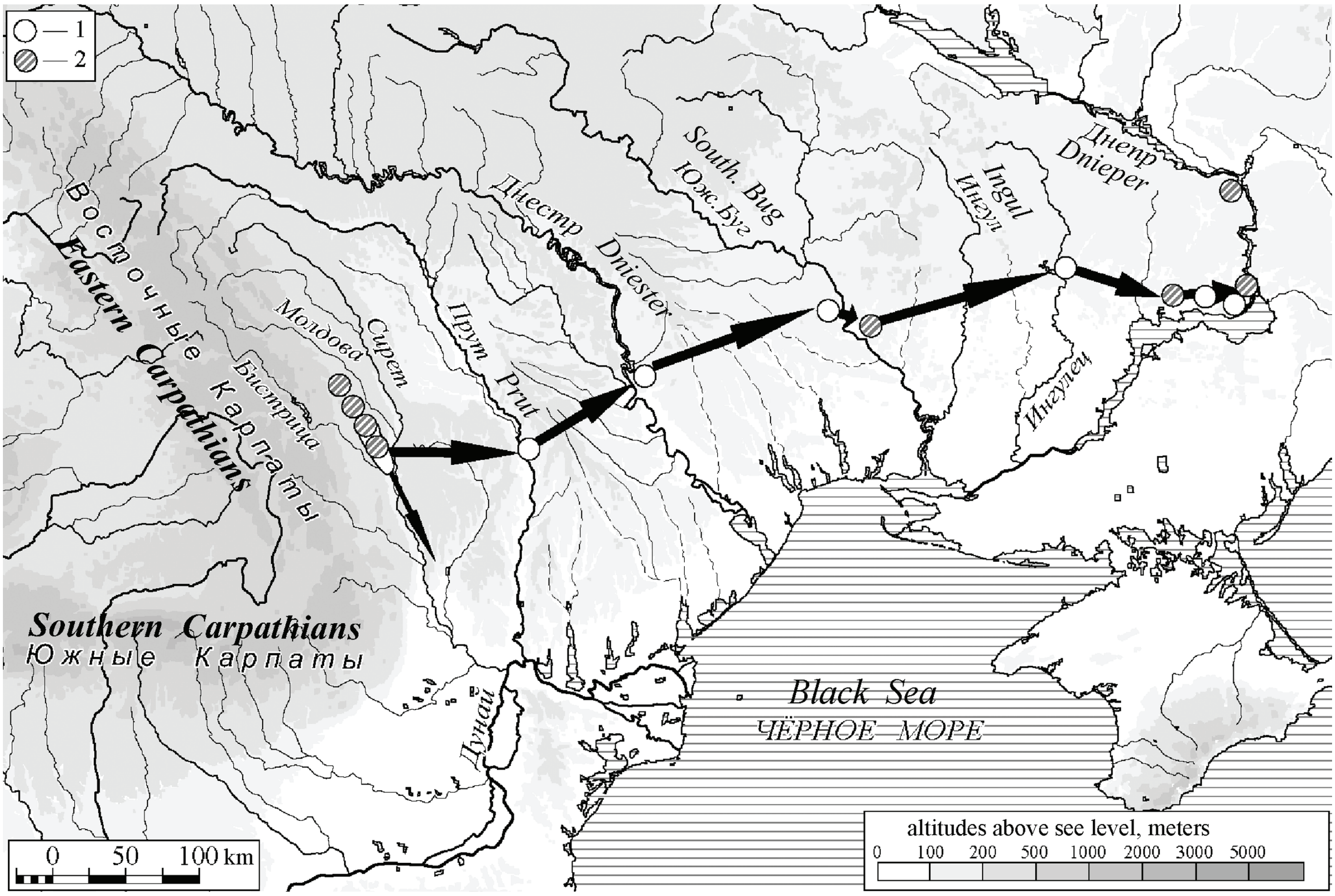

Figure 2 – The site of Mira. Layer I. Probable rout of migration of the group settled the layer, based on data of raw materials analysis. Circles mark areas of probable origins of siliceous (1) and not siliceous (2) rocks

provenance. The absence of typical flint raw materials known in the upper and middle segments of the Dniester valley, and the lack of characteristic Lower Danubian flints strengthen the justification of this direction of movement. The quantitative prevalence of the most remote raw materials points to the notion of comparatively rapid movement from the Carpathians to the Dnieper. Paragenetic association of zeolitised tuffs, actinolitites, amphibolites, and effusives also points to Carpathian origins, while sandstones, quartz milonite-ultramilonite, migmatite or gneiss, and probably quartz-diabase have local origins. Typomorphic peculiarities of flints and non-siliceous rocks allow to trace rather precisely West-to-East about 750 km long movement of Mira layer I occupants (Petrougne 2002-2003) (Fig. 2).

4 – Mira layer I lithic assemblage

As it was revealed by the petrographical analysis, the major portion of flint artifacts and almost all non-siliceous artifacts which were recovered in the uppermost (I) layer might be defined as originated from the fairly remote locales, likely East Carpathian. Practically all further flints were also collected rather far from the site. Worthy to note, by the way, that the overall weight of presumably East Carpathian flints and stones from the layer I not exceed 5 kilos grams.

The complete absence of primary local flint outcrops in the area of localization of the site, seasonal constraints in acquisition of any available redeposited lithics, and, therefore, the impossibility of any significant renewing of initial stock of lithic raw materials had resulted in the situation that might be described as a permanent acute shortage of lithics for knapping, literally the “starvation” of stone industry. Two processes were might potentially be turned on due to this dire shortage of stones. These two are: *a)* intensification of physical exploitation of available flints, i.e. working until compete exhausting, intensive re-use, re-shaping and re-sharpening, and b) invention of more sophisticated ways of exploitation of available lithics, which would allow to get the desired result at a lower cost of raw materials.

Many technological and typological features witness for intensive utilization of available raw materials. Layer I flint assemblage provides obvious and expressive instance of extremely transformed industry, which exhausted appearance resulted from the intensive utilization and re-utilization of limited number of initially thoroughly sorted lithic artifacts.

