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PETROGRAPHICAL-LITHOLOGICAL  
CHARACTERISTICS OF STONE MATERIALS FROM  
LATE-TRIPOLYE CEMETERIES OF THE SOFIEVKA TYPE

Investigated collections from the four monuments\* comprise both sedimentary and crystalline (magmatic and metamorphic) rocks, with generally prevailing burnt flint samples, however, actually unstudied due to the aforementioned feature.

The article uses common geological and mineralogical terms [Polovinkina et al. 1948; Polovinkina 1966; 1968a; 1968b; Atlas 1973; Geologicheskiy 1978], except for few specially outlined cases, and are not provided with special explanations in the text.

Principle methods for studying the stone collections included expert-visual and immersion-microscopic [Tatarsky 1965: 207-209, 286] techniques which provide for actual integrity of the artefacts, which was inevitably lost, for instance, in the process of making thin sections, selection of representative samples for silicate chemical analysis, potassium-argon dating, etc. Although standard thin sections are indispensable for principally important evaluation of mineral assemblage texture, in this particular case their lack was partly compensated for by viewing under the microscope of several - instead of one - immersion samples taken from different parts of an article. For flint rocks, these were thin scales (taken according to the technique initiated by G.I. Bushinsky) easily received with the help of wringing technology. In the case „battle-axe”, slightly changed by hypergenic processes, a rather accurate evaluation of texture is achieved through investigation in reflected light or under lens, while immersion allows to define mineral composition of the powdered samples. Calcitonite preparations obtained through a similar technique allow not only to compare the flints represented in the collections to each other or regional standards, but also to find their analogs, for instance, in reference books [Atlas 1973]. Finally, classification of articles into specific groups according to their material on the grounds of visual evaluation was done in case of maximum similarity of series of features [Petrogne 1971:295] to those of similar but immersion-tested rocks.

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\* The paper does not discuss the full set of „Sofievka” sources [see Videiko, „Archaeological. . .”, in this volume]. It is based on a certain selection of the sources whose nature was justified by the author’s objective: to identify the general principles of differentiation between „stone materials” with respect to raw materials and genesis.

Table 1

Cemeteries of the Sofievka type. Types of the flint raw material

No	Specified types of flint material	Names of monuments and number of samples (visual/immersion)			
		Chernin	Krasny Khutor	Sofievka	Zavalovka
1	„Volhynia” of touronian age	11/19	7/4	0/1	44/13
2	„Dniester plated” and cenomanian apogaize	5/5	2/3	–	2/1
3	„Moraine” Northern hornfelsoidal	1/4	14/4	–	0/5
4	„Dnieper-Kanev”	–	–	–	1/1
5	gelatinous-like- apoinoceramoidal of the Ukrainian Shield zone	1/0	1/3	–	0/3
6	gelatinous-like- apoinoceramoidal of the Middle Dniester zone	0/4	2/4	–	0/1
7	gelatinous-like- apoinoceramoidal of Northern re-deposited (?)	–	0/1	–	–
8	„glauconized” re-deposited	0/3	–	–	1/2
9	undefined – non-affiliated	0/1	0/2	0/1	–
10	Total	18/36	26/21	0/2	48/26

Obviously, selection of materials for immersion preparations theoretically involve at least macroscopic uniformity of the raw material, although this provision is not always observed in practice: if a large knife made of so-called „Volhynia flint” rather often displays samples of smoky well-transparent stone as well as grey opaque material, this cannot be neglected, while if similar calcedonite is used for making smaller arrowheads, one sample might appear purely smoky, and another is grey, without any transition in color, this might cause an illusion of different raw material, although, naturally, the material is the same.

Therefore, in general, the collections flint is characterized by groups (Table 1) as well as by statistically representative series of tools, flakes chunks of unitype material (preferably, at least ten samples), due to small amounts of sampling, provides a rather limited affiliation with possible locations of raw material sources, and appears to be regional, that is, to be related to major parts of Ukrainian territory [Bondarchuk 1959; Pasternak at all 1968:Fig.22; Spravochnik 1975; Granitoidnye 1984]. Only in case of some unique artefacts, for instance, chops of a wedge-shaped tool from the Zavalovka ground cemetery (see below), the affiliation can crucially limit the source are of the material.

