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Among the various lithic raw materials processed by the Neolithic inhabitants of the Kyzyl-kums, Central Asia, milky white, porcelain-like material deserves special attention.[1] It is petrographically identified as chalcedonite often turning into opal (Michniak 1998; Szymczak, Khudzhanazarov, Michniak 2006: 590). This easy to recognize rock is usually non transparent, although it has fairly transparent, opalescent varieties (**Fig. 1**). In other cases it can bear a slightly yellowish, or pinky shade. Rarely, black or dark navy blue, a millimetre or so thick veins of intrusions appear in the uniform white rock mass. The cortex, when preserved, often has reddish or pinky yellow shade, but in general the cortex is naturally removed (washed up), and such surfaces bear traces of natural heavy damage: crushing, tearing off, etc.

The petrographic analysis of three samples of the raw material under discussion showed an exceptionally uniform structure without any, even single, spikes or microcaverns. On the microscopic pictures of thin sections observed under an optical microscope with polarized light, as well as on the freshly knapped surfaces observed under a SEM (**Fig. 2**), a monomineral, siliceous rock with excellently uniform micrograining could be seen. Diagrams of the microsound spectrographic data present the most pure silica with very rare, minor trace admixture of calcium (Ca) and magnesium (Mg) components. Also the roentgenographs show in all their range only pure quartz, without any other polymorphic varieties of siliceous minerals (Michniak 1998).

A problem of the location of the natural outcrops of white chalcedonite/opal has not yet been positively solved. Some premises could indicate that we should look for these outcrops probably in the most northern or northwestern part of the uplands of the Central Kyzyl-kums (the Bukantau and the neighbouring mountain chains). During our trip to that region in August 2002 in one of the gorges of the southern slope of the Bukantau Mountains we found a single natural, unworked fragment of white chalcedonite/opal pebble. It was most probably washed up and transported by seasonally flowing water (Szymczak, Khudzhanazarov 2003: 7). This is the only information which could indicate that the natural sources of the presented lithic raw material are situated somewhere in the northern Central Kyzyl-kums, and that during our trips there we could be not very far from them.

Many authors emphasize an important, or even leading role of white raw material in the Neolithic of the Kyzyl-kums: U.I. Islamov (Gulâmov, Islamov, Askarov 1966: 29–30), A.V. Vinogradov (Vinogradov, Mamedov 1975: 212), N.U. Holmatov (2004: 20). However, the intensity of its appearance is quite differentiated, both in time and space. The main aim of this paper is to show this differentiation and in that way to add some details to the picture of life of the Neolithic peoples of this part of Central Asia.

As far as chronology is concerned, the local Neolithic could be divided into three main phases: the early (Dariasai) phase, dated ca 6200–5400 BC, the middle (Tuskan) phase, dated ca 4000–3000 BC, and the late (Akčadaria) phase, dated ca 3000–2100 BC (note that the middle phase was formerly called the 'Džanbas phase' by A.V. Vinogradov (1981: 132), but, as we know now, its eponymous site should be dated from the Late Neolithic, so we had to propose a new name). An about 1.5 millennium settlement gap observed in Ayakagytma 'The Site', and probably in Učaši 131, is due to rise of the water level of the sea, which we called the Io Sea. By the times of the Early Holocene it covered a good part of the Kyzyl-kums, up to a contour line of ca 200 m above msl (Khudzhanazarov, Szymczak: 2006). The most characteristic typological marks of the Tuskan phase, among others, are: a presence of small shouldered points of Kelteminarian type, rhomboid inserts, and microlithic rectangles, while for the Akčadaria phase – points with flat, surface retouch on both faces, and/or large amounts of microperforators. None of these forms appear in the Dariasai collections.

The nomadic Kelteminarian groups, keeping not very far from the seashore, for many times were leaving and

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Table 1. The appearance of white raw material in the Tuskan surface collections gained during the 2004 survey from the area of the Tuskan Lakes (K. Szymczak).
Tabela 1. Występowanie białego surowca w powierzchniowych kolekcjach znad Jezior Tuskańskich.

No. of site	No. of finds of chalcedonite/opal	Total No. of lithic finds	Significant finds
Point 1	24	25	
Point 3	9	9	rhomboid insert
Point 7	8	8	
Point 10	88	131	Kelteminarian point
Point 13	61	86	Kelteminarian point
Point 14	14	16	
Point 17	13	20	rectangle

then coming back again to the same, or nearly the same place. Such a way of life led to a formation of dense clusters of sites in certain areas. In the Kyzyl-kums we can differentiate now fourteen such clusters. Their names, starting from the south-east, then northwards, and around the Io Sea, are as follows: 1. the Lavlâkan Lakes, 2. Ayakagytma, 3. Učaŝi (eastern Dariasai), 4. the Tuskan Lakes (Mahandaria), 5. Čorbakti, 6. Ečkiliksai, 7. Bešbulak, 8. Minabulak, 9. Bukantau, 10. Northern Aral, 11. Southern Ustiurt, 12. Uzboi, 14.Akčadaria, 15. the Amudaria's left bank; only Džebel, marked as 13, is a single, cave site (the numbers correspond to marks on **Figs. 3–5**). For Džebel, as well as for the Northern Aral, Southern Ustiurt, and Uzboi clusters, we do not have reliable data concerning a detailed raw material description.