Mira layer I assemblage contains very rare and critically exhausted "secondary" cores, that is the forms prepared on either flakes or bifacial pieces, followed by few small fragments of raw materials, series of flakes, flake tools, bifacial tools, and crucially predominate chips or micro-flake-wastes of bifacial and flake tools' knapping, sharpening and reshaping (Stepanchuk, 2005; 2011a).The assemblage of Mira, layer I currently consists of preponderant micro-flakes but its definition as flake-oriented and micro would be wrong. As it revealed by the detailed analysis, in fact we deal with industry basically oriented to production of large blades and bifacial tools. There are definite indications of utilization of single platform cores. The preparation of crest at the pre-core stage is anticipated and revealed by the presence of crested products in the assemblage.

Thus, the initial composition of lithics which were included in tool-sets of occupants of Mira layer I at the beginning of their migration to the Dnieper valley was likely represented by large, massive, and wide blades, likely products of utilization of parallel single-platform volumetric cores, and large bifacial pieces. Retouched flake tools and bifacial tools and/or semi-products, and probably few pieces of raw materials in form of blanks and tested fragments were also delivered at the site. Different techniques were applied for the further transformation of the initial set of flint artifacts, among these are: intentional fragmentation, reshaping and rejuvenation, various thinnings, including core-like thinning, core-mode knapping of bifacial artifacts and larger blades and flakes, and regular knapping of fragments of raw materials. Should be stressed that assemblage includes no indisputable cores on fragments of raw materials, common products of regular knapping are rare (fig. 3), while the small-sized wastes of routine curation of stone tools are extremely numerous.

5 – Technological aspect of Mira layer I industry

Only limited number of technologically meaningful aspects of the industry under discussion can be discussed. At least one important aspect is completely impossible to investigate, because Mira layer I provides literally no cores. Therefore, the features of lithic technology might only be traced in available series of flake products and bifacial pieces.

The series of flakes, bladey flakes, and blades of Mira layer I represents rather complex conglomerate of products which were appeared at different stages of utilization and re-utilization of initially not numerous number of lithics.

Technical indices of Mira layer I assemblage are represented in table 3. They were calculated upon a series of 650 comparatively large flakes, including retouched ones, recovered during the field season of 2000.

The series demonstrates comparatively high percentage of faceted butts, medium range of index of blades, and rather high quota of flakes with centripetal pattern of dorsal surface. There are frequent signs of soft hammer stone technology, as well.

Flakes, which were appeared – either as end-products or as waste-products - in course of that or those biface or uniface operational sequences, sometimes are characterized by rather clearly recognizable morphological features. This fact provides an opportunity to conduct more differentiated evaluation of technical indices (Tabl. 4). Large number of faceted butts might be evaluated as a marker of the specificity and archaism of applied knapping technique. Generally correct, this notion should be critically interpreted in the case of Mira assemblage. It is quite possible that the certain quota of flakes with

