The importance of raw material factor for Final Paleolithic investigations in Trans-Baikal region (Russia)

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Резюме: В работе представлены результаты петроархеологических исследований, проведённых авторами на базе материалов памятников Усть-Менза I и II в Западном Забайкалье. Проведён полный анализ коллекций указанных памятников, который выявил, что артефакты из яшмы, кремня и халцедона доминируют в горизонтах стоянки Усть-Менза I, составляя 69% от общего числа. Для Усть-Мензы II кремень, яшма и халцедон также преобладают, совокупно составляя 59% артефактов, что близко к значениям Усть-Мензы I. Для выяснения источников этого сырья высокого качества были использованы данные о распространении этих горных пород в регионе. В результате было выяснено, что источники сырья были удалены от памятников Усть-Мензы на расстояния не менее 150 км. по прямой. Таким образом, мы полагаем, что отсутствие жизненно необходимых минералов и горных пород в значительной части территории Западного Забайкалья, вынуждало человеческие коллективы постоянно перемещаться, с целью пополнения запасов этого сырья

Ключевые слова: Ключевые слова: верхний палеолит, Забайкалье, петроархеология, перемещения в палеолите.

Abstract: *The results of petroarheological research conducted by the authors based on materials sites of Ust-Menza I and II in the Western Transbaikalia are presented in the given work. A full analysis of these sites' collections was made and proved that artifacts on jasper, chalcedony and flint (in total, 69%) dominate in the levels of Ust-Menza I site. Similar to the Ust-Menza I raw material data of flint, jasper and chalcedony also prevail (all together 59%) among the Ust-Menza II artifacts. To find out the source of these high quality raw materials the data on the distribution of these rocks in the region were used. As a result, it was found out that the sources of raw materials were removed from the Ust-Menza sites at a minimum distance of 150 km. in a straight line. Thus, we believe that the absence of vitally necessary minerals and rocks in the significant part of the territory of Western Trans-Baikal region forced Paleolithic humans to move permanently in order to replenish stocks of these raw materials.*

Key-Words: *Upper Paleolithic, Trans-Baikal region (Russia), petroarcheology, movement in the Paleolithic.*

1 INTRODUCTION

For more than a century, the study of Stone Age archaeological sites in Trans-Baikal region resulted in finding of a number of stratified sites geochronologically related to the time of Final Pleistocene - Early Holocene. As usual for Stone Age sites, tools were produced using different minerals and rocks. Namely, varieties of minerals and rocks do constitute a subject of the present study.

A series of books have been already published after the region's site excavations during last thirty years (e.g, Okladnikov &. Kirillov 1980; Konstantinov 1994; Lbova 2000; Tashak 2005). Almost all basic stratified Trans-Baikal Stone Age sites were described in the books. The main sites among some other ones are Studenovsky, Ust-Menzinsky and Ust-Kyakhtensky archaeological complexes, as well as Tolbaga, Podzvonkaya, Varvarina Gora, Hotyk, and Kamenka settlements that did serve for creation of some Trans-Baikal Stone Age industrial-chronological periodizations.

Although geological (Bazarov *et al.* 1982; Karasev 2001), spatial pattern (Razgildeeva 2003) and habitation structure (Konstantinov 2001) studies were realized for the region's sites, the priority was still devoted to stone artifact analyses. Namely, Paleolithic stone artifacts are used basic archeological method studies, such as typological, technological and functional approaches that can be named as "culture determined" methods allowing to differentiate stone artifact assemblages through techno-typological and functional features (Girya 1997). Along with these basic artifact studies, a little or almost no attention was paid to raw material varieties applied to stone artifact production for the Trans-Baikal Stone age sites. Also, any Paleolithic human migration possibilities have not been actually investigated for the territorially huge area.

It is well known that raw material data started to be studied with many special observations during ca. last 30 years with an emphasis on interrelations between Paleolithic human communities and surrounding paleoenvironments. For example, thanks to various mineralogical and petrographic analyses, a great attention is paid now to recognition of different flint outcrops used by Paleolithic humans and ways on bringing of raw material blocks and artifacts to archeological sites (e.g. Demars 1982; Dibble 1991; Miller 2001).

