Current Projects of the Institute of Archaeology Russian Academy of Science for the Study of Paleoart

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Abstract. The article focuses on the research conducted by the staff the Palaeo Art Centre of the Institute of Archaeology of the Russian Academy of Science on the comprehensive documentation and study of rock art sites from various regions of Russia. During the years 2014–2022, rock art projects were successfully implemented in Russia, including its most remote parts, such as South Ural, Transbaikalia and the Amur region. Our report will focus on two important projects: Petroglyphs of the Lower Amur and Ussuri (Far East, the Amur region) and Kapova cave (South Ural). These monuments have been nominated for the UNESCO World Heritage List and in 2014–2021 significant efforts were made to promote these rock art sites as cultural heritage and to research with use of new remote approaches to documenting and subsequent processing of data of rock art.

Keywords: study of paleoart · rock art sites · cultural heritage

1 Introduction

During 2014–2022, rock art projects of the Palaeo Art Centre of the Institute of Archaeology of the Russian Academy of Science were successfully implemented in our country, including its most remote parts, such as Ural, South Siberia, the Amur region, and Chukotka. One of our most significant achievements in recent years has been the widespread use of new remote approaches to documenting and subsequent data processing.

Our report will focus on two important projects: Petroglyphs of the Lower Amur and Ussuri (Far East, the Amur region) and Kapova cave (South Ural).

Since 2014, the petroglyphs of the Amur-Ussuri province of rock art have been monitored by the Institute of Archaeology and the Remote Sensing and Spatial Data Analysis Laboratory (Moscow). The project was triggered by the observed deterioration of Amur valley sites, affected by the pressure of increased touristic activities and periodical flooding of boulders with petroglyphs. Field works over Far Eastern sites were aimed at accurate and throughout mapping and documenting of sites and surfaces by means of aerial photography of unmanned aerial vehicles, ground photography, laser scanning and photogrammetric processing of digital photographs.

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Kapova cave (Shulgan-Tash), located in the Republic of Bashkortostan, is one of the largest karst caves on the western slope of the Southern Urals. Well-known for its paintings, Kapova Cave is also an archaeological site with extensively dated Upper Palaeolithic cultural layers in which ochre pieces were found in spatial association with artefacts and structures. The description and geochemical characterisation of pigment pieces allow us to differentiate those processed by grinding, crushing, hand formation and calcination. The results show the various activity involving pigments that indicate the great importance of the red ochre for the upper-Palaeolithic cave visitors and a deep knowledge of pigment properties as well as the ability to transform minerals to obtain red colour.

2 Southern Urals

Kapova cave (Shulgan-Tash), located in the Burzyansky District of the Republic of Bashkortostan, is one of the largest karst caves on the western slope of the Southern Urals. It is a natural, historical, and cultural monument. The cave is a well-preserved site with rock art from the Upper Palaeolithic of Central and Eastern Europe, dated from 20.6 to 16.1 cal ka BP. Uncalibrated ages were published (Kotov 2019), and calibration was carried out by AP with OxCal (v4.3.2: Bronk Ramsey 2017) using the IntCal13 calibration curve (Reimer et al. 2013).

From 2015–2021, archaeological research, documentation program and conservation work continued in Kapova Cave. Most of the activities were happening in a framework for the development of nomination to the UNESCO World Heritage List. In 2018, rock paintings of Shulgan-Tash Cave were submitted to the tentative list. The nomination was separated from the previously inscribed in the 2012 "Bashkir Ural" area. This new nomination allows us to consolidate most of the available scientific data and develop the program for further research. In 2018, the construction of the historical and cultural museum "Shulgan-Tash" began in the cave area and finished in 2022. In 2018, the corroded stairs between the cave chambers, installed in the 1960s, were dismantled. Also, inaccessible areas of the cave were traced with stainless steel ladders. Chambers with Palaeolithic paintings were entirely closed to tourists.

In recent years, using the AMS, several series of dates of bone use and charcoal finds from the cultural layers of the Upper Palaeolithic age were obtained. One charcoal trace on the ceiling of a niche in the Chamber of Paintings was dated. A large-scale program for uranium-thorium dating of images has also been implemented.

Two dates were set using the bones from the pit in the Dome Chamber: 15 235 ± 70 BP (AAR-20982) for a sample from horizon 6 and 28050 ± 250 BP (AAR-20983) for a sample from horizon 4. Also, prerequisites for the direct dating of images are discussed (Zhitenev et al. 2015).