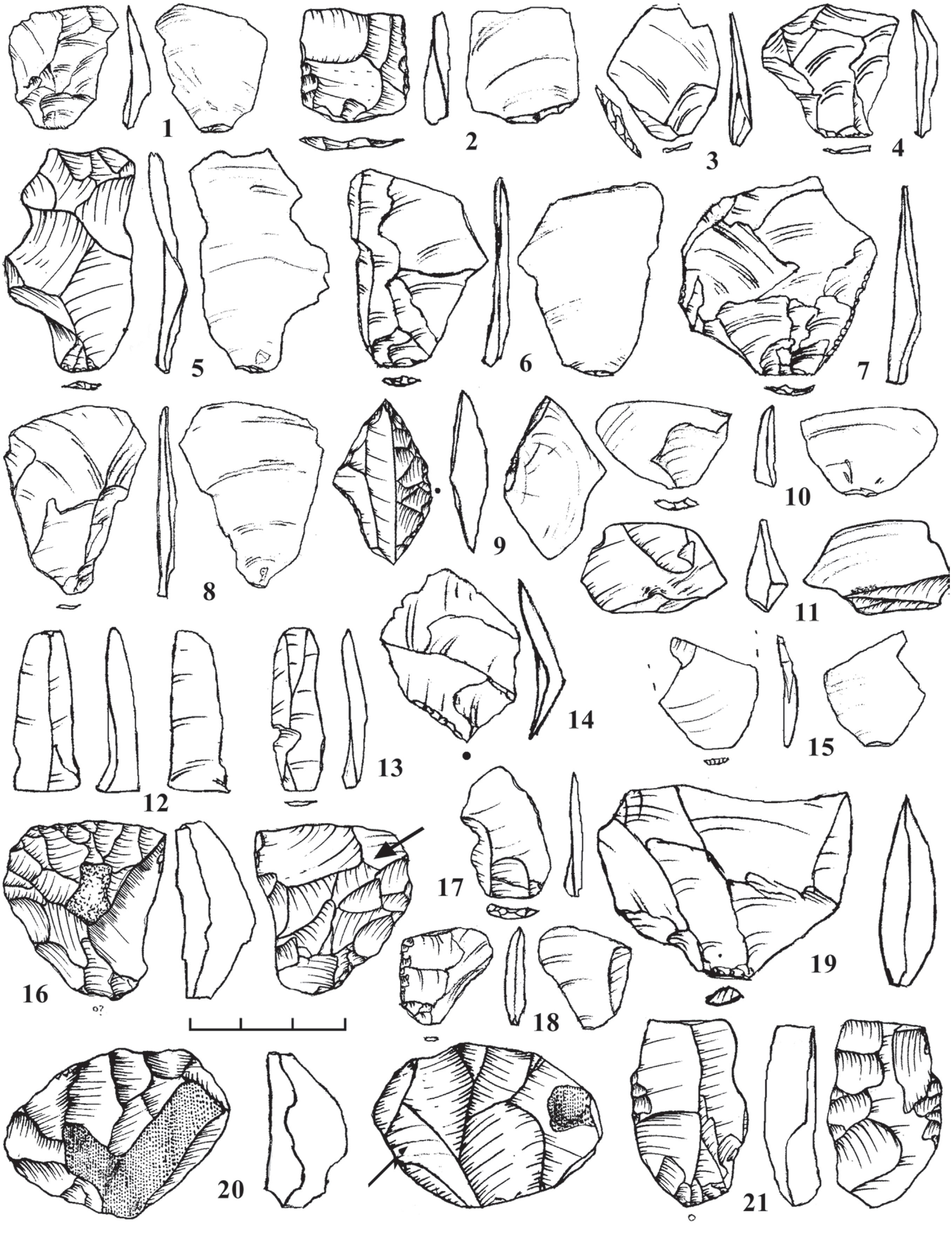

Figure 3 – The site of Mira. Layer I. 1, 2, 4-8 – products of knapping of bifaces; 9, 14 – products of transversal knapping of blades; 3, 10, 15, 17 – products of knapping (thinning) on ventral surface of flakes; 11-13, 18 – products of longitudinal knapping of flakes (12, 13 – blades); 16 – «core» - an instance of knapping of massive endscraper *; 19 – regular flake; 20 - «core» - an instance of knapping of massive flake *; 21 - «core» - an instance of knapping of massive blade. * arrow points to survived area of ventral surface of initial flake

faceted butts recognized in assemblage of Mira layer I and identified as likely products of knapping of cores with facetted striking platforms (Tabl. 4), represents, in fact, either by-products or end-products of treatment of bifaces, which were might served as cores.

Should be emphasized, that the site of Mira is localized outside of zone of development of Upper Paleolithic with bifacial tools, but in the zone of fairly intensive development of bifacial Middle Paleolithic industries, instead. That is why any manifestation of bifacial technology might be regarded as reminiscences of earlier traditions.

As to bifacial pieces, the mode of rough shaping and further finishing of retouched edges finds the close similarity with so called Middle Paleolithic Micoquian technology (Wetzel & Bosinski 1969). Plano-convex sections are predominating. Thoroughly retouched edges are localized on more convex surfaces. Signs of technological innovations elsewhere recognized in Upper Paleolithic context (Bradley, *et al.,* 1995; Girya, 1997) are not visible in the assemblage of layer I. Bone retouchers were likely broadly involved into biface curation, at least these artifacts are rather frequent among finds. Once again, these tools show no difference with their Middle Paleolithic analogies.

The relatively large quota of facetted butts may indicates the application of the Middle Paleolithic way of curation of working zones of cores. Flake-wastes of bifacial treatment are identical with standard Middle Paleolithic products of this kind.

By the other hand, high frequency of flakes with lips allows to conclude about the intensive use of soft hammer technique. Very frequent reduction of the outer zone of striking area on flakes signalizes the commonly Upper Paleolithic way of controlling the parameters of striking zone (Girya & Nekhoroshev, 1993).

In general, the uppermost layer of the site demonstrates, in certain sense, a mixture of Middle and Upper Paleolithic technological features, or, if to formulate more cautiously, some mixture of more sophisticated and "progressive" and less developed and "archaic" lithic technologies.

Examination of metric parameters of initial flake-blanks was performed for 39 secondary retouched artifacts. 27 of them (69%) were manufactured on blades and

Mira layer I. The main technical indices of the series of flake products							
Index of flakes with parallel dorsal pattern	Index of flakes with centripetal dorsal pattern	IF	IFs	Index of flakes with punctiform butts	I lam	Index of flakes with lipped butts	Index of flakes with reducted striking zone
43.14	14.51	31.6	26.57	14.62	15.56	60.48	44.36

Table 3 – Mira. Layer I. The main technical indices of the series of flake products

	products of regular knapping of raw materials		waste-products of working of bifacial pieces		waste-products of ventral thinning of flake pieces		products of regular knapping of raw materials		waste-products of working of bifacial pieces	
	N=257		N=336		N=34		N=659		N=1286	
	N	index	N	index	N	index	N	index	N	index
IF	11	12,09	145	53,31	12	66,67	18	5,56	186	26,23
IFs	7	7,69	140	51,47	10	55,56	17	5,25	174	24,54
Ilam	47	38,52	16	2,38	1	2,94	107	16,24	171	13,29

Table 4 – Mira. Layer I. The main technical indices of series of flakes appeared at various stages of exploitation of raw materials

		"MP *vs.* UP" habitus of the series of flake tools					
		MP	UP	micro-component	indefinite	Total, N	Total, %
The type of initial blank	(0) piece of raw materials	-	-	-	1	1	0,14
	(1) Product of testing of raw materials	6	9	7	21	43	5,96
	(1 or 2) Product of either testing or decorticage	-	1	3	7	11	1,53
	(2) Product of decorticage of initial raw material pieces	9	21	29	57	116	16,0
	(3) Product of reshaping of core or bifacial blank	-	2	-	-	2	0,27
	(4a) Product of reshaping and resharpening of flake tools	3	3	178	49	233	32,3
	(4b) Product of reshaping and resharpening of bifacial tools	1	1	34	34	70	9,71
	(4c) Product of modification of already finished tool	7	12	2	24	45	6,24
	(??) Product of undefined position	10	10	23	157	200	27,7
	Total N	36	59	276	350	721	
	Total %	4,99	8,18	38,28	48,54		99,9

Table 5 – Mira. Layer I. Correlation of "MP vs. UP" habitus of flake tools and the type of initial blank

bladey flakes. Their average width and thickness constitute 24,96 and 8,59 mm, respectively. Likely length of these products varied between 10 and 15 cm.

This data witnesses for rather developed blade standard of Mira layer I industry. The practically lack of products with bi-directional parallel dorsal pattern (cf. Tabl.5) probably points to predominant exploitation of (semi) volumetric cores with one striking platform, with likely formation of crest at the early stage of core reduction.

As it is expected coming from raw material shortage, the bifacial artifacts of the initial tool set were rather big and, undoubtedly, larger than forms currently represented in the assemblage of the uppermost Paleolithic layer of the site. Such a notion is supported by the fact of presence of relatively large flake-wastes of bifacial treatment in the Mira layer I assemblage. These flakes are metrically obviously not correspond to available bifacial pieces and were struck from the evidently larger tools.

