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TECHNOLOGICAL EXPLORATION AND RITUAL USE OF OBSIDIAN IN ANCIENT CULTURES OF THE PACIFIC

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Abstract. The article examines a range of directions and current stage of obsidian studies within the Pacific basin such as (1) geochemistry, identification of volcanic glass sources used in ancient cultures; (2) technology, obsidian exploration methods, their evolution, as well as experiments, and (3) cultural context, the use of obsidian in ritual practice, in the format of prestigious technologies, and in decorative art. While the geochemical studies have reached significant progress within the Pacific basin two other directions obviously require further development. Experimental works, conducted in 2020–2021 in Primorye, allow making useful observations both about the peculiarities of the local raw material base and about the behavioral side of the knapping process (such as the process of teaching and learning of knappers' competencies). In turn, the study of cultural meaning of obsidian includes not only the interpretation of the archaeological artifacts of high quality from the burials and caches (ritual, prestige, nonutilitarian), but also addressing to the ownership of the raw material sources, trade/exchange mechanism, and the status of the highly skillful knappers in ancient and traditional societies.

Key words: Pacific, Paleolithic, Neolithic, obsidian, exploration, prestige technologies, experiments, behavior

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ТЕХНОЛОГИЯ ОБРАБОТКИ И РИТУАЛЬНОЕ ИСПОЛЬЗОВАНИЕ ОБСИДИАНА В ДРЕВНИХ КУЛЬТУРАХ ПАСИФИКИ

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Резюме. В статье рассматриваются основные направления изучения обсидиана в тихоокеанском бассейне, включая (1) геохимическое, нацеленное на идентификацию источников вулканического стекла, использовавшегося в древних культурах; (2) технологическое, связанное с анализом методов обработки обсидиана, их эволюцией, а также экспериментами, и (3) культурный контекст, использование обсидиана в ритуальной практике, в формате престижных технологий и в декоративном искусстве. В то время как в геохимическом направлении достигнут серьезный прогресс, два других направления требуют дальнейшей разработки. Серия экспериментальных работ, проведенных в Приморье в 2020–2021 гг., позволила сделать весьма полезные наблюдения как по поводу особенностей местной сырьевой базы, так и по поводу поведенческой стороны процесса обработки обсидиана мастером и учениками (таких как обучение и наработка компетенций). В свою очередь, изучение особой роли обсидиана в культуре предполагает не только интерпретацию артефактов исключительного качества из кладов или погребений (ритуальная, престижная, неутилитарная), но и обращение к таким сюжетам, как контроль над источниками сырья, механизмы торговли/обмена, а также особый статус особо искусных мастеров по обработке камня в древних и традиционных обществах.

Ключевые слова: Пасифика, палеолит, неолит, обсидиан, обработка, престижные технологии, эксперимент, поведение

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Introduction

The Pacific basin is characterized by increased volcanic activity and widespread magmatic effusive materials. These include obsidian (volcanic glass), which is formed during rapid cooling of lava. The water content in obsidian is not more than 1%, which determines its uniformity and, accordingly, the possibility of artificial use — in the process of percussion and retouching, as well as polishing. In fact, all ancient and traditional cultures of the Pacific, since the time of the initial settlement, have used obsidian to one degree or another in tool and ritual activities, in the manufacture of jewelry, and in trade and exchange operations.

All these processes are known for the Russian Far East and adjacent territories of Korea, China, and Japan. As for the Russian part the use of obsidian is traced from the Final Pleistocene (15–14,000 BP) and during Early and mid-Holocene periods (10–5, 500 BP) (Popov, Tabarev, 2008, 2017; Popov, Tabarev, Mikishin, 2014; Tabarev, 2014).

Within the framework of Pacific archaeology, the study of obsidian can be divided into three interrelated directions:

— geochemistry, identification of volcanic glass sources used in ancient cultures, tracking the directions and distances of obsidian movement in different epochs — modern methods of analysis allow obtaining data based on minimal samples. A separate place in this direction is occupied by methods of dating artifacts according to the degree of hydration;
— technology, obsidian exploration methods, their evolution, as well as experimental studies that allow reconstructing the features of blade, microblade, flake and bifacial techniques, as well as various behavioral aspects of the operation of this type of raw material — in this case, the characteristics of raw materials (nodule size, quality) are extremely important;
— cultural context, the use of obsidian in ritual practice, in the format of prestigious technologies, symbolism and mythological meaning of volcanic glass of different color and texture.