Identification of individual artefacts materials with raw stuff originating from a particular geological outcrop, after it is preliminary referred to a major region usually implies additional use of series of parallel investigations (according to the „artefact material - anticipated result material” scheme) by means of such modern

petrological-mineralogical study techniques as chemical, spectroscopic, petrofabric and electronmicroscopic analyses, as well as thermography, diffractometry, petrophysics (definition of resistance to monoaxis compression, porosity, electromagnetic and radioactive dimensions, etc.), possibilities of which have already been demonstrated by the author in some papers, although they have not been discussed in full in Ukrainian archaeological literature.

## 1. FLINT ARTEFACTS

Table 1 and Fig.1 offers an idea about types of flint as the most widely spread stone represented by articles in all the four collections. Table 1 includes both generally known terms like „Volhynia flint” [Kanivets 1956:102] „Volhynia-Podolia flint” [Danilenko, Makarevich 1956:97], or „Dniester plated flint” [Bibikov 1953:78-80] or „moraine flint”; as well as terms suggested by the author according to a set of characteristic features, including territory of occurrence, microfaunistic (apospiculate, apoinoceramoidal, etc.) or secondary mineralogical characteristics (glauconitization), and macroscopic (gelatinous-like) feature of the stuff. Although detailed description of microscopy or dissemination areas go beyond the scope of this publication, generalizations offered below are drawn from personal experience of many years of intent investigation of hundreds of thousands flint samples both from archaeological collections and natural outcrops mentioned or neglected in the regional table of Ukraine and neighboring states.

Almost all of the most sophisticated flint artefacts of the ground cemeteries under discussion were made of smallest-texture and homogeneous „Volhynia flint”, smoky, often with grey patches and stains.

In the Krasny Khutor cemetery these artefacts are presented by end-scrapers on blade (grave 50) [see Videiko, Archaeological. . . , Fig.25:1, in this volume], ordinary blade knife (grave 137) [see Videiko, Archaeological. . . , Fig.39:2], big asymmetric blade knife (grave 133) [see Videiko, Archaeological. . . , Fig.38:3], ordinary blade daggers (graves 89, 114) [see Videiko, Archaeological. . . , Fig.31:3;33:2], double spike-ended presser (grave 94) [see Videiko, Archaeological. . . , Fig.31:4], blunt-ended pressers (graves 32, 168) [see Videiko, Archaeological. . . , Fig.21:1;40:10], ordinary blade strikers (graves 120,146) [see Videiko, Archaeological. . . , Fig.35,40:3], arrowheads (grave 116) [see Videiko, Archaeological. . . , Fig.34:1].

In burial interments near Chernin there were ordinary blade striker (grave 84) [see Videiko, Archaeological. . . , Fig.12:8], asymmetric blade perforator (grave 42) [see Videiko, Archaeological. . . , Fig.6:1] and ordinary blade knives (like those from 66 complex) [see Videiko, Archaeological. . . , Fig.11].

The stuff described hereabove prevails in the Sofievka monument and is represented by fragmented (graves 44,45) [see Videiko, Archaeological. . . , Fig.55,56:1]