Table 6 contains some statistics concerning the flakes or pieces of raw materials which were used for production of tools, with special reference to their expected position in the technological operational sequence.

Following stages of this latter were distinguished, namely: 0 – piece of raw materials, 1 - testing of raw materials, 2 – decorticage of initial raw material pieces, 3 – reshaping of core or bifacial blank, 4a – reshaping and resharpening of flake tools, 4b - reshaping and resharpening of bifacial tools, 4c - modification of already finished tool, ? – undefined position.

Worthy to stress that there is no clear interdependence between the type of flake and type of secondary retouched tool.

Summarizing the Mira layer I industry in its technological aspect it would probably be more accurate to define it as basically Upper Paleolithic but possessing expressive archaic features.

dorsal pattern/ type of flake	flakes most likely appeared in course of utilisation of cores					waste-flakes of biface working			waste-flakes of utilization of flake tool			Total	
	flakes	blades	flake tools	blade tools	*Total*	flakes	tools	*Total*	flakes	tools	*Total*		
plain	3		4		*7*							*7*	7
cortex	2		2		*5*				2		*2*	*6*	7
cortex+crest			1									*1*	
convergent	1	1	4		*9*	45	5	*50*	11	5	*20*	*72*	79
convergent+cortex			2	1					2	2		*7*	
centripetal		1	2			51	5		2	1		*62*	
centripetal + cortex			1		*4*	1		*57*			*3*	*2*	64
parallel	2	2	4	6		7			5	2		*28*	
parallel + crest				1								*1*	
parallel + cortex	2		1	3	*38*			*42*	1		*49*	*7*	129
subparallel	4		7			26	5		31	7		*80*	
subparallel + cortex	2	1	2	1		3	1		3			*13*	
bipolar	1					2	3					*6*	
bipolar + cortex					*2*	1		*6*				*1*	8
bipolar + cortex + crest	1											*1*	
perpendicular	1		4	1		6			6	3		*21*	
perpendicular + cortex	1	1	2	1	*17*	1		*26*		1	*20*	*7*	63
subperpendicular	1		1	1		17	1		9	1		*31*	
subperpendicular + cortex	1		2			1						*4*	
retouched			11				1			1		*13*	30
indefinable	3		11		*25*			*1*	2	1	*4*	*17*	
TOTAL	25	6	61	15	**107**	161	21	**182**	74	24	**98**	387	387

Table 6 – Mira. Layer I. Correlation of "MP vs. UP" habitus of flake tools and the type of initial blank

Quantitative shortages of raw materials influenced to a considerable transformation of the original appearance of the industry. The industry, initially focused on production of large blades, ultimately looks like a flake-oriented. Bifacial tools that were originally large, were almost completely exhausted through use as a mobile reserve of flint raw materials.

6 – Typological aspect of Mira layer I industry

The industry under discussion is characterized by certain mixture of more developed or "progressive" and less sophisticated or "archaic" features in typology, as well. To be more strongly expressed, this difference is described – conditionally, of course – as Middle Paleolithic and Upper Paleolithic features (Tabl. 7).

The following characteristics of the industry under discussion should be emphasized, these are: developed blade-oriented technology, skilled application of bifacial technology, combination of Middle and Upper Paleolithic typological elements, certain techno-typological features usually regarded as typically Aurignacian, and also certain Gravettian techno-typological features.

Middle Paleolithic flake tool types are represented by the points and sidescrapers (Fig. 4: 2, 10, 11). There are canted points and sidescrapers, including forms with dorsal thinning of area opposite to the point, and also sidescrapers with thinned dorsal surface, including pieces with base thinning. Certain tools referred to the group of so called convergent forms might be defined in different way. For instance, some among secondary worked pieces might be regarded as point on blade or as pointed blade, and further conclusions clearly depend on this very subtle difference in definitions. The typological status of one more artifact is also uncertain. It might be defined as either point, or pointed area on the angle of truncated blade. Worthy to note the large blades and their fragments equally served as the most preferable blank for both conditionally Middle Paleolithic and Upper Paleolithic tool types. This type of flake blank is followed by struck flakes from bifacial pieces, and completed by the far less frequent products of regular knapping.

Mousterian points	13	Krems or El-Wad points	4
Canted points	3	Micro-points	7
Simple sidescrapers	3	Dufour bladelets	15
Double sidescrapers	2	Mira type microliths	138
Canted sidescrapers	5	Truncated pcs.	6
Convergent sidescrapers	2	Piece esquilles	20
Limaces	2	Percoir	8
Sidescrapers	3	Retouched blades and bladelets	45
Combined tools	15	Retouched micro-blades	50
Endscrapers	36	Retouched flakes	81
Burins	5	Retouched nicro-flakes	87
Pointed flake pcs	18	Fragments of tools	153
Total 721 pcs.			

Table 7 – Mira, layer I. Typological structure of flake tools, recovered in 2000

layer	Laboratory code	age, years BP, uncalibrated dates	age, years BP, calibrated dates, Fairbanks0107 calibr. curve
I	Ki-8152	27600±370	32943±420
I	Ki-8153a	27200±380	32518±434
I	Ki-8154	27300±390	32625±442
I	Ki-8158	27050±350	32359±403
I	Ki-10283	26610±400	31888±456
I	Ki-10284	27080±400	32391±453
I	Ki-8381	28450±1100	33822±11490
I	GrA-20019	26590±490/460	31866±548/516
II/1	Ki-8155	26800±390	32092±443
II/1	Ki-10346	27160±390	32476±445
II/1	GrA-20020	27830±580/540	33184±631/588
II/2	Ki-8156	27200±360	32519±413
II/2	Ki-8201	27510±400	32847±451
II/2	GrA-20033	27750±590/550	33090±642/601

Table 8 – Mira. Absolute radiocarbon age: AMS and conventional *Uncal* and *Cal* dates

Upper Paleolithic types are represented by points, *piece esquilles* (Fig. 4: 5), sometimes rather intensively retouched blades (Fig. 4: 9), endscrapers, numerous and embracing a raw of variations, the subtriangle laterally retouched subtype of which is the most common in Mira layer I materials (Fig. 4: 1, 3, 4, 7). Typically Aurignacian endscrapers are few, though endscrapers made on "thick" blanks are quite common and tools of *á museau* type are also represented. Burins are also not frequent, both angle and carinated forms are represented (Fig. 4: 6). Some of bladey flakes demonstrate alternatively disposed blunted edges and resemble artifacts of Dufour type, though this resemblance is probably incidental.