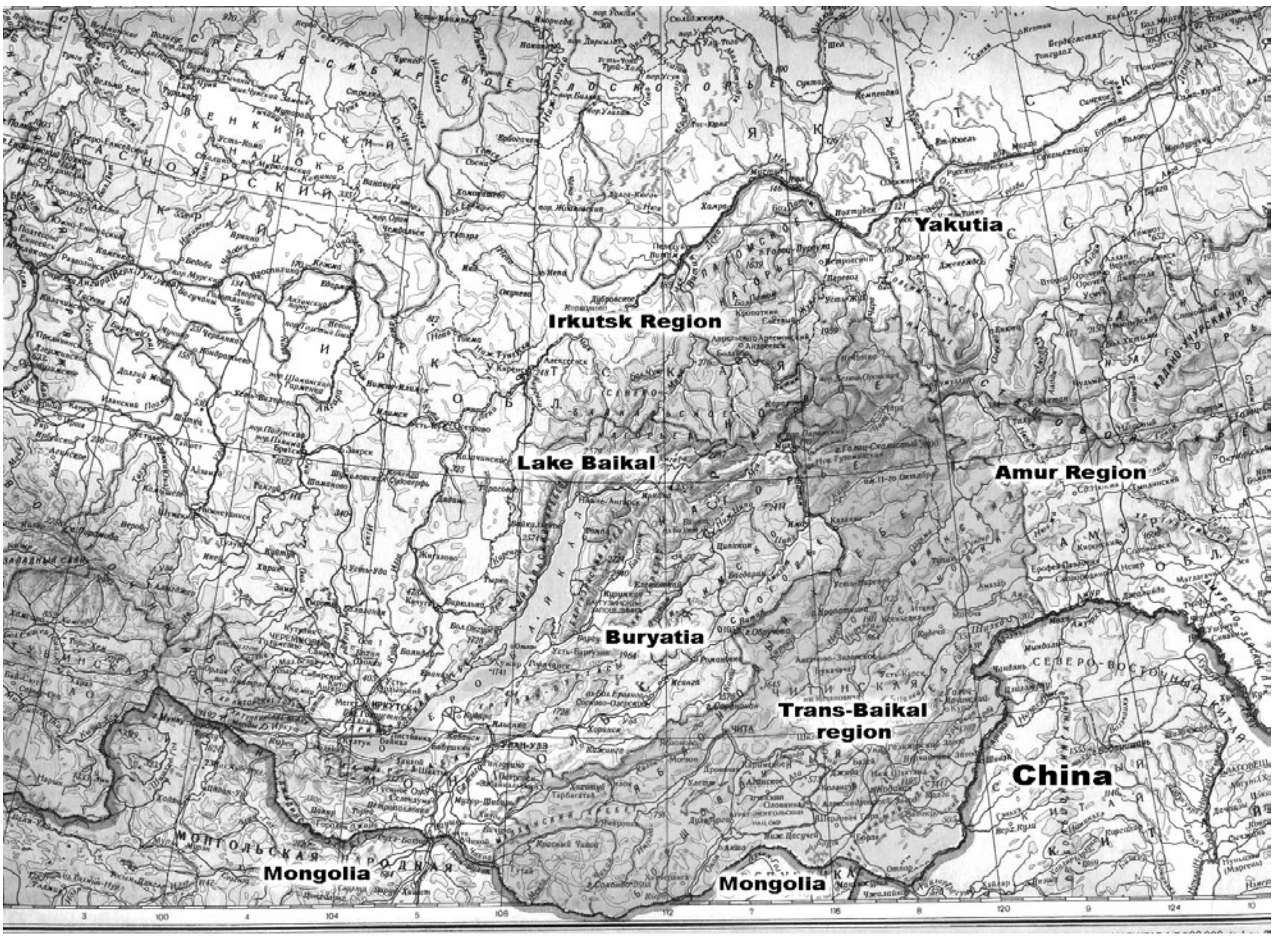
In the ex-Soviet Union, such mineralogical and petrographic studies have been organized much less extensively. However, it should be mentioned the name of V.F. Petrun, who even developed a concept of "archeological petrography" at the intersection of geology and archeology in Ukraine (Petrun 1990; 2000). At present time, some successful Paleolithic raw material studies have been already performed for some European Russian Paleolithic materials (see Otte *et al.* 2006; Matioukhin 2010; 2012) and Paleolithic materials in Altai region (e.g. Postnov *et al.* 2000). Some very special raw material studies have been also realized on Ural mountain region flint and jasper materials (Mosin & Nikolsky 2008) and on Far East obsidian data (Kuzmin & Glascock 2010).

2 A SHORT OVERVIEW OF TRANS-BAIKAL UPPER AND FINAL PALEOLITHIC

At the present stage of the Trans-Baikal Stone Age studies (**figure 1**), most researchers use the scheme developed by Mikhail V. Konstantinov. It was created by him after thirty years of field work and combines the Stone Age sites in the region on the basis of cultural, chronological and stratigraphic data. The scheme is a tripartite one with three stages for each important Stone Age epoch in the region, Upper Paleolithic, Mesoilithic and Neolithic (Konstantinov 1994).

By basic features of stone artifacts, Trans-Baikal Early Upper Paleolithic is characterized by two various primary flaking strategies corresponding to two different archaeological cultural traditions. On one hand, Kunaleiskaya culture demonstrates an archaic primary reduction directed to mainly flake production. On the other hand, Tolbaginskaya culture clearly features a blade primary flaking reduction. At the same time, both cultures do contain mainly Upper Paleolithic tool classes and types, although Kunaleiskaya cultural tradition is usually considered to have a less developed stone treatment characteristics. From the point of view of their tools and tool-blanks, both cultures are known through presence of a rather massive tools produced on large-sized flakes and/or blades. The cultures' chronology is placed into interval in between ca. 35 000 and 25 000 BP uncalibrated. Almost no attention was paid to raw material data used in stone treatment processes for the two culture sites.