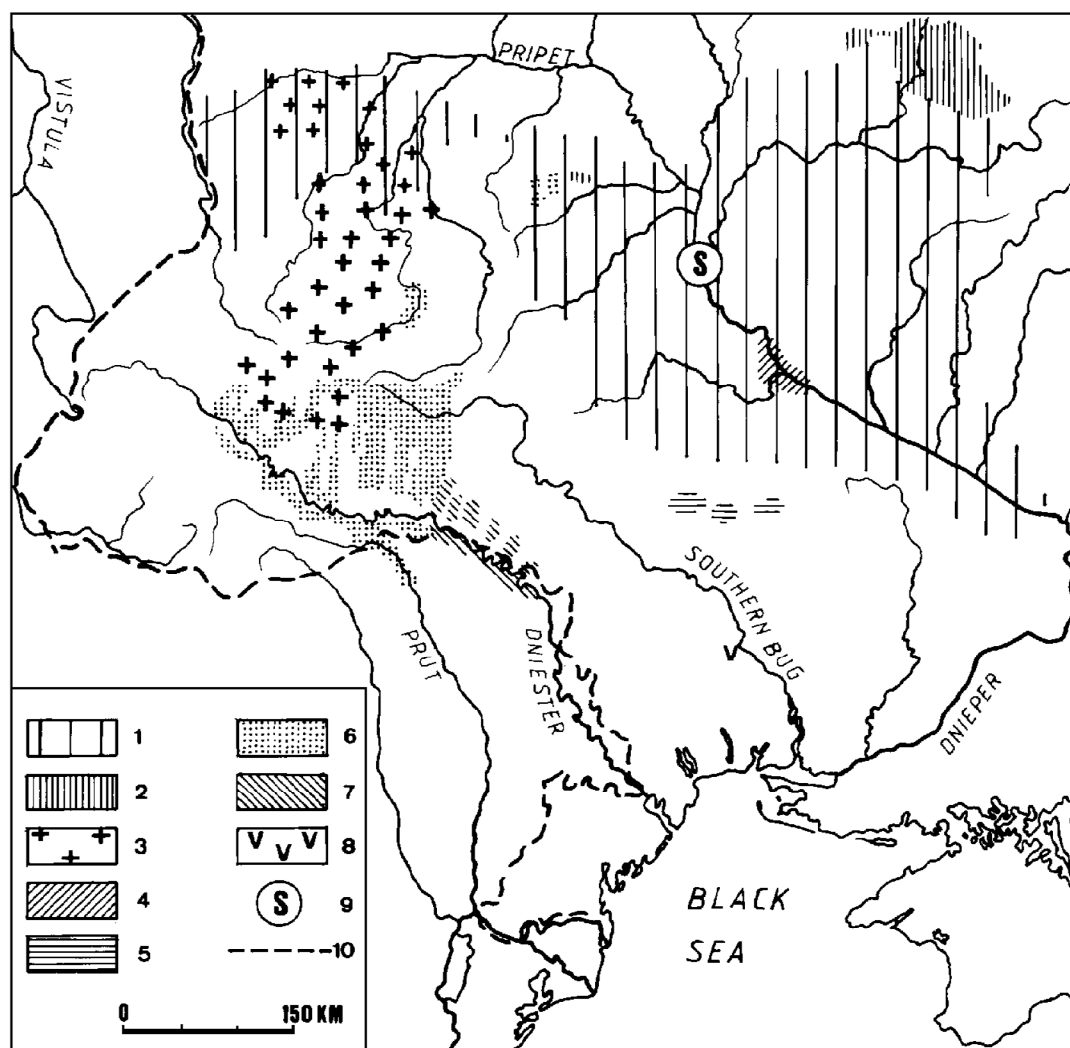


Fig. 1. The orientated scheme of the flint bearing areas and separate deposits of silicites along the periphery of the burial ground of the Sofievka type in the territory of Ukraine (without the most remote the Carpathian, the Crimea, the Donets regions and also apportionment of zone of paleoabrasional or alluvial reekposit of flint raw material). 1 - the area of spreading of the moraine type flint; 2 - the Desna type flint, 3 - the Volhynia type flint, 4 - the Dnieper-Kanev type flint, 5 - the Shield type flint, 6 - the chert type, the gaize type and the "plated" type from Podolye (Dniester) and Volhynia, 7 - Middle Dniester type flint, 8 - Bakshal type flint, 9 - location of the Sofievka type, 10 - border of the examined area

and actually undamaged square axes (graves 19, near 43,67) [see Videiko, Archaeological... , Fig.50:2,54:6,59:1] also spike-ended presser made from pseudo-blade knapped from square axe (grave 70) [see Videiko, Archaeological... , Fig.59:4], ordinary blade knives (graves 22,44 and surface) [see Videiko, Archaeological... ,