Bifacially worked tools recovered in the context of the uppermost layer of Mira are represented by 16 complete and fragmented (mainly constituted by pieces of tips) leafpoints or points (Fig. 5), including bipointed slightly asymmetrical shape (Fig. 5: 10), followed by convergent sidescraper, and also by 15 further indeterminable fragments.

As it was stressed above, the bifacial tools of Mira layer I seemingly correspond to the Middle Paleolithic technological pattern. It is true for virtually all artifacts; probably save for the above mentioned isolated bipointed foliate. This latter artifact also has pronouncedly plano-convex section, but appeared to be more carefully manufactured, even maybe with application of pressure flaking technique.

The presence of so thoroughly manufactured bifacial item in the context of Mira layer I makes a reason to regard the majority of other bifacial artifacts as just that they look as, i.e. as - sometimes reutilized - products of the processes of reduction of the initial set of larger foliates as a cores. In its turn, it probably means that the main techno-typological idea of Mira layer I tool-makers was to prepare the bifacial foliates, only one of which survived intact, while other were used as mobile flint reserves under the terms of raw materials shortage and lose their shape.

Typical for Mira layer I assemblage, the series of so-called combined tools represents various combinations of endscrapers, sidescrapers, points, scaled thinnings etc. Such a very expressive instances as endscrapers-Mousterian points (Fig. 4: 1, 7) provide good analogy for above-mentioned subtriangular laterally retouched endscrapers (Fig. 4: 3, 4).

Retouched or used - i.e., with retouch of utilization - bladelets comprise several dozen pieces (Fig. 6: 17-25). Rather atypical Krems-points (Fig. 6: 1-4), inversely retouched bladelets of Dufour (Fig. 6: 5-11) and Roc-de-Comb (Fig. 6: 12-16) types, and also micro-truncations, micro-points (Fig. 6: 26-30; 54-56) and considerable series of micro-flakes with light, often partial, edge retouch are represented in the Mira layer I assemblage.

The major portion of these artifacts represents the products of slightly elongated micro-flakes (chips) appearing in the course of reshaping and rejuvenation of tools on flakes and more rarely of bifacial tools. Their proportions are rather short, and they occasionally have a twisted profile.

Dufour-like bladelets recovered in the uppermost layer of Mira are rather atypical, and artifacts more similar either to the Dufour or the Roc de Comb subtypes might be defined. There is no need to suppose the reduction of core-like pieces to explain the origins of these artifacts, though certain artifacts is possible to regard as cores for lamellar products (Fig. 4: 5). By the other hand, so abundant in the Mira layer I assemblage micro-wastes of retouching and resharpening yield numerous atypical bladelets. Among of more than four hundred atypical bladelets, there are 149 straight in profile, 136 slightly curved, 73 curved, and 72 twisted. Worth noting is the presence of regular retouched bladelets, as well.

Presence of micro-component in the layer I of Mira is of great importance, because points clearly to the very likely exploitation of composite tools. Of course, the usage of composite tools is not revolutionary thing neither from the viewpoint of Mira layer I chronology (ca. 30 ky BP) nor its context (Early Upper Paleolithic). Nevertheless, this point deserves a special attention from the viewpoint of probable consequences of raw materials shortage in the uppermost Paleolithic layer of Mira.

The next highly unique feature of the Mira layer I assemblage is the presence of a large (more than 140 pieces) series of micro-flakes with retouched edges. They represent mostly short trapeze-like chips with blunted transversal edge (Fig. 6: 31-53, 57). Sometimes the retouched edge is obliquely to the striking platform, or along the