FIGURE 1 Trans-Baikal region geographical position.



Middle stage of Trans-Baikal Upper Paleolithic is less studied in comparison to the Early UP one. The most known Mid UP sites are Masterov Klyuch and Melnichnaya 2. The sites' stone artifact assemblages are of specific characteristic being different from the Early UP ones in the region (Moroz 2002; Mescherin & Moroz 2003). The stage's main techno-typological characteristics are as follows: a clear both morphological and technological irregularity of blades; absence of any bladelet reduction; a dominance of tools on flakes; size of tools and debitage decreases in comparison to the respective data for the Early UP sites. Chronologically, the Mid UP stage is referred to the time span in between ca. 23 000 and 16 000 BP uncalibrated. Only some limited raw material data studies have been done for some site assemblages.

Late stage of Upper Paleolithic is very different from the two previous stages by both technology of core reductions and raw material data. A number of multilevel stratified sites (Ust-Menza 1–3, Studyonoe 1–2) demonstrate the appearance of bladelet technology, and namely, microblade technology. Microblades (1 – 3,5 cm long, no more than 0,5 cm wide, 0,1 – 0,2 cm thick) become the main debitage class. Various narrow flaked and wedge-shaped cores have been used for their reduction. The core and tool overall sizes reach their minimal indications during the Late UP stage (ca. 18 000 – 13–12 000 BP uncalibrated) that is well seen on materials from lower levels at Ust-Menza II site (Moroz 2007). An intensive raw material data study was realized for materials from Ust-Menza archeological complex.

In sum, there is a sort of the region's UP development during ca. 30 000 years represented by dozens of sites having in total several hundred archeological levels. Of course, each site and/or its level contain artifacts produced from different rocks and minerals. Traditionally, our archeologists have been only studied the following artifact data: technology of primary flaking processes, morphology and typology of tools. Much less attention was even paid to the size of cores, debitage and tools as there was a generally accepted opinion that the average size of artifacts was gradually decreasing from Early Upper Paleolithic until Neolithic. The "size decreasing trend" has been explained by cultural factors and a development of projectile hunting weaponry "insert technology" leading to so-called microlitization of stone assemblages through time. Along with this, artifact size studies were certainly at a "side road" of the Trans-Baikal UP assemblage investigations. The same can be said to the raw material data studies. As a rule, our colleagues were just noting basic raw material types occurred in such and such assemblage and indeed have never studied any possible interrelations for raw material types – technologies of primary flaking – tool formation processes.

3 RAW MATERIAL TYPES KNOWN FOR THE LATE PERIODS OF UP IN TRANS-BAIKAL REGION

First time for the Trans-Baikal Late and Final Paleolithic the present authors work on petrographic studies of artifact assemblages using materials from Ust-Menza archeological complex. Moreover, we do not study only some artifact samples but involve into the studies all artifacts from all sites and their archeological levels (Moroz 2008; Yurgenson & Moroz 2009). The situation with Ust-Menza raw material data (**figure 1**) can be summarized as follows.

Flint, chalcedony, prase, microslate, microquartzite, two-mica schist, rock crystal, quartz sandstones, quartz, volcanic glass, hornfels and jasper have been recognized for artifacts from 17 levels of Ust-Menza I site.

But artifacts on jasper, chalcedony and flint (in total, 69 %) do clearly dominate there and this tendency is traced for each level of site showing one and the same raw material pattern. Additionally, some more raw material data for particular tool classes are also very indicative for Ust-Menza I materials. End-scrapers on jasper (34 %) do prevail, while flint (23 %) and chalcedony (20 %) are equally less represented. At the same time, end-scrapers on microquartzite (13 %), microslate (7 %) and prase (3 %) are of minor importance. In most cases, scaled tools were made on flint (66 %). All Ust-Menza side-scrapers (*sic!*) have been manufactured exclusively on microslate. Burins were made on chalcedony (50 %), prase (25 %) and flint (25 %). Borers were equally produced on flint and microquartzite equally. Blades have been made on chalcedony and flint.

Ust-Menza II site's tool-kits do show a greater variability of used raw material types. Petrographic analyses have shown the following rocky types: flint, jasper, chalcedony, microquatzite, microslate, felsite, obsidian, albitophyre, sandstone, opal, chalcedony, granite, quartzite, metamorphosed diatomite, prase, lamprophyre, hornfels, quartz, rock crystal, porphyry and microcline. Similar to the Ust-Menza I raw material data, flint, jasper and chalcedony also do prevail (all together 59 %) among the Ust-Menza II artifacts. The total rate of microquartzite, microslate and hornfels is 18 % showing a rather important role of these rocks too. However, a share of each other raw material type is much lower and do not exceed even 3 %. At the same time, shares of different rocks for tool-kits within of Ust-Menza II levels are enough similar to the respective data for Ust-Menza I site. Chalcedony, flint and jasper collectively make up 70 % of tools of each level at Ust-Menza II. Such raw material data are not considered as accidental and are influenced, in our opinion, by primary flaking technological peculiarities.