Different character has a settlement of the contemporary Džejtun culture from the Kara-kums (Brunet 1998: 33). This unit is characterized by stable villages with quite sophisticated clay architecture, advanced farming and stockbreeding, painted pottery production, and art (Masson 1971; 1992; Charles, Harris, Limbry 1992: 98, 99). Nevertheless, sites of this culture also keep the 200 m above msl contour line (Masson, Sarianidi 1972: 54–55, see also: **Figs. 3, 4**).

The early, Dariasai phase of the Kelteminarian at present day is represented only by three assemblages from Učaŝi 131: House I, II, and III (Vinogradov 1981: 60–69, also Vinogradov, Mamedov, Suleržicki 1977), Ayakagytma 'The Site', lower settlement layer (Szymczak, Khudzhanazarov 2006: 47–55), and probably by some surface collections from the Lavlâkan Lakes, e. g., points marked as L-13 or L-326 (Vinogradov, Mamedov 1975: 212). In any of these collections we do not find even traces of white raw material using, which would suggest that during the earliest stages of the Neolithic local human groups did not know anything about this material (**Fig. 3**). Less probable is a possibility that the neighbours of Učaŝi, Ayakagytma and the Lavlâkan Lakes groups used chalcedonite/opal by that time, because it would have surely left its traces, at least as single imports.

The middle, Tuskan phase of the local Neolithic is represented by the collections from: the Tuskan Lakes, Čorbakti, Ečkiliksai, Ayakagytma, Učaŝi, the Lavlâkan Lakes, Bešbulak, Northern Aral, Southern Ustiurt, Uzboi, and Džebel (**Fig. 4**).

Based on surface materials we gained during our 2004 survey, the white raw material in the Tuskan collections from the area of the Tuskan Lakes always prevails. It is presented in **Table 1** (Szymczak, Khudzhanazarov, Brunet 2005).

Also the archaeologists formerly excavating in this area underline that on such Middle Neolithic sites as Darbazakyr 1 and 2 "dominated the best quality flint of milky white and yellowish-white colours" (Gulâmov, Islamov, Askarov 1966: 29–30).

According to N.U. Holmatov (2004: 20), particular concentrations from the Čorbakti cluster of sites have a similar character. He mentions a collection of Čorbakti 15A, where pieces of chalcedonite/opal are "in absolute majority". The same goes to the other surface series of finds, among which the rhomboid inserts appear.

Quite opposite is the situation with the Ečkiliksai cluster, which we visited in 1995. Among quite numerous artefacts from the area we found only a single white specimen, while in the most numerous (87 pieces, with one rectangle) collection from the Hodžagumbaz concentration (Szymczak, Gretchkina 1996: 107, 108; Szymczak, Khudzhanazarov 2006: 63, 64, pls. CII, CIII) we did not notice any objects of that kind.

In an upper settlement layer of Ayakagytma 'The Site,' which yielded an inventory in good part representing the middle (Tuskan) phase of the Kelteminarian, among a little more than 33 thousand lithic artefacts, we differentiated only 15 pieces produced of white raw material. Beside one flake, the remaining 14, with a Kelteminarian point and a rhomboid insert, were retouched tools of various forms (Szymczak, Khudzhanazarov 2006: 193–195; Szymczak, Khudzhanazarov, Michniak 2006: 591). It would indicate that they were imported to Ayakagytma, and most likely they mark some contacts between the local inhabitants and their neighbours, who had a direct access to the white material, and used it much more often.

Also in the area of Učaŝi white surface artefacts which could be attributed to the Tuskan phase are rather

rare. The first impression could be different, if we said that in our 64 surface pieces, with one Kelteminarian point, the collection from Učaši (survey in 2003), we have as many as 11 items made of white material. The fact is, however, that such pieces were more interesting for us than the artefacts of normal flint, so we picked them up much more often, and thus we cannot treat this collection as a random sample (Szymczak, Khudzhanazarov 2006: 64).

Interesting is the situation with Tuskan phase concentrations on the Lavlyakan Lakes. In such collections as: L-26I-IV (Kelteminarian points), L-102 (Kelteminarian points), L-120 (Kelteminarian point), or L-165, a good majority (well over 50%) of artefacts are made of chalcedonite/opal (Vinogradov, Mamedov 1975: 43, 54, 60, 63, 65, 104). There are even cases when the entire lithic collection is white: L-101 (30 pieces), or L-119 (100 pieces) (Vinogradov, Mamedov 1975: 52, 61). But also such collections are present, like L-24, or L-107, where chalcedonite/opal is represented by a few pieces only, similarly as in Ayakagytma 'The Site,' the upper layer (Vinogradov, Mamedov 1975: 29, 57).