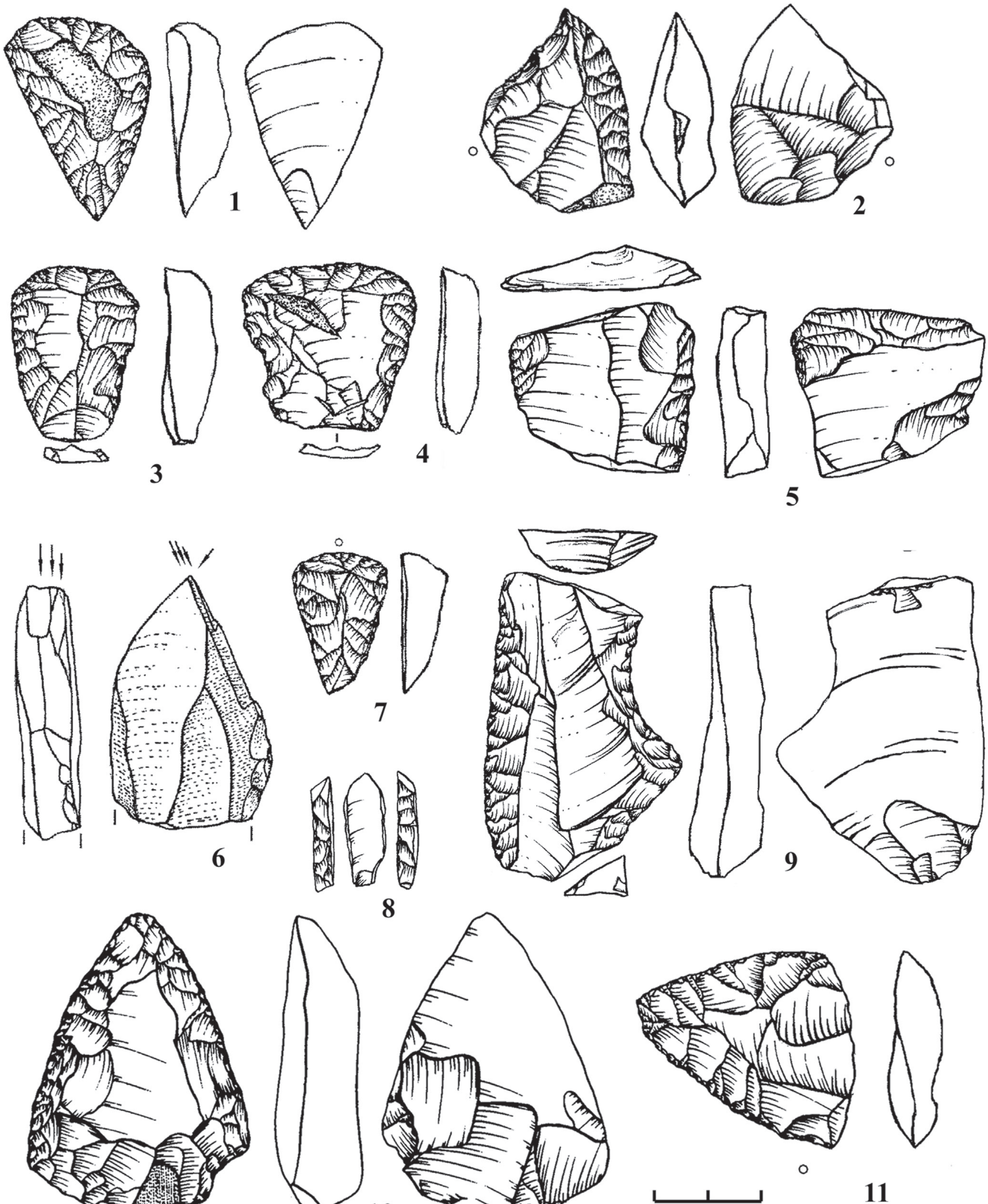

Figure 4 – The site of Mira. Layer I. 1, 7 – endscraper combined with point/ bilaterally retouched subtriangle endscraper; 2 – base thinned flake point; 3, 4 – endscrapers; 5 – piece esquille on fragment of large blade; 6 – burin; 8 – micro-tool with abruptly blunted edges; 9 – intensively retouched and reshaped large blade; 10 – base thinned point/ convergent sidescraper; 11 – canted sidescraper

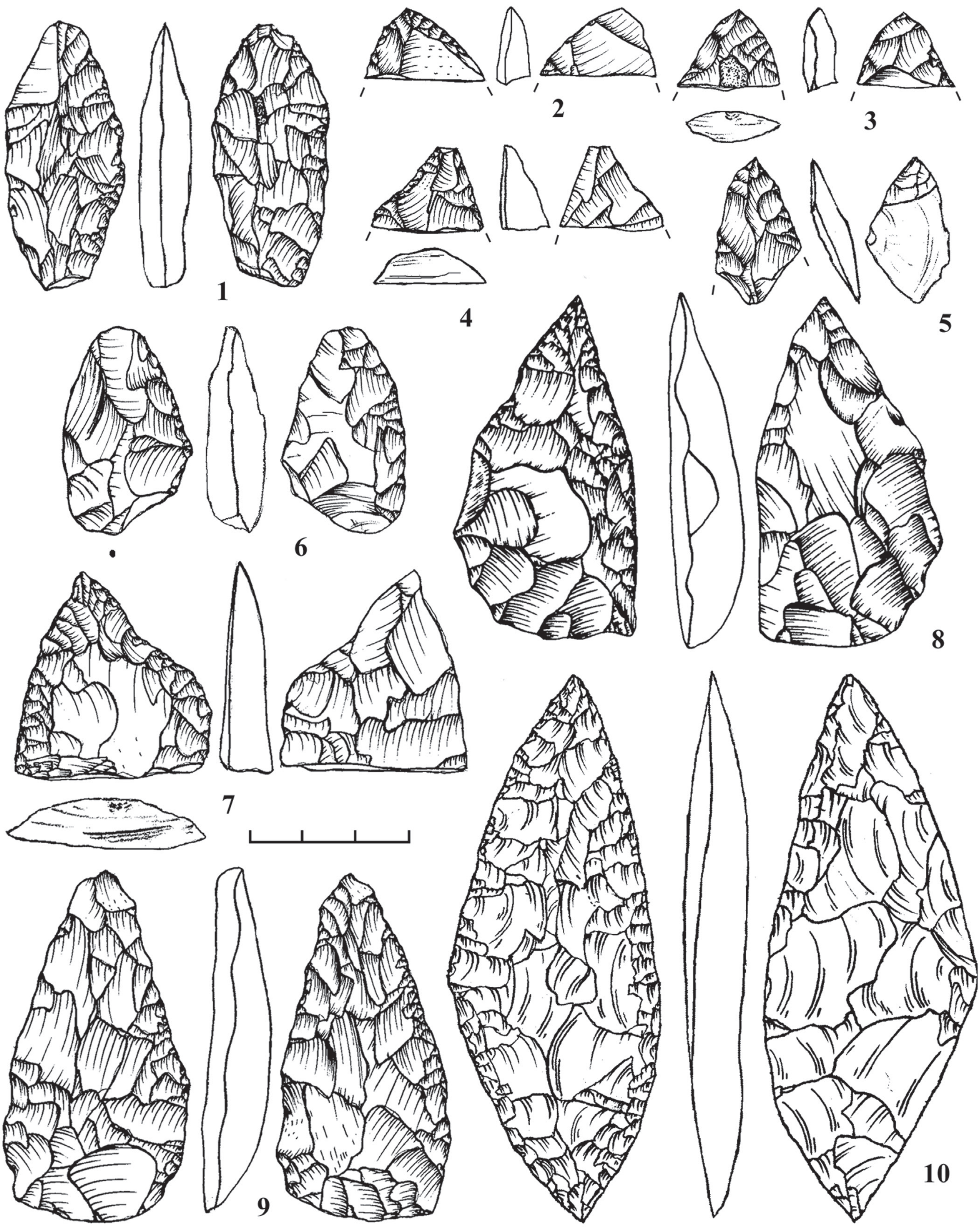

Figure 5 – The site of Mira. Layer I. Complete (1, 6, 8-10) and fragmented bifacial artifacts. 1 – exhausted bifacial foliate artifact used as piece of raw materials; 2-5 – fragments of tips of foliate pieces; 6 – massive flake used for core-like knapping and resulted in partial bifacial artifact; 7-9 – bifacial foliates used as raw material pieces and later reshaped in various extent; 10 – thoroughly reshaped bifacial foliate