Fig.51:1,55,71:6], big asymmetric blade knife [grave 71 - see Videiko, Archaeological. . . , Fig.60:1], spike-ended presser (near grave 60) [see Videiko, Archaeological. . . , Fig.56:4], fragments of undefined blade tools (graves 45,47) [see Videiko, Archaeological. . . , Fig. 56:1, 56:3]. Actually, the same stuff was used for a series of straight- and concave-based arrowheads (from surface) [Videiko, Archaeological. . . , Fig.71:1].

Most of scarce flint finds in the Zavalovka cemetery represent burnt opaque samples, practically impossible to determine diagnostically.

Kinds of flint and other siliceous rocks, represented by single samples are not included in Table 1.

For instance, among the Krasny Khutor finds there is a hammer made from fragment of axe made of apoinoceramoidal stuff (the one in which fragments of mollusc folds are completely substituted by calcedony, but still, as well as in other kinds of ghost flint can be traced due to relict shapes outlined by clay microadmixture) in grave 137 [see Videiko, Archaeological. . . , Fig.39:2]. Another hammer made from square axe from grave 128 [see Videiko, Archaeological. . . , Fig.38:1] from the same cemetery has of white polished (dead on the fracture) almost opaque calcedonite with thin dark-brown and black lining of broad facets. Most probably, this mineral assemblage is of residual-infiltration nature without even approximate territorial affiliation.

An amorphous striker made from axe fragment found in grave 63 [see Videiko, Archaeological. . . , Fig.26:7] was made of so-called „plated” hornfelsoidal Dniester stuff.

Of special interest is brownish-yellow striker made from flake from axe found in the grave 137 [see Videiko, Archaeological. . . , Fig.39:2]. Actually that was primary calcite-flint „Malinovtev-type” rock [Petrougne 1992: 13] from the Middle Dniester basin which completely lost the carbonate component as a result of hypergenic lixiviation already in the culture layer, and presently represented by undersolid microquartz-calcedony aggregate, ash-grey in the fraction.

Occurrence of such rock in the grave directly points to the fact that cultural relations existed between the Middle Dnieper and the canyon part of the Dniester basin during the late Tripolye period.

The cemetery near Chernin reveals an ordinary blade knife of gaize-flint cenomanian material (grave 66) [see Videiko, Archaeological. . . , Fig.11], and arrowheads made of apoinoceramoidal stuff of presumably Northern origin (grave 69) [see Videiko, Archaeological. . . , Fig.12:2] as well as of some stuff of indefinite origin (grave 69) [Videiko, Archaeological. . . , Fig.12:2].

In the Sofievka area, those artefacts were represented by arrowheads [Videiko, Archaeological. . . , Fig.71:2] made of small-impregnated brown-grey translucent „gelatinous-like” flint, presumably originating from the Upper-Chalk residua from the territory of the Ukrainian Shield in the Southern Bug-Dnieper basin; and arrowheads [Videiko, Archaeological. . . , Fig.71:2], probably from the Stara Ushitsa area in the Dniester region, which displays apoinoceramoidal flints besides apospi-

cular cenomanian flints [Gavrilishin et al. 1991:21]. Furthermore, in the Sofievka ground cemetery there was a single flake of heavily sanded light-grey siliceous rock, not presented in the Table 1 (grave 67) transitive to calcedony alevro-sandstone consisting of fragmented quartz, often in clay coating, scarce glauconite grains in calcedony fulfilment cement. According to large-size spherulithic microtexture of the calcedony substratum (with individual indivisibles up to 0.1-0.2 mm long), this is presumably new infiltration formation from the Tertiary sands section like those occurring in the Southern Bug, Dnieper, Northern Donets basins, initially covering crystalline rocks of the Ukrainian Shield and then going North.