From the badly mixed up Middle and Late Neolithic collections from Bešbulak 1, 14 and 15, some Tuskan phase elements could be differentiated only typologically (Čalaâ 1972). A.V. Vinogradov (1981: 100–101) mentions that they could be produced of flint, as well as of chalcedonite/opal, though in the same sentence he also admits that in all collections white material always clearly prevails. Thus, we can assume that by that time in Bešbulak white raw material was in common use.

If we look at a map now, we notice that we have three different zones, where the use of chalcedonite/opal took place: the southern (the Tuskan Lakes, Čorbakti), where knappers based on white material; the middle (Ečkiliksai, Ayakagytma, Učaši, in some part the Lavlâkan Lakes), where objects of white material appear only occasionally; and the northern one (the majority of the Lavlâkan Lakes, Bešbulak), where again white material plays a major role (**Fig. 4**). It is quite possible then, that we have to do here with three larger human groups, who surely knew about one another (imports), had common lithic toolmaking tradition, but economically were organized in quite different ways. Knowing nothing about the outcrops of chalcedonite/opal, we cannot say too much about the way it was so widely distributed (the distance between the Tuskan Lakes and Bešbulak exceeds 300 km), but coastal navigation is the first what comes to mind.

The concentrations of the late, Akčadaria settlements are present in the following clusters of sites: the Tuskan Lakes, the Lavlâkan Lakes, Bešbulak, Minabulak, Bukantau, Southern Ustiurt, Uzboi, Akčadaria, the Amudaria's left bank, and the single site of Džebel (**Fig. 5**).

In his description of the Late Neolithic (Eneolithic) materials with flatly retouched points and arrowheads from the Tuskan Lakes cluster, U.I. Islamov (Gulâmov, Islamov, Askarov 1966: 69) does not mention the presence of the white raw material. During our 2004 survey we did not find any clearly Late Neolithic flint artefacts, but with some collections where chalcedonite/opal was present (but not dominating) goes pottery which could be attributed to the Late Neolithic/Early Bronze Age. Thus, we suppose that by that time the local inhabitants could be still familiar with that rock, but its importance was limited (Szymczak, Khudzhanazarov, Brunet 2005).

The youngest concentrations from the Lavlâkan Lakes cluster do not give a clear picture. There are collections with flatly retouched implements, like L-62/II and L-62/III, where we note only single white artefacts (Vinogradov, Mamedov 1975: 93, 101, 102), while in the others, like L-106, L-219, or L-301 (with bifacial points, or microperforators) the white finds prevail, or at least are distinctly represented (Vinogradov, Mamedov 1975: 56, 60, 146, 159, 183, 185).

In generally Late Neolithic/Eneolithic collections from Bešbulak 1, 14 and 15 (bifacial implements, and a number of tiny perforators) the chalcedonite/opal artefacts are, according to A.V. Vinogradov (1981: 100–101), in overwhelming majority.

Quite opposite seems to be the situation with Minabulak. This cluster provided exclusively Late Neolithic collections, but no white items were noted. E.g., in published by us surface materials from Minabulak Site 2 (64 artefacts) and 4 (556 artefacts) with fine and very fine perforators, chalcedonite/opal pieces were completely absent (Szymczak, Khudzhanazarov 2006: 64–65).

In the exclusively Late Neolithic collections from Bukantau, with thick, perfectly fired pottery, again white items clearly prevail. Among the materials found by us in the area during a systematic survey in August 2002 (Szymczak, Khudzhanazarov 2003: 6–8; 2006: 66–68) the indices of white artefacts are as shown in **Table 2**:

Table 2. The appearance of white raw material in the Late Neolithic surface collections gained during a systematic survey in August 2002 from the area of the Bukantau Mountains (K. Szymczak).
Tabela 2. Występowanie białego surowca w późnoneolitycznych kolekcjach powierzchniowych pozyskanych w górach Bukantau podczas systematycznych badań w sierpniu 2002 r.

Site	No. of chalcedonite/opal finds	Total No. of finds	Significant finds
Bokhale	178	182	bifacial point
Urazli I	21	28	bifacial point
Urazli II	35	35	
Dzharylkap II	13	13	

The very rich Late Neolithic Akčadaria cluster with numerous bifacial pieces yielded chiefly the concentrations where chalcedonite/opal is well represented, but does not seem to play a leading role. According to A.V. Vinogradov (1968: 42), in a lower layer of the site of Džanbas 4, white artefacts are more rare than brown flint ones. The same goes to the collections from Džanbas 5, Džanbas 12 (ca 10% of white finds), and Kavat 7 (Vinogradov 1968: 54, 56, 88). In many surface collections white material is not present at all. Such a general situation was confirmed during a systematic survey in that region (2005–2009), but there are single collections where white finds prevail (annual reports edited by F. Brunet, M. Khudzhanazarov and K. Szymczak).