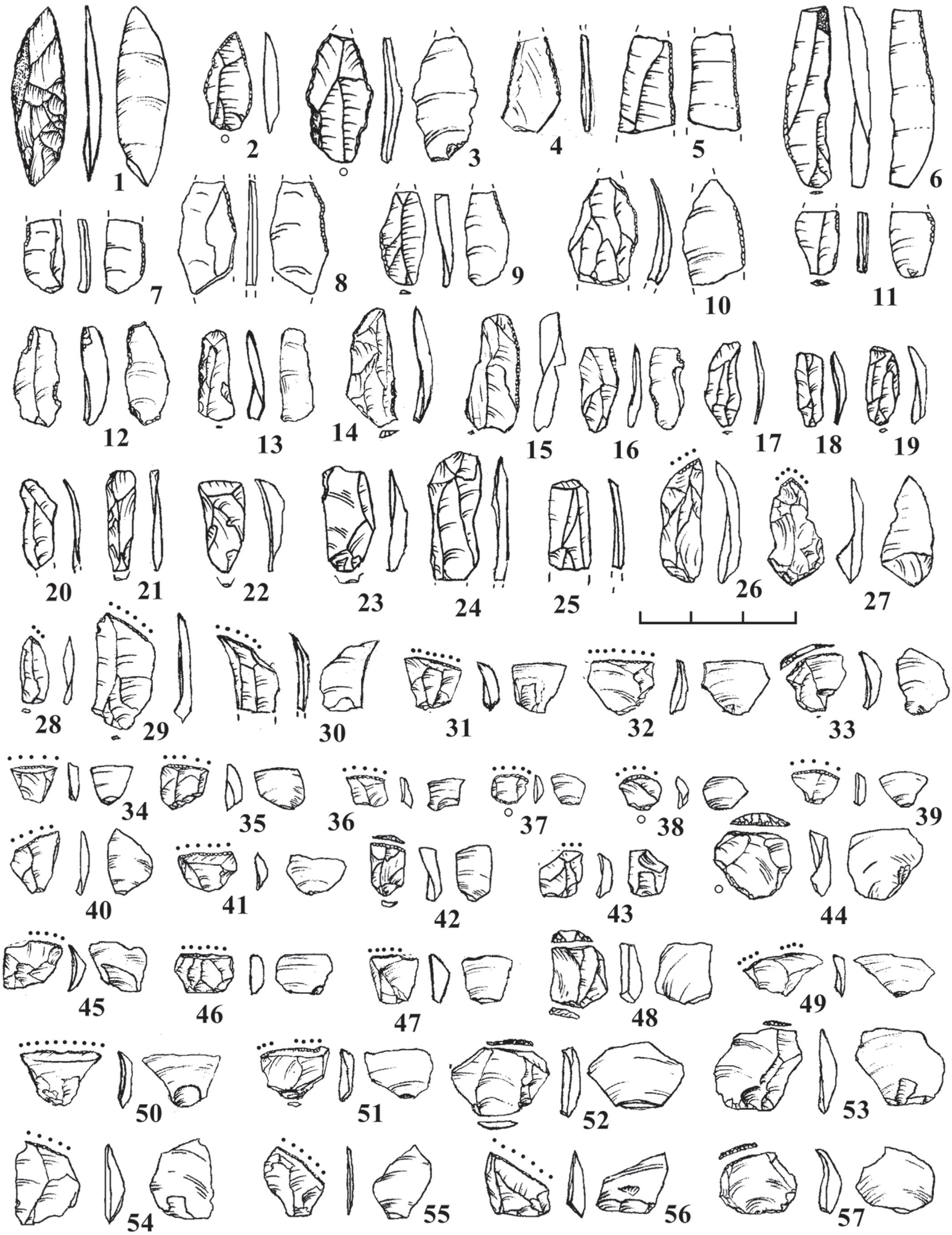

Figure 6 – The site of Mira. Layer I. 1- artifacts similar to Krems points; 5-16 – artifacts similar to Dufour bladelets of Dufour (5-11) and Roc-de-Comb varieties (12-16); 17-25 – micro-blades; 26-30, 54-56 – oblique micro-points; 31-53, 57 – microliths of Mira type

striking axis; double-edge artifacts are rare. Some specimens bear what seems to have been the result of use-wear damage (?) (Fig. 6: 31, 36, 43).

Non-geometrical microliths of Mira type represent analogies of East European Epi-Aurignacian assemblages of Zolotovka-Muralovka type (Praslov and Shchelinskij 1996). These assemblages are dated to 22-20 ky BP and include numerous non-geometrical microliths technologically similar to Mira type artifacts, although morphologically not completely compatible.

Generally speaking, microliths of Mira and Zolotovka-Muralovka types are of the same technological idea as Aurignacian Dufour bladelets of Roc-de-Comb subtype. The most common feature of these two is that micro-flakes which were appeared in course of retouching of comparatively thick flake tools and were characterized by mostly shortened proportions were used as blanks for manufacture of non-geometrical microliths. In fact, in certain chronological and typological sense, Mira layer I represents some intermediate link between earlier Aurignacian industries and later Epi-Aurignacian assemblages of the steppe area of the South of the Estern Europe.

Mira layer I assemblage also includes not numerous microlithis with abrupt blunted retouch along the perimeter (Fig. 4: 8). To these one can add the certain number of fragments of bladelets and micro-blades with similar abrupt retouch disposed along edges. Technological features of their manufacture make them more likely as product of Gravettian circle of industries.

Therefore, at the baseline, the industry of Mira layer I was aimed to manufacture of big blades and flakes, and also of bifacial pieces. Later, under the terms of raw materials shortage, the forcedly intensive transformations of the initial set of lithic artifacts were resulted in formation of flakey appearance of the assemblage, its microlithitisation, and distortion of morphological features of the inventory. As it seems, Mira layer I tool-makers were rather sophisticated and open-mind experts for independent invention and intensive applying of micro-tools and insert technologies.