There is a clear tendency to use certain types of rocks for tool production in all levels of the two sites. The priority of using of high quality rocks and minerals is unambiguously confirmed. Flint, jasper and chalcedony were of the highest value. These three raw material types dominate for about all tool classes. Most likely, high petrophysical properties of these rocks do explain it. First, hardness of jasper is more than 5.5, flint - 6, and chalcedony and praze - 6.5–7 units on the Mooca scale. Second, these minerals and rocks have small and microgranular structures (**figure 2**), also being in some cases with an aphanic structure. All of these characteristics are the most important when choosing a material for stone treatment processes. Grain size of any material is extremely important for treatment processes as nature of the rock structure affects the formation of Hertzian cone in an isotropic body, as well as then a behavior of fracture. The having microgranular and aphanic structures the used raw materials are almost perfect to obtain conchoidal fracture.

An interconnection between size of raw material types and produced tools is even more evident. Based on geology data, high quality Transbaikalia chalcedony and prase are formed in a view of tonsils (Yurgenson 2001). The tonsil length does not exceed 5–6 cm and the formed tonsils are not always a sort of volumetric nodule. As a rule, a chalcedony tonsil is a flattened piece with cellular surface structure, often containing voids, cavities and extrinsic inclusions that complicate to some extent its primary flaking, but still certain high petrophysical properties have been making it attractive for Paleolithic human primary and secondary treatments. Namely, small sizes of chalcedony and flint original pieces / nodules have actually led to the miniaturization of cores and debitage produced on these rocky materials by Late UP humans at Ust-Menza sites. Debitage more than 6 cm long from these raw material types are completely absent in the sites' assemblages and it was caused by not any cultural but raw material causes.

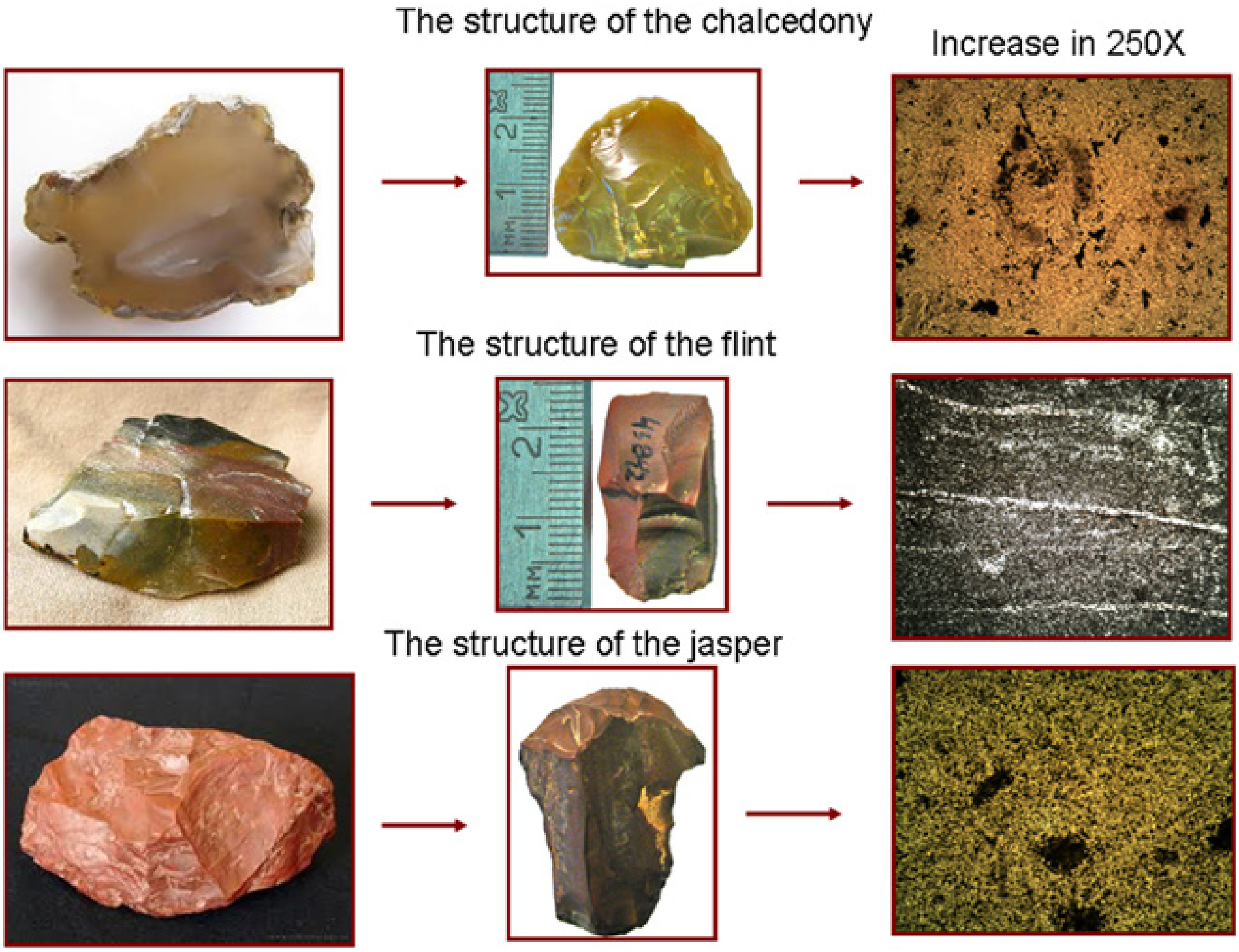


FIGURE 2 Trans-Baikal region's main raw materials and their structures.