The cluster on the left bank of the Amudaria is quite similar to the above one. Chalcedonite/opal is present, but does not prevail. E.g., in the surface collection from Karrikyzyl 1, among a total number of 570 lithics we find 240 white ones – less than a half (Vinogradov 1981: 105).

Taking into account all what was said about the white raw material during the last phase of the local Neolithic, we could assume that the system of its long distance distribution somehow changed. Nevertheless, chalcedonite/opal still played an important role in lithic tools production (**Fig. 5**).

At the end we could try to summarize in a few sentences the Neolithic history of the Kyzyl-kums as seen from a perspective of chalcedonite/opal distribution.

During the early phase (ca 6200–5400 BC) white raw material seems to have been unknown to the Kyzyl-kums inhabitants, who were generally living by a coast of a vast water reservoir, today called the Io Sea. Only in the second phase (ca 4000–3000 BC) the outcrops of the material under discussion were discovered, probably somewhere in the northern part of the Central Kyzyl-kums. A purposefully created system of distribution of this rock allowed chalcedonite/opal to become the most important, basic lithic raw material during that period for the groups living in the northern (Bešbulak, the Lavlâkan Lakes), as well as in the southern (the Tuskan Lakes, Čorbakti) parts of the Kyzyl-kums. Only peoples from the middle part (Ečkiliksai, Ayakagytma, Učaši, in small part the Lavlâkan Lakes) did not have a direct access to this material, so they rather exchanged the ready products in small quantities than knapped it all by themselves. It would suggest that this group, or groups, could create a separate unit, economically different from those from the North and the South, though united by a common toolmaking tradition. During the Late Neolithic phase (ca 3000–2100 BC), when the Io Sea rapidly reduced its size to disappear completely, the clusters of sites representing a group, or groups inhabiting the middle part of the Kyzyl-kums, which did not have a direct access to the white raw material, vanished. In other clusters of sites, also in those new ones, located on the former sea bottom (Akčadaria, the Amudaria's left bank) chalcedonite/opal still played an important, although not always the most important role. Only in Bukantau, in the area being probably the closest to the outcrops, the white material still prevails in lithic collections. It seems as if a system of white material distribution had somehow changed, but was still quite effective. In the Bronze Age chalcedonite/opal most probably lost its importance; on the rare sites with numerous lithics from that period (e.g., the Kukayaz cluster of sites on the Uzbek-Kazah border in the northern Kyzyl-kums – examination in 2009) we find only single white artefacts. Generally, after vanishing of the Io Sea at the turn of the Late Neolithic and the Early Bronze Age, some 2100 BC, the Neolithic ways of life (stock breeding Kelteminarian, as well as farming Džejtunian) fell down, and people moved from the now arid steppe-desert area to the surrounding oases to build a new civilization.

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Dystrybucja mlecznobiałego chalcedonitu/opalu w neolitycznej kulturze kelteminarskiej Kyzył-kumów, Uzbekistan

W neolitycznej kulturze kelteminarskiej Kyzył-kumów istotną rolę odgrywał mlecznobiały surowiec kamienny, zidentyfikowany jako chalcedonit przechodzący w opal. Autorzy analizują intensywność jego użytkowania w poszczególnych horyzontach chronologicznych i poszczególnych zagęszczeniach osadniczych. Dochodzą do wniosku, że:

1) podczas fazy najstarszej osadnictwa kelteminarskiego (ok. 6200–5400 BC) społeczności ludzkie nie używały analizowanego surowca;

2) podczas kolejnej fazy (ok. 4000–3000 BC) biały surowiec miał podstawowe znaczenie w strefach północnej i południowej Kuzuł-kumów, podczas gdy w strefie środkowej pojawiają się tylko pojedyncze, importowane wyroby z niego wykonane, co sugerowałoby istnienie w ramach kelteminarienu odrębnych grup;

3) podczas fazy najmłodszej (ok. 3000–2100 BC) społeczności strefy środkowej Kyzył-kumów, które nigdy nie miały bezpośredniego dostępu do złóż białego surowca, zanikają, podczas gdy w innych zagęszczeniach osadniczych chalcedonit/opal nadal utrzymuje pewne znaczenie, lecz nie jest już surowcem dominującym, tak jakby system jego dalekosiężnej dystrybucji znacznie się zmienił;

4) od początku epoki brązu chalcedonit/opal był użytkowany jedynie okazjonalnie.