On the territory of the Russian Far East, the systematic studies of obsidian started in the 1990th (Glascock et al., 1996; Kuzmin et al., 1999; Shackley et al., 1996). To date, there are real progress in geochemistry and technology of volcanic glasses used during the Stone and Paleometal periods in Primorye, the Amur Region, Sakhalin, Kamchatka, Chukotka, as well as in adjacent territories of the Japanese Archipelago and the Korean Peninsula, the bibliography includes several dozen works (articles, monographs, reports) in Russian and foreign languages (for example, Gillam, Tabarev 2004; Kuzmin, 2005, 2012; Kuzmin, Glascock, Sato, 2002; Kuzmin et al., 2021).

Recently, both Russian and foreign experts (Freund, 2013; Kuzmin, Oppenheimer, Renfrew, 2020) have been evaluating the achieved results of obsidian studies and determining the prospects for further research. It should be noted that this mainly concerns the first of the above-mentioned directions — it is about expanding the database and developing geochemical methods.

In turn, it seems to us extremely important to determine the perspective for studying the technology of processing volcanic glass, experimental research, and the role of obsidian in the cultural context (ritual, art, contacts and exchange). In Russian archaeological literature this aspect has only been outlined so far and, to a large extent, is based mostly on the materials from foreign territories.

Experiments and Some Observation on the Knappers' Behavior

The technological/experimental direction involves a detailed study of the entire technological sequence (*Chaîne opératoire*) of the relationship between man and raw materials — from the search and sampling of material at the outcrops to the production of tools and their disposal during economic activity:

— search and selection of material, its preliminary testing;
— transportation (transfer) from the sources to the camps or living areas;

— selection of tools (hammerstones, abraders, pressure flakers etc.);
— blanks production (blades, microblades, flakes) within the framework of various percussion systems and techniques (Tabarev, 2012);
— manufacture of tools (edge and fascial retouching, burination, grinding, etc.);
— their rejuvenation and final disposal in the course of economic activity.

Fig. 1. Experiments with obsidian: 1 — tested obsidian pebble, Ilystaya River, Primorye; 2 — instrumental set for experiments

Рис. 1. Эксперименты с обсидианом: 1 — тестированная обсидиановая галька, р. Илистая, Приморье; 2 — инструменты для экспериментов

Fig. 2. Experiments with obsidian: 1 — bi-polar percussion with the anvil and hammerstones; 2 — results of bi-polar percussion

Рис. 2. Эксперименты с обсидианом: 1 — биполярное расщепление с наковальней и отбойником; 2 — продукты биполярного расщепления

As an example, let us consider an interesting experience of experimental workshop for exploration of obsidian on the base of the Steklanukha archaeological project in Primorye in 2020–2021.

The natural outcrops of obsidian are found on the Shkotovsky Plateau in the south of Primorye. From volcanic glass there are deposits of pillow lavas and their individual fragments formed about 12–22 million years ago. When destroyed, lava beds give many fragments that

are carried by water and settle in river sediments, forming secondary sources (from rolled pebbles), which people have been guided by since the end of the Paleolithic (15–13, 000 BP). In the described experiment, the upstream of the Ilystaya River was chosen for searching of raw material (Fig. 1.-*1*).

The next stage was the preparation of working tools from antler and stone — hammerstones and anvils, which were assembled on nearby pebble river banks, taking into account the optimal size, configuration and weight. The percussion of obsidian pebbles was carried out in the format of two techniques: by bipolar splitting (hammerstone and anvil) and direct impact percussion using a hammerstone. Further processing of the obtained blanks was performed by pressure (edge and fascial) retouching, as well as burning with the use of pressure flakers armed with antler or copper tips (Fig. 1.-*2*).

The type of raw material — obsidian pebbles (3–10 cm) — predestined the leading technique — bipolar reduction (Fig. 2). This technique is well-known in archaeological contexts not only within the Pacific but in global scale and was studied in details including the experimental format (Ebert et al., 2015; LeBlanc, 1992; Shott, 1999).