Also, initial raw material pieces / nodules more than 6 cm long are extremely rare in the assemblages and, of course, even not each of them was good enough for a core formation and reduction. In such situation, microblade reduction seems to be an objective and easy technological solution, especially remembering that projectile inserts were solving problems of both raw material economy and easy renovation of the tool-kits.

The sites' assemblage artifact metrical parameters show clearly small sizes of tool made on chalcedony, flint and jasper from all archeological levels there. End-scrapers, scaled tools and debitage produced on these raw material types are equally miniature in all levels of the sites. Moreover, all tools made on high quality rocks have clear signs of multiple re-shaping of their working edges and also cores are extremely exhausted. We inclined to think that the basic cause of such "repetitive diminutiveness" is the size of initial raw material pieces / nodules that were not changing through time. It has also limited a set of technologies that could be applied to treatment of these raw materials. As a result, microblade reduction was the most suitable for the existing in the region's raw material types that brought its usage for a long time then, even including Trans-Baikal Iron Age time period. It was also a main reason why techno-typologically Trans-Baikal both Late Upper Paleolithic and Final Paleolithic are so similar one to another.

4 RAW MATERIAL AVAILABILITY FOR THE TRANS-BAIKAL FINAL PALEOLITHIC

But where were sources of the high quality raw materials? There was no answer for the question before our studies, however. That's why the present authors have conducted a special research on natural distribution of various minerals and rocks within Ust-Menza archeological complex. The complex has the most significant concentration of Final Paleolithic sites in Trans-Baikal region. Our research was based on the following factors:

- A number of cortical and semi-cortical debitage pieces in levels of Ust-Menza sites significantly prevails over quantity of debitage with parallel scar pattern;

- Dimensions of raw material pieces / nodules, used for production of particular tool or debitage class, directly dependent on type of a rock or mineral. The smallest in size residual cores are on rock crystal. Tools and debitage pieces on flint and chalcedony are no more 4 cm long. Jasper debitage pieces are usually in average 4 – 5 cm long, only rarely approaching 6 cm. Large-sized tools with the maximum size in 15 cm, side-scrapers and choppers, were generally made on microslate, microquartzite and lamprophyre;

- Raw material types used in stone treatment processes by human inhabitants of Ust_Menza sites are mainly represented by small- and medium-sized alluvial gravels and only rarely by some boulders up to 15 cm long.

Keeping in mind the enumerated factors, we have chosen an object for the study – gravels of 1st and 2nd terraces of Menza river. According to some geochronological data (Konstantinov 1994), fluvial gravels of the 1st terrace are dated to ca. 13 000 BP uncalibrated and fluvial gravels of the 2nd terrace are related to the time span in ca. 30 000 – 25 000 BP uncalibrated. Namely, this chronological interval in ca. 25 000 – 13 000 BP uncalibrated envelopes human occupations at Ust-Menza sites found in the alluvial deposits there. Accordingly, the sites' humans were able to collect easily various raw material types from the river's alluvial sediments. Therefore, there was analyzed a petrographic composition of modern pebble beaches of Menza river, as well as bars of creeks that flow into the river and bring coarsely fragmented bedrock materials in it, to trace a dynamic development of fluvial gravels during Final Pleistocene – Early Holocene. Sampling of different raw material pieces / nodules was done taking into account metrics of Ust-Menza sites' debitage and tool pieces.

Analyses of clastic rocks were repeatedly held in Trans-Baikal (Borsuk 1973), but they were of only geological *sensu stricto* character. That's why the analyses data have been adapted for our particular petroarcheological study. There were also established minimal and maximal metrics (3 – 15 cm) for the tested raw material samples. As a statistically reliable sample is considered to be a one with no less than 70–80 pebbles (Borsuk 1973:21), minimum number of studied samples was 100 items and larger samples were multiple to 100. In sum, there were studied 6 raw material type samples with the total 2 000 pieces / nodules collected within 20 km length of the river bank.