## 2. NON-FLINT ARTEFACTS

Archaeological-petrographical characteristics of other, non-flint kinds of stone stuff (from sedimentary to magmatic and metamorphic rocks) which occur in the cemeteries is performed on a by-complex basis.

### 2.1. „BATTLE-AXES”

*Krasny Khutor.* A „battle axe” (type 2) found in grave 120 [see Videiko, Archaeological. . . , Fig.35] was made of ash-grey argillaceous (most probably, metahalusite-based) fractioned quartz undersolid basal-cemented alevrolithe which made the raw-material easy to process, but the ready artefact was virtually unfit for multiple beat, and moreover, for battle use. This makes the artefact similar to some early- and middle Tripolye drilled axes made of ash-carboniferous rocks [Petrougne 1967:56], marbles and ofioalcite [Petrougne 1968:21], and there’s nothing strange that it survived till our time in fractioned form.

A „battle-axe” (type 1B), broken in old times, had been made of igneous rock of oligophyric andesite type with apointersertal- doleritic texture (of plagioclase grains, monoclinic pyroxen, basaltic-like hornblende, accessory magnetite and apatite. It was found in grave 119 [see Videiko, Archaeological. . . , Fig.34:2]. Greenish on the surface and mouse-grey in fracture, the rock is crossed by a thin vein, and obviously is less solid compared to other axes of standard forms and dimensions. Most probably, the material originates from the Carpathian region, the Prut river basin, that is, the South-West. Presumably, this was also source territory of xenolite-bearing andesite (according to its texture and composition), represented in a greenish-brown „battle axe” (type 1) from grave 127 [see Videiko,

Archaeological. . . , Fig.37]. With other conditions equal, a „battle-axe” (type 1B) from grave 12 [see Videiko, Archaeological. . . , Fig.17:1] can be considered as originating from the Carpathians or at least the Western part of the Ukrainian Crystalline Shield. The material of that axe - grey with greenish hue palaeoandesite or diabasic porphyrite (a thin section is required for more precise definition) occurs not only in the Carpathians, but also in the Volhynia region [Petrougne 1993:385].

The rest of „battle-axes” (types 2x1B and 1A) are represented by gabbro-amphibolites, green-grey on the surface and almost black in the fracture, of massive structure and apogabbro-hypidiomorphic granular texture - from graves 33,123,167 [see Videiko, Archaeological. . . , Fig.21:2,36:2,41:2]. Usually these crystalline rocks comprise plagioclase, green hornblende (something of brownish shade, probably because of heating in the open air in the burial fire), in some cases with slight admixture of biotite or ore mineral (magnetite) scales. The nearest outcrops of similar metamorphic rocks are located in the Southern Bug region, the Gorny Tikich and the Gniloy Tikich river basins [Spravochnik 1975:163] that is, regions to the South from the cemeteries, in the central part of the Ukrainian Crystalline Shield.

Genetically similar to these rocks is the material of a fragment of the „battle-axe” (type 2) found beyond the grave [see Videiko, Archaeological. . . , Fig.42]. It was made of dark-grey pointed, and exfoliated (possibly due to successive heating and abrupt cooling) material. The article, covered by a glue pellicle for preservation at the museum, requires study of thin sections. However, its material can be preliminarily classed among rare-biotite plagioclase amphibolites, similar in origin to that of the previously considered artefacts.

Finally, the part of „battle-axe” (type 1A/B) broken along the drill-line partially corroded on the polished surface, consists of small-grained pyroxene-plagioclase gneiss of micrograinoblastic texture, which developed up to 4 mm brown hue as a result of hypergenesis. The material's origin remains unclear; it might be both native rock of the Ukrainian Crystalline Shield and moraine rock brought from the North [Velych 1982:Fig.2], considering low firmness and decay of the material.