The participants of the experiment were divided into three groups — (1) an experienced knapper who conducted introductory instruction and training in the format of a masterclass; (2) students and schoolchildren without experience, and (3), during the second year of the experiments, senior students of the Novosibirsk State University and the Fareastern Federal University, who were familiar with the basics of making obsidian tools and have the opportunity to work independently (Fig. 3.-*1*). In addition to experience, other factors influenced the quality and speed of mastering skills — body size, strength hands and fingers, right or left preference of the leading hand (considering the fact that the instructor was right–handed), predisposition, attention to detail, concentration, motivation, etc., everything that could affect the qualitative and quantitative characteristics of the results in the past.

It is noteworthy that high physical endurance is not required to work with a stone, the accuracy of fine motor skills, the perseverance of the student and the spatial understanding of the performed movements are much more valuable. Such a predisposition of a person was revealed during training. Correct working posture, clear statement of movements and stable position of the workpiece in the hands of the knapper — these requirements and their quality depended both on the correct explanation by the instructor and on the desire of the student to get clear positive result of the experience of working with a stone. With proper training, consisting of several stages (introductory part, safety techniques, body positions and techniques of obsidian percussion), each participant had the ability to independently manufacture a tool (scraper, cutting tool, burin, small point etc.) (Fig. 3.-*2*). On average, it took about 25–40 minutes to create one experimental sample. With the development of skills, this time is significantly reduced.

We also note the importance of the objective factor — if in 2020 there were no problems with the collecting of raw material, while in 2021 we met with the limitation of obsidian pebbles, and the pebbles themselves were smaller (in other words — the model of the so-called "stressful situation"). The consequence of this was the need to be neat with raw material, which, in turn, affected the size of the final tools. So, during the first season, a collection of tools with an average size from 2 to 10 cm along the maximum axis was obtained, and during the second — in the range from 2 to 6 cm only.

Fig. 3. Experiments with obsidian: 1— pressure flaking produces by students with basic competencies; 2 — instruments, produced in frames of the experiments

Рис. 3. Эксперименты с обсидианом: 1 — отжимное ретуширование в исполнении студентов с базовыми навыками; 2 — орудия, изготовленные в ходе экспериментов