The most representative collected pebble sample was received on modern beaches of an island, located opposite the Ust-Menza sites. The sample includes 1 000 items. Taking into consideration the accessibility of large area to exploration, the island's beaches were subdivided into squares of 10 sq. m each and 100 pieces of pebbles and small boulders were collected at each of the square. This method with some modifications was also applied to other samples. Fluvial gravels of the 1st terrace were selected straight at excavation block of Peschanaya Tropa site (Ust-Menza - 8). Around 80 – 100 pieces were collected for each square meter there. Pebbles from the base of the 2nd terrace gravels were selected at the place ca. 5 km upper along the Menza river, where the river undercuts the terrace opening alluvium there. 40–50 pieces were gathered for each square meter there. Identification of clastic rocks, brought down by streams, was realized in the mouth and the bar of the creek, as boulders and pebbles found up the stream exceeded the selected metric standard. Most of the sampled pieces / nodules were determined macroscopically, whereas determination of the dominant rocks was done on 25 transparent sections served then as references for the rest of sampled items.

Modern gravels of Menza river provide the widest range of rocks: slate, microslate, granodiorite, granite, pegmatite, gneiss, microgneys, quartz, quartzite, microquartzite, metamorphosed sandstone, metamorphosed sandstone with separate secretions of quartz, and jasper.

The most numerous rocks in the sample are metamorphosed sandstones (32 %). The metamorphosed sandstones include two similar rocky types: metamorphosed sandstone (10 %) and metamorphosed sandstone with separate secretions of quartz (22 %). Both rocks were heavily metamorphosed why their petrophysical properties have changed to some extent. They have got a considerable hardness and viscosity in comparison to unmetamorphosed sandstones. Along with this, still having the fine-grained structure, the rock is not isotropic at all being not suitable for any treatment processes. As a result, this raw material type is only known through presence of a few tested pebbles and flakes, while tools are completely unknown on it.

The group of granites and gneisses occupies the second place, representing in total 22 % of the sample. It includes different types of granite (12 %), pegmatite (1 %), gneiss (1 %) and microgneiss (8 %). It should be noted that obtaining of conchoidal fracture by flaking of these rocks is practically impossible. That's why only hammer-stones do occur on granites and pegmatites. A chose of granite and pegmatite for a hammer-stone use is explained by the fact that the roundness coefficient of granite pebbles and pegmatite is the highest among all local rocks and is ca. 3 - 4 by the scale of Khabakov. These pebbles also have about perfect ellipse shape, enough weight and density to be hammer-stones. Unlike granite and pegmatite, gneiss and microgneiss were not used by Ust-Menza Final Paleolithic humans at all.

Granodiorite composes 6 % of the sample. It indicates a modest presence of it in the modern gravels but it is completely absent in the discussing archaeological collections. From the petrophysical point of view, this rock doesn't have the potential to be used as raw material by Paleolithic humans because it cannot produce debitage pieces with a good conchoidal fracture being in an intermediate position between the group of granites and quartzites.

Quartzite and microquartzite do compose in total 5 % of the sample. Both rocks are present in the discussing archaeological assemblages. Moreover, microquartzite was used for medium-sized blade production at Ust-Menza sites.

The rocks in the assemblages are characteristic by several varieties of color, ranging from dark gray to light green. Microquartzite, which occurs in modern gravels, has the best flaking properties in area. It has a microgranular structure without any heterogeneous inclusions. According to the Mooca's scale, the rock's hardness is no less than 5 units. The collected microquartzite pebbles of mikrokvartsit are in average no more 8 cm long, have a good roundness and a rich gray or light green color, as well as fresh surface when it is flaked. It was possible to easily get blades, bladelets and even microblades using a quartz hammer-stone with almost no special core preparation in a course of our experiments. As petrographic analysis testifies, the microquartzite was widely used by humans of Ust-Menza sites. Moreover, this rock was predominantly recognized for blade / bladelet *sensu lato* debitage and tools made on it and the tiniest chips, where the latter items clearly indicate intensive on-site tool re-sharpening processes and its significant importance for the sites' Final Paleolithic humans.

Quartzite composes 2 % of the sample. This rock is of much less flaking properties in comparison to the microquartzite, but it was, however, often used for short end-scraper production at Ust-Menza sites. Also, blade / bladelet *sensu lato* reduction is almost impossible on quartzite.

Lode quartz composes 4 % of the sample. It occurs in a view of large-sized pebbles and also small- and medium-sized boulders in Ust-Menza area. Despite the fact that the lode quartz is a hard material for flaking, a few end-scrapers on the material are present among assemblages of Ust-Menza II site. Also, lode quartz debitage is known in almost every assemblage of Ust-Menza sites. According to the petrographic analysis, lode quartz from the archaeological assemblages is identical to the one collected by us in the modern gravels why it surely has the local origin.

Lamprophyre pebbles are very similar visually to local microslate but it is much more solid and viscous that makes it more difficult to flake. However, lamprophyre was used for some flake and short blade / bladelet production. Also, tools on lamprophyre do compose 3 % at Ust-Menza II site. The same share in 3 % of lamprophyre is known within the modern gravels too.

Slate and microslate make up 13 % within the modern gravels. Slates at pebble beaches of Menza river are mainly composed of quartz-feldspathic material mixed with amphiboles. Such properties have given a considerable strength and viscosity for the slates that, however, make it very difficult for flaking. That's why debitage pieces received from these slates are very fragile due to the shale their inner structures. They were almost not used for knapping like metamorphosed sandstones.