*Sofievka.* Erupted rocks of the Sofievka collection of artefacts are represented, first of all, by grey hornblende diabasic porphyrite of a „battle-axe” (type 3) - from grave 65 [see Videiko, Archaeological. . . , Fig.58], presumably of material from the Western part of the Ukrainian Crystalline Shield [Petrougne 1993:385-386]; and secondly, by two „battle-axes” typical of the late Tripolye graves.

The first artefact (type 1B) was discovered near graves 114-115-116 [see Videiko, Archaeological. . . , Fig.66:3], and consists of clinostatite andesite of microdoleritic texture, greenish-grey on the surface and almost black in a fresh fracture, presumably of the Carpathian origin (but not necessarily from the territory of the Transcarpathian region of Ukraine). Of similar origin is another prominent „battle-axe” (type 1) - from surface [see Videiko, Archaeological. . . , Fig.70], made of hypersthene andesite of similar microdoleritic texture; both materials belong to the effusive class, most probably to well-holocrystalline textures of a Carpathian type [Maleyev 1964:196].

Intrusive rocks are presented in the Sofievka cemetery by grey smallgrained biotite-hornblent granite, originating, most probably, from the Western Volhynia or somewhere to the South of the Kiev region [Granitoidnye 1984:Fig.4-5] used in a standard „battle-axe” found in grave 8 (type 1A) [see Videiko, *Archaeological. . .*, Fig.48:4]; by amphibolized, originally pyroxenic gabbro of relict ophytic texture in an artefact of a similar form „battle axe” (type 1A/B) - from grave 44 [Videiko, *Archaeological. . .*, Fig.55] (presumably from outcrops in the central part of the Ukrainian Crystalline Shield, along the Southern Bug, the Tikich river basin or the Uman - Novy Mirgorod pluton); and genetically related to it gabbro-amphibolite represented in a drilled polished and than intensively corroded broken „battle-axe” from grave 19 (type 2) [see Videiko, *Archaeological. . .*, Fig.50:2] featuring apodia-basic heterogranuloblastic texture and massive structure.

## 2.2. PEBBLES, WHETSTONE AND FRAGMENTS OF SANDSTONE

*Chernin.* Of ten smaller subellipsoidal pebbles found in grave 66 [see Videiko, *Archaeological. . .*, Fig.11], only three (IAF: No 91, No 92, No 97) feature traces of possible utilization represented by marks of beating or rubbing on the opposite edges. The material of the first of them, as well as that of similar pebbles No 88, No 89, No 90, No 94, No 95 is vein quartz (represented by samples of various colour, from glass-like to milky-white, multigrained, granulated, cataclastic, etc.), sometimes slightly ferrous. Pebble No 91 (judging from traces of wear, possibly, a stamper for grinding ochre) consists of smallgrained quartzitic sandstone with quartz contiguity cement. Unlike the others, pebble No 93 consists of smallgrained (0.2 to 0.7 mm) aplite or felsite-aplite (thin section study is required for more exact definition).

One with two pebbles from grave 90 [see Videiko, *Archaeological. . .*, Fig.31:1] (IAF: No 124) with unclear layered texture and one grinded-in working surface (currant-grinder) consists of quartz-feldspathic pyroxen-hornblend black firm smallgrained gneiss-quartzite of heterogranuloblastic texture and bearing features of cataclase.

All the aforementioned pebbles are, most probably, of local moraine origin.

*Zavalovka.* Peculiar for scarceness of its stone artefacts, this cemetery reveals, in addition to aforementioned items, two smaller pebbles: one, found in grave 16, [see Videiko, *Archaeological. . .*, Fig.75:5] of mylonitic quartzite sandstone of unclear layered structure (due to alteration of differently coloured layers up to 0.8 mm thick) with smaller negative cavities formed in the course of lixiviation of previously displayed minerals, according to a rather typical scheme of pseudomorphic formation [Grigoryev, Zhabin 1975:266]; and another pebble, found in grave 1 [see Videiko, *Archaeological. . .*, Fig.74:1] and represented by leucocratic migmatite-permatoid quartz-feldspathic aggregate of heterogranuloblastic texture.