PLANSZA 13

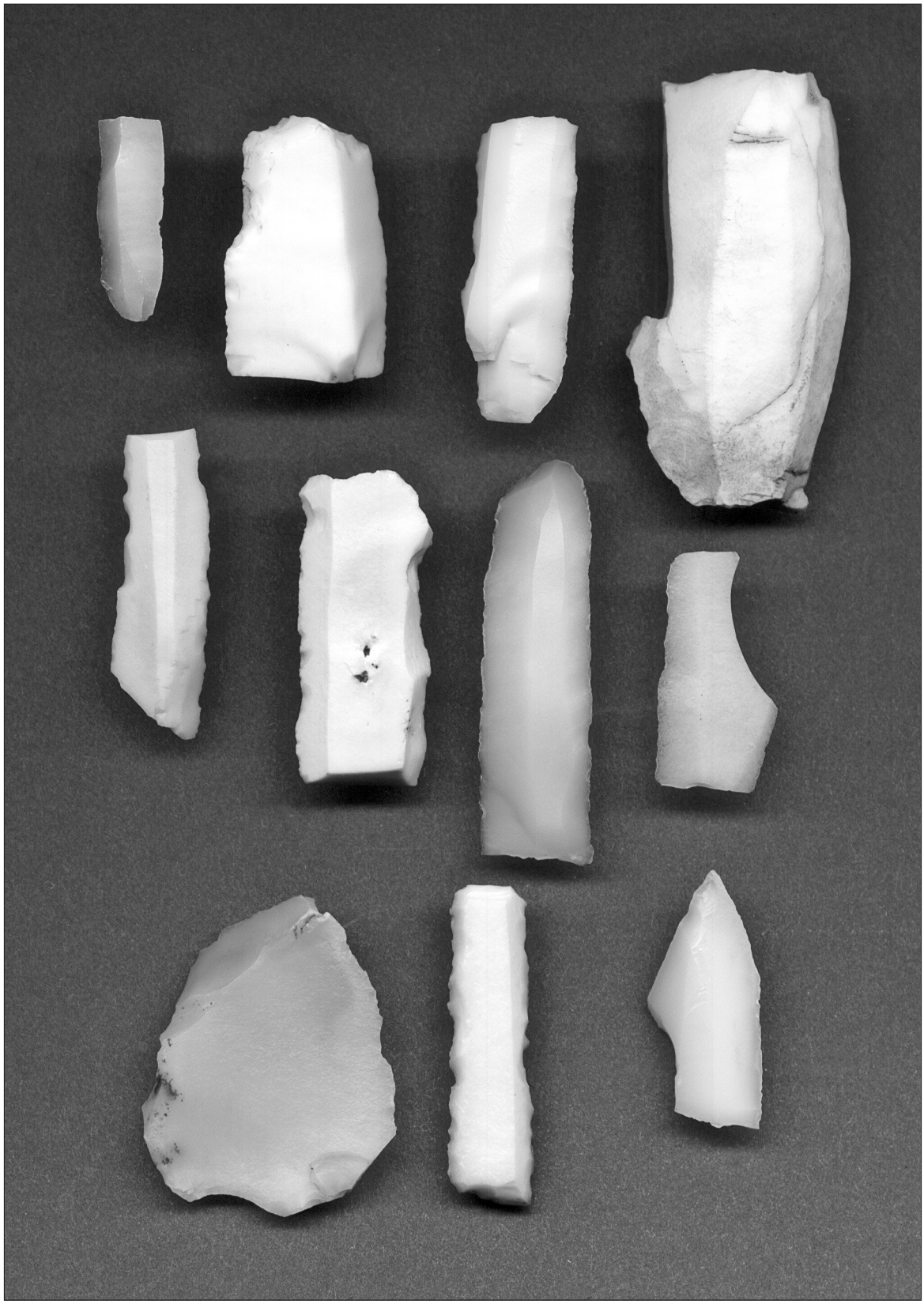

Fig. 1. Examples of artefacts produced of milky white chalcedonite/opal. Učaŝi and Ayakagytma surface finds (Photo K. Szymczak).

Ryc. 1. Przykłady zabytków wykonanych z mlecznobiałego chalcedonitu/opalu. Znaleziska powierzchniowe ze stanowisk Učaŝi i Ayakagytma.