At the moment of discard, Mira layer I assemblage comprises flake points and sidescrapers of Middle Paleolithic appearance, and also typically Upper Paleolithic endscrapers on flakes and fragments of blades, and few burins. Bifacial forms includes foliates, points, backed forms of mainly Middle Paleolithic exterior. This tool-set was complemented by numerous non-geometric microliths of Mira type, the series of atypical inversely retouched bladelets and atypical Krems-Dufour points, micro-truncations etc.

There are grounds to believe that the initial Mira layer I assemblage was composed by a wide and long retouched blades, endscrapers on such blades, few burins, and bifacial leafpoints. This set was likely complemented by sidescrapers and points, as well. But it also seems very likely that the micro-tools prepared on wastes of rejuvenation and re-shaping initial set were not included in initial tool-kit, and were invented already in Dnieper valley, somewhere ca. 30 ky BP.

The major portion of these micro-artifacts represents products of slightly elongated micro-flakes appeared in course of reshaping and rejuvenation of flake and more rarely of bifacial tools. There are some grounds to believe that appearance of original micro-component of Mira layer I, as well as Aurignacian-like products, might be explained as an independent innovation under the circumstances of scarcity of available raw materials.

7 – Mira layer I industry: concluding remarks

The initial appearance of the assemblage of Mira layer I was essentially transformed under the terms of raw materials shortage and acquired its current look due to the intensive exploitation and repeated reshaping of a limited number of probably carefully sorted artifacts. This initial set of artifacts was probably represented by big massive and wide blades and large plano-convex bifaces, most likely, foliated.

Cores – or rather core-like artifacts - are few. Already knapped pieces of raw materials, like flakes, flake tools, bifacial pieces were used as blanks for knapping. Centripetal manner of knapping prevailed. Both the faceting and trimming were applied for curation of properties of striking area. The overwhelming majority of the assemblage is represented by micro-wastes of rejuvenation of bifacial and flake tools.

By the typological point of view, Mira layer I assemblage contains points, sidescrapers, endscrapers, combined tools (mostly various combinations of endscraper-sidescraper-point), burins, pointed blades, *pieces esquielles*, retouched flakes, blades and bladelets.

Bifacially worked artifacts include complete and fragmented foliates, points, convergent sidescraper, indefinable pieces.

Micro-component consists of Krems points, Dufour bladelets. These Aurignacian-like elements of the assemblage are rather atypical although well recognizable and complemented by micro-points on bladelets, micro-truncations, and specific blunted pieces.

The highly specific non-geometric artifacts defined as microlithis of Mira type is quite original and represents completely distinct typological feature of Mira layer I industry.

Mira layer I assemblage also includes numerous bone retouchers, fragments of points, needles (?), polishers, pierced fox and polar fox tooth, pieces of bone objects with engravings, amber pendant.

Mira is dated by the means of radiocarbon method to 28-27 uncalibrated ky BP (Table VIII). The calibration procedure according the curve Fairbanks0107 points to the calendar age of 33-32 ky BP. Calibration curves CALPAL 2005 SFCP and Fairbanks0805 settle Mira occupations between 31-29 ky BP (Kiosak 2008). Absolute dates are in good accordance with geological, palinological, paleontological, and archaeological evidence.

The lithic industry of the layer I is rather original and multi-component. Different contexts may provide parallels for the Mira layer I assemblage. For instance, the industry might be defined as Szeletoide or post-Micoquian and found analogies in regional East European Middle Paleolithic with bifacial leafpoints, i.e. in para-Micoquian (Stepanchuk 2006). In this sense, the morphologically, chronologically, and spatially most close analogy of Mira I is provided by the Kiik-Koba MP industry of the Eastern Crimea.

At the same time, the industry is similar to archaic Streletskaya and Gorodtsovskaya EUP industries of Middle Don area. In this sense, Mira I is most close to Gorodtsovskaya, although it is differentiating by the more developed bifacial component. The most essential difference with Streletskaya is absence of triangular bifacial points in the context of Mira. Certain *Aurignacoïdeness* is specific for Mira layer I but this feature is not unknown in the context of Gorodtsovskaya sites, as well (Stepanchuk 2011b).

Territorially most remote though techno-typologically rather close analogies of Mira layer I are represented by East European archaic EUP industries of Zaozerye, which age is defined between 34-33 ^{14}C ky BP, and Byzovaya (29-28 ^{14}C ky BP) (Kanivets 1976; Pavlov 2009; Svendsen *et al.,* 2010) reported for the Kama and Pechora basins in the north-east of European Russia.

Less remote analogies in area between Dniester and Carpathians might be seen in such assemblages as Gordineshti I, Ceahlău-Cetătica, layer 1, Brynzeny I: III. An important aspect of these and similar industries is a combination of archaic and advanced Upper Paleolithic, often Aurignacian, components, as well as familiarity with the bifacial technology (Anikovich *et al.,* 2007; Borziac 2008; Păunescu 1993; 1998; Noiret 2004).

Thus, there are several options to define the industry of Mira layer I, more or less comparable by their validity. It might be regarded as post-Micoquian (or Szeletian), as archaic (symbiotic) Gorodtsovskaya industry or its analogy, as Aurignacian industry rich in bifacial component (similar idea was recently argued by J. Hoffeker (2011), finally, as original phenomenon of the Southern East European steppe.

Whatever it was, this industry demonstrates impressive picture of deformation of its initial habitus by multiple re-workings of limited number of initially available lithics. Raw materials shortage was clearly impacted on intensive microlithisation of the inventory, stimulated the transformation of typo-morphological pattern of the assemblage, and likely promoted the independent invention of original category of flint implements.

To date, the site of Mira represents a unique instance of well-documented archaeological records recovered in the continental Ukraine and directly related to the final stages of the period of coexistence of Middle and various kinds of Upper Paleolithic cultures in Eastern Europe. One of its highly peculiar features is relying on very remote raw materials. Long-distance migration, followed by the rather durable stay in area devoid of suitable siliceous rocks was resulted in specific Mira case of raw material exploitation

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