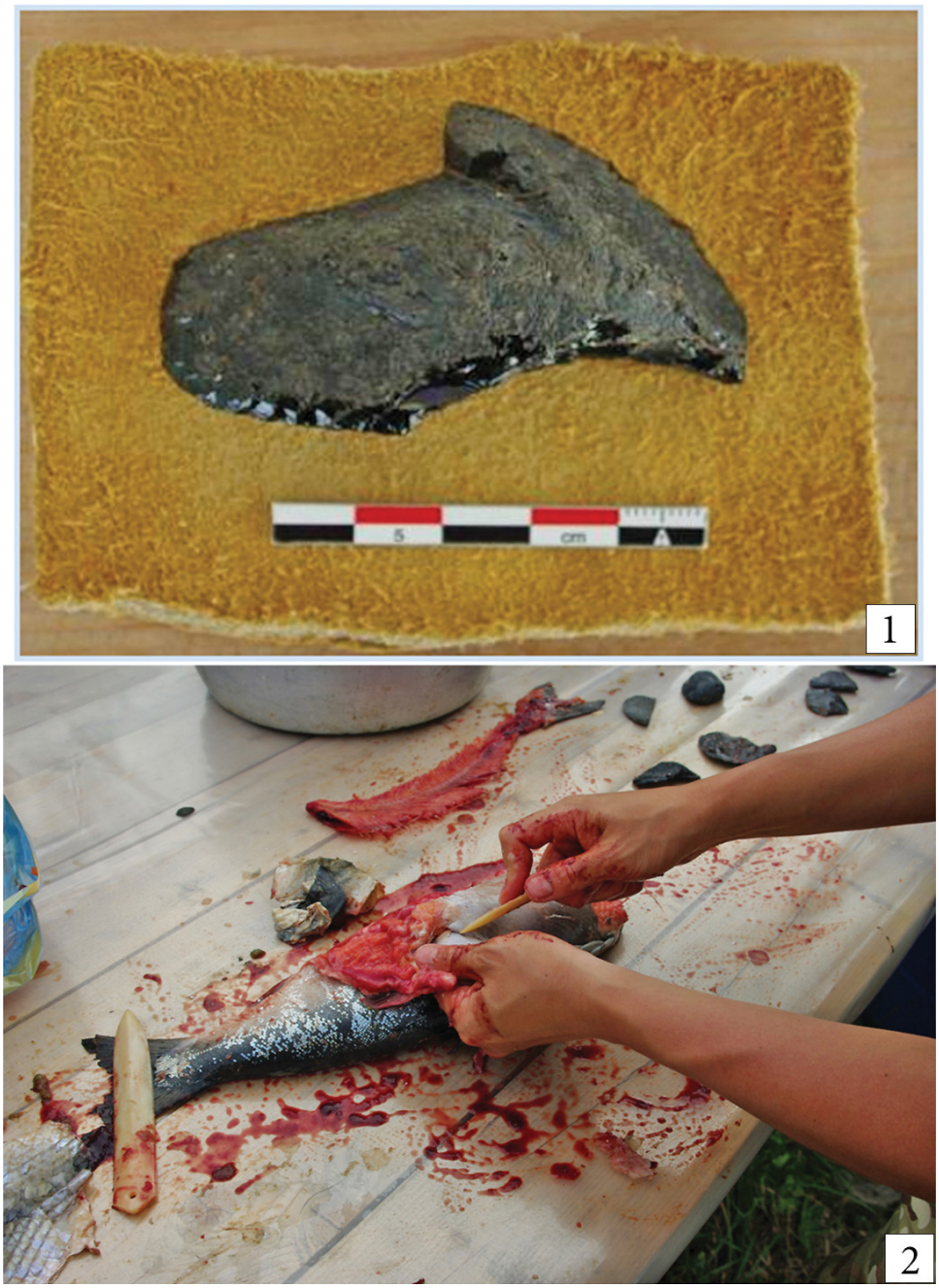

Fig. 4. Work with experimental tool: 1 — fishing knife;
2 — red fish processing with obsidian and bone knives

Рис. 4. Использование экспериментальных орудий: 1 — рыбный нож;
2 — разделка рыбы с помощью обсидиановых и костяных инструментов

We also had the opportunity to test experimental tools in food processing — fish cleaning and chopping. Working edge of the tools (combined knives) turned out to be very sharp due to the quality of raw material and careful processing techniques (Fig. 4.-*1*). When cutting fish, the tools matched their task, but the obvious disadvantage of using obsidian tools is its fragility, the danger of small particles of volcanic glass getting into the fibers of food should not be excluded. In such case bone knives well-known from the ethnographical records are of better choice (Fig. 4.-*2*).

Thus, the experimental study of obsidian, in addition to technological data on the characteristics of a particular type of raw material, allows us to obtain interesting information related to the cultural context and to the behavior — the process of learning and acquiring skills, individual character and abilities, the effectiveness of tools in work (products of hunting and fishing) etc.

Cultural Context: Some Archaeological and Ethnographical Examples

Cultural interpretation of obsidian proposes special technological analysis of the archaeological materials with the recognizing of utilitarian and nonutilitarian (prestige) technologies (Hayden, 1998). Prestige technologies may be traced in the collections as: (1) the utilization of obsidian only for specific types of tools; (2) the production of obsidian tools (points, knives, blades) of unusual size, form and configuration; (3) the presence of obsidian artifacts of high quality in burials; (4) the production of decoration objects from obsidian (mirrors, bracelets, pendants, beads, figurines etc.).

Such facts have been preliminary registered in the archaeological materials for the Paleolithic (Ustinovka culture, Ogon'ki culture) and for the Neolithic (Boisman culture, Zaisanovka culture) which with the information on the distribution of obsidian from the sources allows suggesting intensive cultural exchange and use of obsidian in decorative art and rituals. For example, at Boisman-2 Site (7–5,000 BP) large obsidian biface (20, 5 cm) with extremely high level of pressure technique was found between forearms of woman (22–25 years old) in Burial #4 (Popov, Tabarev, 2008, 2016; Tabarev, 2009) (Fig. 5). The source of this obsidian is Paektu volcano, which is about 300 km from the coast.

Another illustration of the prestige meaning of obsidian artifacts comes from Sakhalin Island — two big polyhedral obsidian cores (black and red colors) were found as a kind of separated complex (cache?) during the excavations of the Early Neolithic (9–8, 100 BP) Slavnaya-5 Site. They demonstrate the hallmark of pressure blade technology on the obsidian which was brought to Sakhalin from Hokkaido sources (about 300–350 km) along with the "red-black" symbolism well known in the mythological systems over the North Pacific coasts and match the category of "lithic caches" described in details for the territory of the Japanese Archipelago both for the Paleolithic and Jomon periods (Tabarev, Ivanova, Kanomata, 2021).