Microslate and microquartzite are the best local rocks suited for knapping. Due to its microgranular shale structure, these rocks can produce very plain debitage pieces along the rocks' microlayers. Therefore, it can be used for producing blade / bladelet *sensu lato* debitage, as it did happen for the Ust-Menza site assemblages. Shares of tools on microslate are enough representative – 14 % for Ust-Menza I and 7 % for Ust-Menza II. At the same time, share of microslate in the modern gravel is 10 %. It occurs in the form of elongated wand black pebbles up to 10 cm in size and small boulders of also elongated form up to 14 cm long. Local microslate has a high content of biotite, which gives the cortex and fresh flaked surface a characteristic dark color. It also has an elongated or teardrop shape of pebbles, distinguishing it visually from other raw material types.

Jasper also looks different from the other rocks, having a distinct red color. It composes 3 % of the studied sample. By petrophysical characteristics, jasper has the best flaking properties among all local rocks. It has a microgranular structure and uniform composition, and gives a conchoidal fracture during knapping. But despite all the positive properties, jasper was rarely used for tool production at Ust-Menza sites. It is explained by two reasons. First, the size of jasper pebbles in the collected sample does not exceed 5 cm, and the majority of them are 3 - 4 cm long. Second, jasper also has a strong internal fracturing. The latter fact was noted during the material knapping that virtually eliminates it from any blady reduction that is also confirmed by the Ust-Menza assemblage data. No one Ust-Menza microblade core, blade, bladelet or microblade occurs on this sort of jasper. It is interesting to note that bladey debitage was produced on wax and dark gray jasper, which is, however, absent in all samples of pebble materials.

Thus, of 14 types of rocks that form the modern pebble beaches, 8 varieties, such as microslate, too-mica slate, granite, quartz, quartzite, lamprophyre, micro-quartzite and jasper were used by Ust-Menza Final Paleolithic humans. Granite pebbles were used as hard hammer-stones. Too-mica slate was probably used, as abrasive and grinding stones because of its structure. The other rocks in rare cases were used for production of flakes, but none of them was used for the microblade reduction.

It is established that the number of rock varieties encountered in modern gravel deposits and Pleistocene terraces, as well as the balance between their raw material types is about the same (Yurgenson & Moroz 2009, 2011). The composition of rocks in stream offsets entirely repeats the identified spectrum of terrace gravels by their structures and parts. Now it can be argued that the nature of the raw material resource base in Ust-Menza area has not undergone any visible changes for at least 25 000 years, and their basis were local indigenous rocks forming the sides of Menza river valley. And only a small portion of these rocks was used for tool production due to a high level of so-called paleotechnological adaptation (Moroz 2009). The most important point of our study is also that the rocks and minerals making up the raw material foundation of industries such as wax and gray colored jasper, flint, chalcedony, prase and rock crystal at the Ust-Menza sites were not found even in a single copy in any of the studied samples of local raw materials. It clearly indicates their absence in river gravels of the area.

Thus, these rocks and minerals were non-local raw materials for humans of Ust-Menza sites. The gravel study of Menza river area does not provide an answer to the question about the origin of chalcedony, flint and jasper, representing more than 60 % of artifacts at the sites' assemblages. For solving the problem it is possible to use geological data on occurrences of significant silica rocks and minerals at the present level of their erosion.

Chalcedony, being almost pure silica, is geologically the result of crystallization of melts with a high content of silica in volcanic rocks, and it occurs in andesites and basalts in a view of small phenocrysts - tonsils. During the destruction of volcanic rocks by various agents in the course of million years, chalcedony, as the hardest mineral, enters into detrital material and under the influence of the gravitational drift flows into streams and rivers. Therefore, chalcedony is objectively absent in the areas where there are no igneous rocks, so-called "parent rocks".