Both artefacts (under 50 mm in diameter) bear no traces of utilization and, judging from their material, most probably represent local moraine pebbles, possibly moved by running waters.

*Krasny Khutor.* A thin flat whetstone from grave 127 [see Videiko, Archaeological. . . , Fig.37] was made of pricked out along layers grey-brown finequartzous-argillaceous (kaoline with fine distribution of ferric hydro-oxides) South-Western argillolith, generally, not more close than similar vend outcrops [Kopelyovich 1965:-27, Fig.1] - of the palaeozoic origin, or possibly Carpathian mezozoic-tertiary folded section.

*Sofievka.* Among the complex's sedimentary rocks, there are two fragments of light-grey quartz sandstone, displaying no traces of utilization, with quartz contiguity cement [see Videiko, Archaeological. . . , from destroyed graves] (IAF: No 436, No 437); the second fragment features small (up to 1 cm) imprints of lamellibranch mollusc shells; both fragments are presumably from the local tertiary sediment section. The latter is connected with two fragments of white low-firmness inequigranular arkose sandstone (on kaolinite cement) - from graves 79 and 92 [see Videiko, Archaeological. . . ].

Firm grey inequigranular arkose (almost quartzite-like) sandstone with quartzous-argillaceous pointed-ferrous contiguity -regeneration cement was used as material for a combined article (subsquare pestle-grinder, which also possibly served as a little anvil for cold forging - ?) - from surface of site [see Videiko, Archaeological. . . , Fig.72:2]. Possible origin of this artefact (presumably Western) remains unclear.

### 2.3. BEADS

A collection of beads gathered from the surface of blown sands of the Sofievka cemetery [see Videiko, Archaeological. . . , Fig.70] includes a fractured jet bead, most probably relatively new (19th century), as was earlier assumed by a recognized authority in the field, G.G.Lemmlein, due to the refraction factor close to similar constant displayed by raw materials of the Caucasian deposits. However, a toroidal bead of calcite aggregate with organogenous structure relicts (a relict shell?) can belong to the Enelithic period. Three cylinder-shaped pipelike beades of pale-olive organic material may also be associated with the late Tripolye monument group (as similar to materials of the Usatovo graves in the Alexandrovka barrow near Odessa, excavated with the author's participation in 1993). The aggregate refraction factor ( $1,610 \pm 0.002$ ) suggests possibly even Mediterranean origin (elevated character of gemmological raw material urges for considering these definitions to be preliminary, though necessary, since this information appeared in generalizing publications [Kruts 1977:121]).

### 3. CONCLUSIONS

Therefore, from the archaeological-petrographical point of view, the stones of aforementioned monuments can be split into five separate groups. In order of declining numbers of investigated samples these include: first, touronide or so-called „Volhynia” flint, tending, in primary deposit state, to the region of Upper Chalk sedimentaries (Fig.1) of Western Ukraine (which was imported to the Dnieper basin) [Pasternak et al. 1968:Fig.22]. Notwithstanding territorial proximity, not a single microscopic proof was found for utilization in the Kiev region graves smoky calcedony stuff from the Desna river basin (Fig.1), resembling, in appearance, some kinds of the Volhynia flint. Second, these are local rocks, mainly associated with moraine material of the Dnieper freeze [Veklych 1982:Fig.2] partially re-deposited (due to alluvial-fluvioglacial processes rocks, flint included). Third, intrusive and metamorphic formations of gabbro-amphibolite and gneiss group of the Southern Bug basin and Central (and possibly part of Western) part of the Ukrainian Crystalline Shield. Fourth, materials excavated somewhere in the Middle Dniester region and mouth parts of its tributaries located in the area. Fifth, effusion and, not excluded, also some sedimentary rocks of the territory of the Volcanic Carpathians to the West of the river Prut, which is also the origin location of such exotic material occurring in some other Tripolye monuments, as zadeitite [Petrougne 1994:256f.].

*Translated by Inna Pidluska*