PLANSZA 14

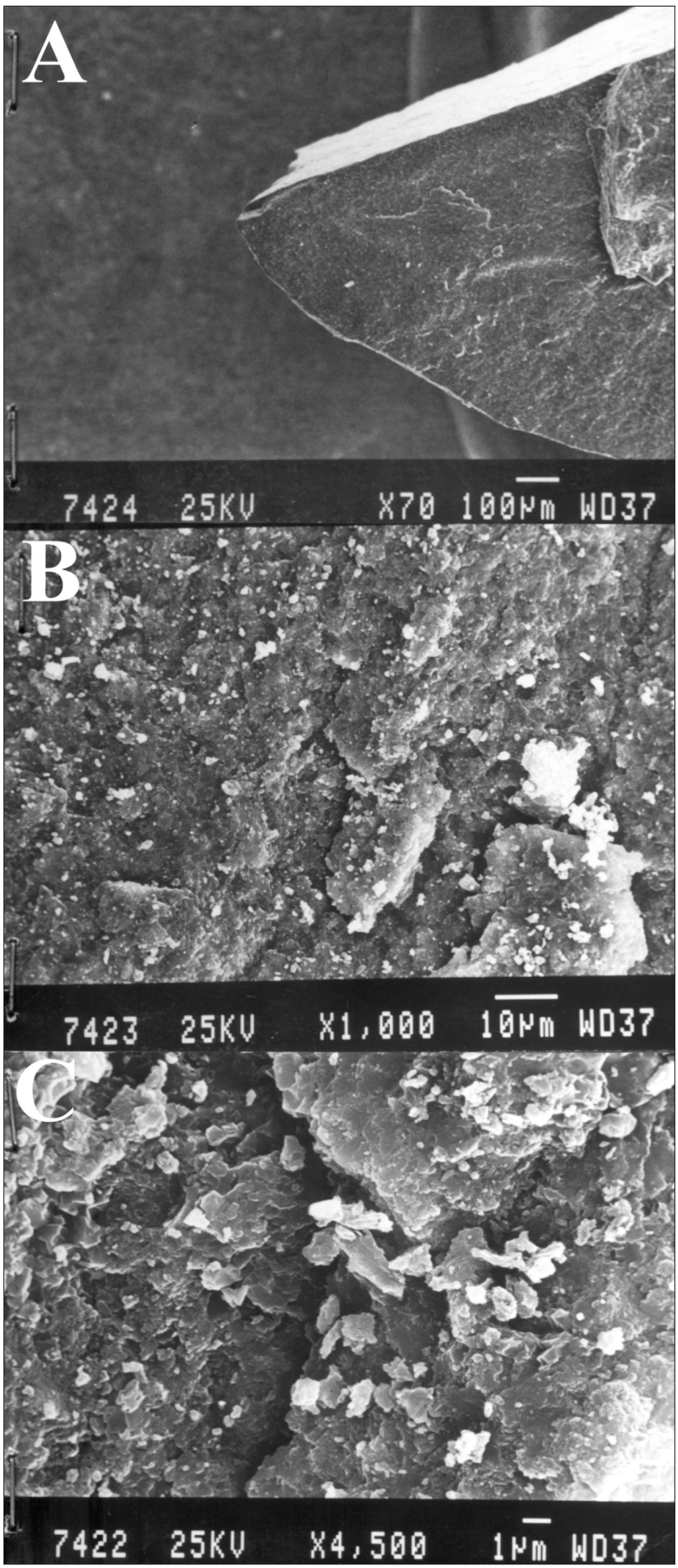

Fig. 2. SEM pictures of chalcedonite/opal showing monomineral siliceous rock with excellently uniform micrograining. Magnification: A – 70×, B – 1000×, C – 4500× (after Michniak 1998).

Ryc. 2. Obrazy SEM świeżych powierzchni chalcedonitu/opalu ukazujące monomineralną skałę krzemionkową z idealnie jednorodnym, drobnym uziarnieniem. Powiększenia: A – 70×, B – 1000×, C – 4500×.