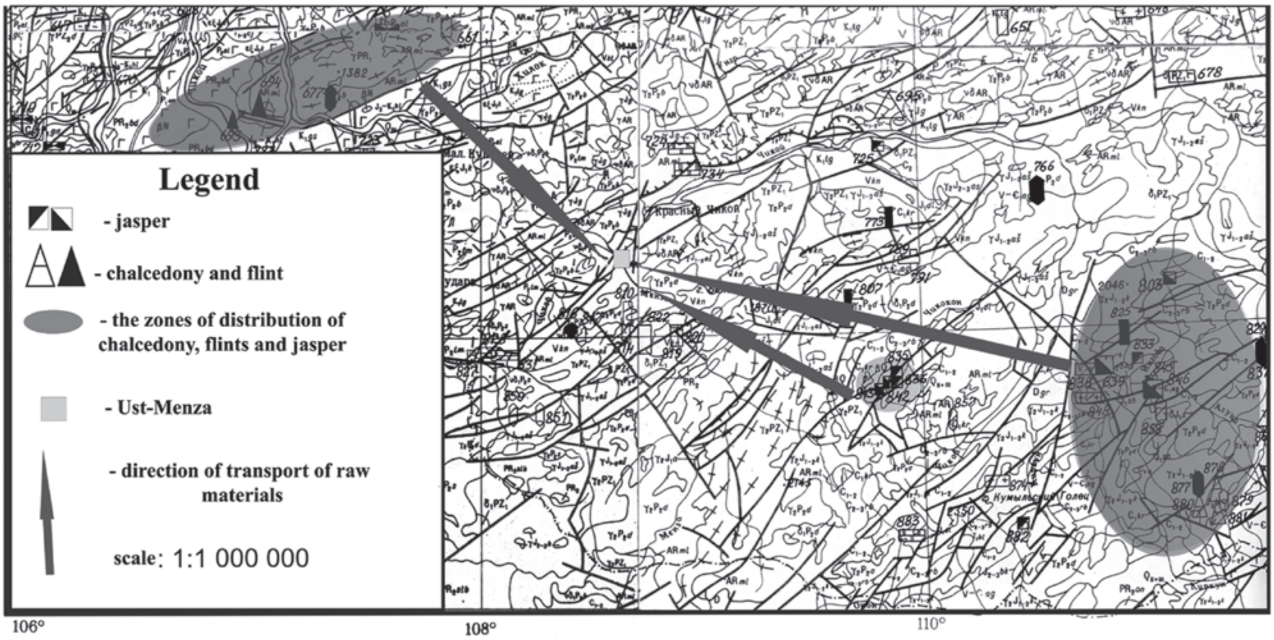


FIGURE 3 Basic distribution areas of stone raw materials in Trans-Baikal region.

According to some Trans-Baikal data (Yurgenson 2001), it should be young volcanic rocks, effused during Jurassic or Cretaceous periods, as ancient volcanic rocks went through metamorphism leading to a change in flints and chalcedonies contained therein. That's why it is possible to predict presence of this raw material with a fairly high degree of accuracy.

Such work was carried out by our region geologists. There was prepared a map of semiprecious raw in Trans-Baikal, including Western Trans-Baikal region), administratively belongings to the Republic of Buryatia. The rocky materials around Ust-Menza sites with radius no less than 60 km are ancient metamorphosed sedimentary rocks and intrusive igneous rocks that excludes presence of chalcedony and high-quality flint in the area. The closest area with volcanic rock distribution is known to the west along the right bank of Khilok river that is no less than 150 km from Ust-Menza sites. Second zone of volcanic rock distribution is located to the east, ca. 170 km from Ust-Menza sites (**figure 3**). Due to the mountain ranges, the water transportation of raw material from the "western zone" is excluded. The contact with the "eastern zone" is also excluded as the rivers that do originate in that area belong to the Amur river basin, and there is Zachikoyskaya mountainous country between Ust-Menza and "eastern zone" (**figure 3**).

High-quality jasper is absent in Ust-Menza region either. Brick-red colored jasper was known to humans of the discussing sites, but it was indeed used occassionally. The preference was given to high-quality wax and gray jaspers, which are a part of Ryabinovskay series of Ingodinsky geological formation (Yurgenson 2001, 2011). Moreover, the known locations of these jaspers almost coincide with the boundaries of the "eastern zone", although the closest source of the jaspers is located in the upper stream of Chikokon river (the inflow of Chikoi river) at a distance of ca. 70 km away from our sites.

5 BRIEF CONCLUSIONS

The conducted research allows us to make the following observations.

Stone artifact assemblages of Ust-Menza sites that are type sites for the region's Final Paleolithic are based on chalcedony, flint and jasper. Their total share in many assemblages at Ust-Menza I and II sites approaches 70 %.

Due to the lack of sources of these high quality raw materials near the Ust-Menza sites, Final Paleolithic humans were bringing debitage pieces, already made tools and cores on these raw materials to the sites. It is indirectly confirmed by almost complete absence of pre-cores and initially flaked cores at the sites.

Because of small initial sizes of raw material, the stone assemblages have "microlithic" characteristics, with length of debitage pieces and tools no more than 6 cm, being in average ca. 3 - 5 cm long.

Large-sized tools were made on local materials, mainly on microquartzite and microslate with also some produced on lamprophyre, quartz, quartzite, granite, and metamorphosed sandstone.

The deficiency of high quality raw materials have certainly forced Final Paleolithic humans to extremely careful handling of the tools made on such rocks and minerals. It is reflected in permanent reshaping of the tools' working edges, until their heavy wearing.

Thus, we believe that the absence of vitally necessary minerals and rocks for a significant part of the territory of Western Trans-Baikal region forced Paleolithic humans to move permanently in order to replenish stocks of stone raw materials. It definitely affected the nature and structure of the analyzed artifact assemblages. Raw material factor seems to be one of the major reasons of human displacements in the Western Trans-Baikal region, as there was no other way to get the needed for treatment processes raw materials. Short-term residence characteristics for archeological levels at all multi-layered Final Paleolithic sites in Western Trans-Baikal region do also indirectly confirm our assumption.

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