For example, elaborated technologies of huge obsidian biface production were traced by some Japanese archaeologists in the Final Paleolithic (18–12,000 BP) on Hokkaido. Unique sizes and such distinctive details of face preparation as overshot flaking makes it possible to compare them with the finest examples of Solutrean leaf bifacies in Western Europe (22–17,000 BP). Focusing on the technological similarities American archaeologists Dennis Stanford and Bruce Bradley built the hypothesis about the possible migrations of Solutreans to North America. From their point of view such similarities as big leaf shaped bifacies and caches of big points

are common only for the Solutre and Clovis cultures (Bradley, Stanford, 2004). Close analysis of fareastern assemblages (Russian Far East, Japanese Islands) gave enough facts about the existence of such technologies and about the chances to discuss with Stanford and Bradley about the uniqueness of "Solutrean-Clovis" similarities (Kornfeld, Tabarev, 2009).

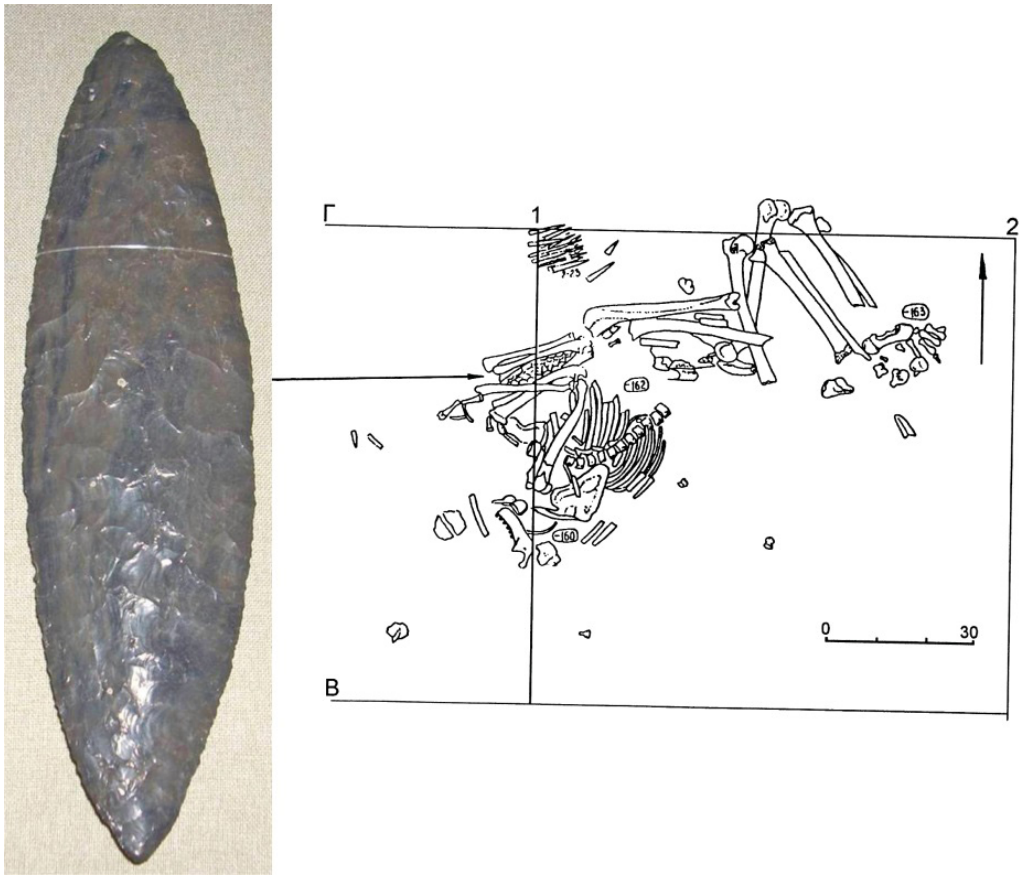

Fig. 5. Obsidian biface from the Neolithic burial at Boisman-2 Site, Maritime Region, Russian Far East