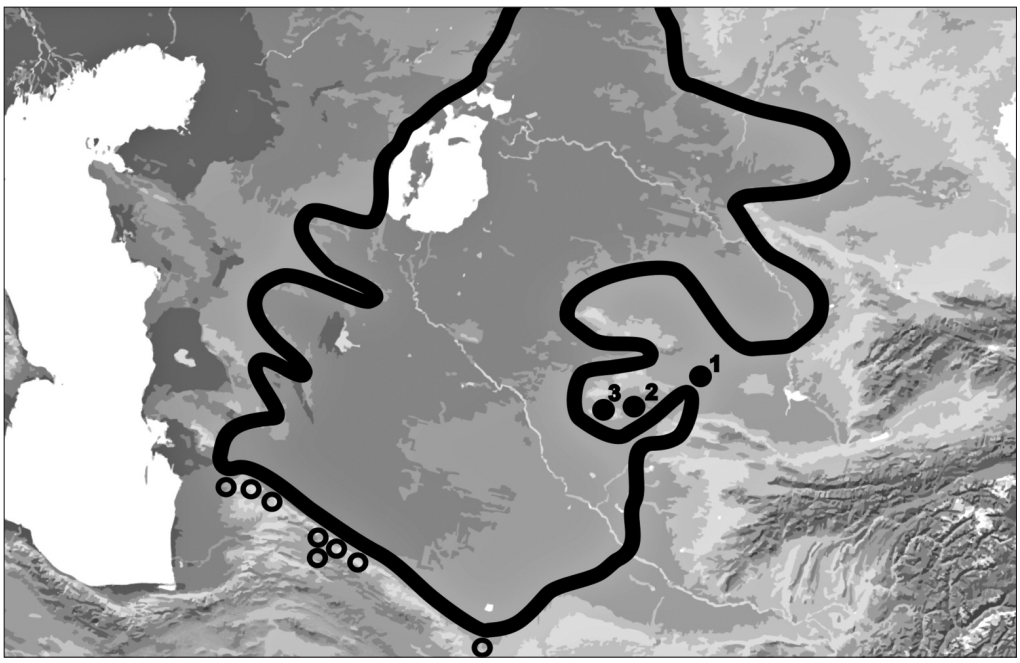

Fig. 3. Kelteminar settlement distribution during its oldest (Dariasai) phase. Bold line shows the run of the 200 m above msl contourline – the maximum range of the Io Sea. Empty dots mark the main sites of the Džejtunian culture along the Kopet-dag Mountain Chain. 1 – the Lavlâkan Lakes; 2 – Ayakagytma; 3 – Učaši (eastern Dariasai) (K. Szymczak and M. Przeździecki).

Ryc. 3. Rozprzestrzenienie osadnictwa w starszej (dairasaiskiej) fazie kultury kelteminarskiej. Pogrubiona linia pokazuje przebieg poziomicy 200 m n. p. m. – maksymalny zasięg morza Io. Puste kropki oznaczają położenie ważniejszych stanowisk kultury dżejtuńskiej.

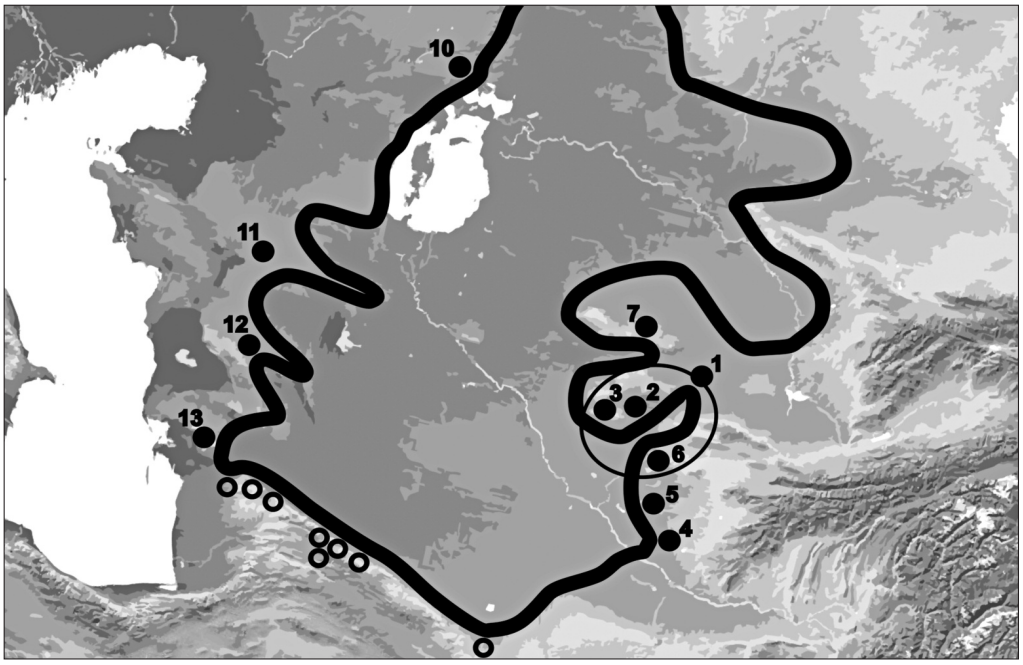

Fig. 4. Kelteminar settlement distribution during its middle (Tuskan) phase. The settlement clusters where white chalcedonite/opal appears only occasionally are outlined. Bold line sthe run of the 200 m above msl contourline – the maximum range of the Io Sea. Empty dots mark the main sites of the Džejtunian culture along the Kopet-dag Mountain Chain. 1 – the Lavlâkan Lakes; 2 – Ayakagytma; 3 – Učaši (eastern Dariasai); 4 – the Tuskan Lakes (Mahandaria); 5 – Čorbakti; 6 – Ečkiliksai; 7 – Bešbulak; 10 – Northern Aral; 11 – Southern Ustiurt; 12 – Uzboi; 13 – Džebel (K. Szymczak and M. Przeździecki).

Ryc. 4. Rozprzestrzenienie osadnictwa w środkowej (tuskańskiej) fazie kultury kelteminarskiej. Skupienia osadnicze, w których biały chalcedonit/opal występuje jedynie okazjonalnie są otoczone linią. Pogrubiona linia pokazuje przebieg poziomicy 200 m n. p. m. – maksymalny zasięg morza Io. Puste kropki oznaczają położenie ważniejszych stanowisk kultury dżejtuńskiej.

PLANSZA 16

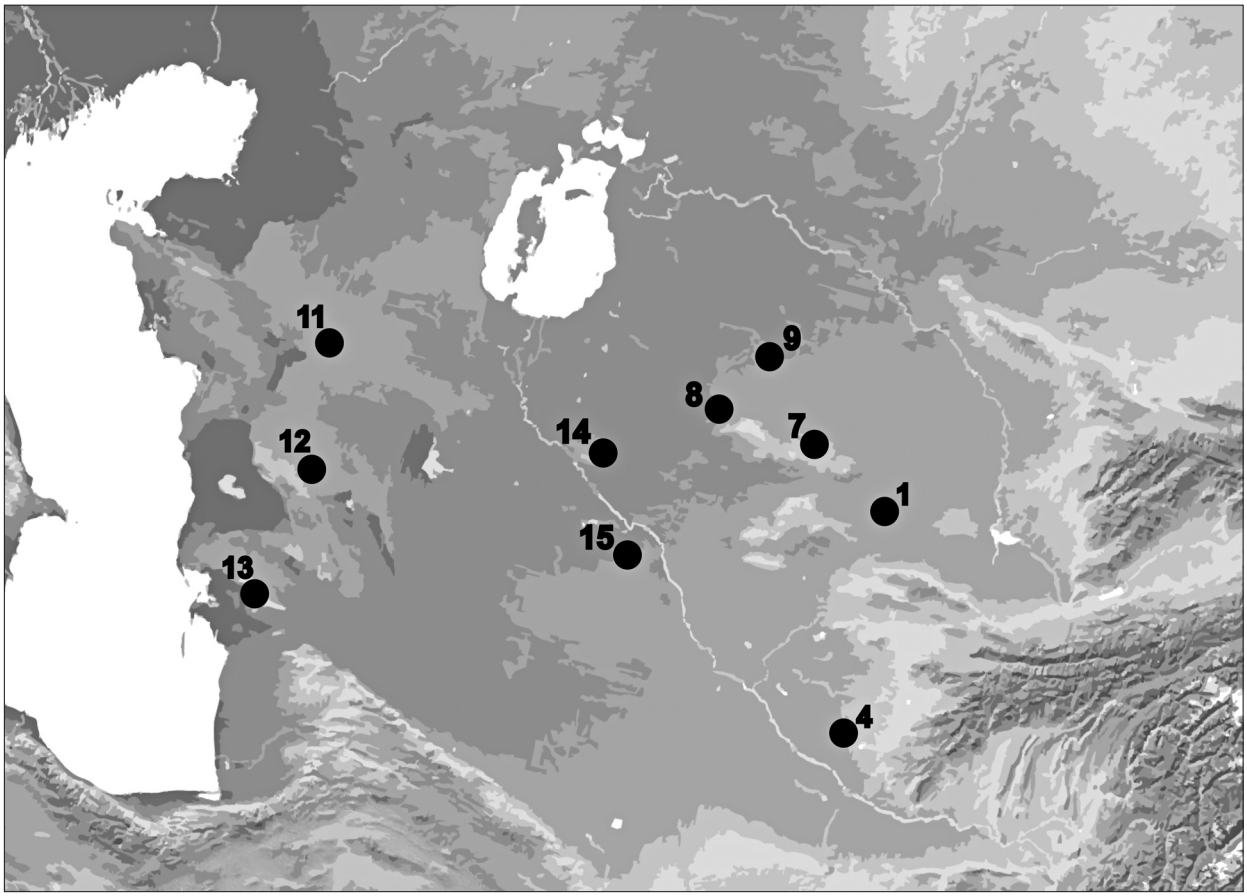

Fig. 5. Kelteminar settlement distribution during its latest (Akčadaria) phase; note rapid diminishing of the Io Sea. 1 – the Lavlâkan Lakes; 7– Bešbulak; 8 – Minabulak; 9– Bukantau; 11 – Southern Ustiurt; 12 – Uzboi; 13 – Džebel; 14 – Akčadaria; 15 – the Amudaria's left bank (K. Szymczak and M. Przeździecki).

Ryc. 5. Rozprzestrzenienie osadnictwa w późnej (akčadaryjskiej) fazie kultury kelteminarskiej; zwraca uwagę szybki zanik morza Io. 1 – Jeziora Lavlâkan; 7 – Bešbulak; 8 – Minabulak; 9 – Bukantau; 11 – Południowy Ustiurt; 12 – Uzboi; 13 – Džebel; 14 – Akčadaria; 15 – lewy brzeg Amudarii.