Рис. 5. Обсидиановый бифас из неолитического погребения на памятнике Бойсмана-2, Приморье, Российский Дальний Восток

It is important to underline that in many cases archaeologists should be very careful using terms "trade" or "exchange" (Kuzmin, 2005). For example, for Sakhalin Island we have tons of obsidian transported from Shirataki region (Kuzmin, Glascock, Sato, 2002) and almost no information about any goods transported from Sakhalin to Hokkaido which allows interpreting just "distribution" and not "exchange". From our point of view, it may be just an argument that people from Hokkaido were doing hunting and fishing on the northern territories during warm seasons of the year and used to take obsidian with them to make and to fix hunting gear.

On Hokkaido the distribution of obsidian from the sources and the types of artifacts (preforms, blanks, finished tools, debitage) were traced over dozens of sites and localities. In many

works of Japanese archaeologists, it was explained as "network" and "symbol of exchange" (e.g., Kimura, 1998) while there are no archaeological evidences of any equivalents of the obsidian. Of course, we may speculate that such equivalents were of organic and perishable nature, and they were totally destroyed by highly acidic Fareastern soils but in any case, this requires additional researches and arguments.

Fig. 6. "Flint-carrier" — participant of the White Deer Skin Dance with obsidian biface. Reconstruction on the base of photos of E. Curtis by Y.V. Tabareva

Рис. 6. «Носитель» — участник танца Шкуры Белого Оленя с обсидиановыми бифасами (графическая реконструкция Ю.В. Табаревой по фотографии Э. Кёртиса)

Archaeological and ethnographical correlations with the other territories and periods over the Pacific may be of special value for reconstructions of obsidian use in the Far East. For example, obsidian industry and raw material distribution known for sites around Mt. Edziza in British Columbia (Canada) with developed bifacial and burin techniques which are dated much younger than Fareastern materials but morphologically identical (Fladmark, 1985).

Very interesting example — ritual use of large (up to 70–90 cm) red and black obsidian bifacies in ceremonial practice (dances, magic, display of social status, burials) among North

Californian Indians (Yurok, Karok, Hupa, and Tolowa groups) (Fig. 6). Recorded by ethnographical and archaeological materials this phenomenon has its origin in the Paleoindian times and relates to the initial peopling of America (e.g., Gould, 1985; Kroeber, 1925; Powers, 1877; Rust, 1905). The similarity of "red-black" obsidian artefacts used in ritual context on the opposite coasts of Pacific matches with this model.

It is also important to pay special attention to the information about the traditions of the obsidian mines and quarries usage. Ethnographical and historical records gave very interesting pictures about the ownership relations of tribes living near and far from the sources (Hodgson, 2005). In most cases the sources were opened for public but also examples of conflicts, and even warfare among the Indians were described (Heizer, Treganza, 1944). Some ethnographical records include the information about professional obsidian knappers and point-makers along with the traditions of transportation and exchange (Hughes, Bettinger 1984). These facts may be of high value for the interpretation of the exploration of obsidian in the Fareastern region during the Final Paleolithic — Early Neolithic times.

Conclusion

The role obsidian (volcanic glass) played in ancient societies has long been a topic of interest to archaeologists, anthropologists and geologists. As it was postulated above three principal direction of obsidian studies could be recognized — geochemical, technological (including experimental part), and cultural. While the geochemical studies have reached significant progress within the Pacific basin two others directions obviously require further development.

In case of experiments, the ideal conditions exist where there is an abundance of high-quality raw materials (Japanese Archipelago, Bismarck Archipelago, American Northwest Coast, California). In the Russian Far East, and in Primorye in particular, the experimental works always will be limited by the quality and quantity of obsidian pebbles. From the other hand, this gives the rare chance to explore all the advantages of bipolar technique — simple way of percussion and high variability in the transformation of products of percussion into effective tools (end and side scrapers, backed knives, perforators, burins etc.). It also allows making useful observations about the behavioral side of the knapping process.

The study of the cultural meaning of obsidian includes not only the interpretation of the archaeological artifacts from the burials, caches and decoration items but also addressing to the ownership of the raw material sources, trade/exchange mechanism, and the status of the highly skillful knappers in ancient and traditional societies. To get a full picture of these phenomena, it is necessary to refer to archeological and ethnographical data on other regions of the world (Near East, Africa, and Europe).

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