The dates of the Upper Palaeolithic layer from the Stalagmite Chamber, obtained by the expedition led by V. Kotov, were published for the first time. Also, one sample of charcoal excavated by V. Schelinsky at the Chamber of Chaos was redated using AMS, which reduced the uncertainty compared to the conventional method (Kotov 2019).

Uranium-thorium dating of underlying and overlying calcite layers show that the paintings were created between 36.4 ± 0.1 ka and 14.5 ± 0.04 ka BP. Such a wide

dating interval is associated with specific paleoenvironment prevailing in the Southern Urals in the Late Pleistocene: a prolonged period of cold climate with no water transfer (Dublyansky et al. 2018).

Images in the Kapova Cave were painted in red; charcoal was used for outlining and presumably for tinting some images. Also, there are black lines on the walls of the cave that are not associated with the colourful images. Direct AMS dating of one of the lines at the Chamber of Drawings revealed that it was probably left in the late 19th – early 20th centuries and is not an Upper Palaeolithic image (Dublyansky, Lyakhnitsky and Spötl 2018).

In recent years, the study of pigments in Kapova Cave focused on analysing samples from cultural layers in different chambers. Traces of pigments, caches and pigments left by Palaeolithic artists on the cave floor were found throughout the chamber and in the space between the first and second floors of the cave. The paper (Pakhunov et al. 2016) provides typology and a review of the composition of pigments from all the chambers with paintings. In the Chamber of Chaos, mulberry colour pigments containing platy hematite crystals were found between the stones; the pigment from the lower grindstone includes a mixture of hematite and goethite, which may suggest the use of fire during its production. Individual drops of paint under the panels with animals and signs in the Chamber of Chaos turned out to be modern paint, applied in the second half of the 20th century by artists who made copies of the paintings.

The limonite raw material found in the vicinity of the cave has been compared with the red pigment from the presumably lower grindstone to test the hypothesis about its possible use in the production of red pigment. The similarity of the elemental and phase composition of the samples allows one to suggest that limonitic ore may have been used to obtain red pigment by calcining (Podurets et al. 2016).

Complete documentation of the cave walls in the main chambers, which has been made using close-range photogrammetry and image processing, made it possible to discover new paintings and to define more accurately the previously known images in a poor state of preservation (Pakhunov 2017).

Starting in 2015, conservation works were performed regularly under Eudald Guillamet's leadership. As a result, the chambers were cleaned entirely of various visitors' inscriptions; a technique for engravings masking was also developed (Guillamet 2016; Grigoriev et al. 2018). One of the most significant discoveries happened in November 2017 during the next stage of conservation and restoration in the Chamber of Chaos. After the removal of calcite layers at the panel called "Horses and Signs", a large, naturalistic image of a Bactrian camel was revealed. The Bactrian camel is about 60cm by 55cm and is outlined in red. It is a naturalistic two-humped figure facing left, with a small, elongated snout, a vertical line dividing the outline of its body, and a filled-in neck. All the details are well-preserved, even on the belly, where you can see a short hatching of hanging wool (Devlet et al. 2018a, 2018b). The Upper Palaeolithic age of the figure is confirmed by the results of uranium-thorium dating of the overlying calcite layers, which date to 14.5 ka BP. (Dublyansky and Lyakhnitsky 2018). The discovery of the image of a camel in Kapova Cave is the first evidence of its presence in the region (Devlet, Pakhunov and Agadjanian 2018). However, it is possible that ancient artists could see the camel in the southern regions far from the cave.

In 2017–2018 comprehensive documentation of the site commissioned by the Shulgan-Tash Cave Museum was completed. The documentation was carried out by a combination of airborne laser scanning with a density of up to 100 points per square meter, aerial photography of the landscape of the site (25 square kilometres), laser scanning of the karst cavity from the Portal grotto to Chaos Hall (1st floor) and to Diamond Hall (2nd floor), photography followed by photogrammetric processing of sections of the cave walls with Palaeolithic paintings. Such detail reliably reproduces the geometry of the surfaces and makes it possible to monitor the development of calcite crust and analyse the fracture system. Photogrammetric models of cave sections are referenced to the laser scanning point cloud. The uniform geodetic network combines diverse spatial data into a single system. Spatially interconnected models of the landscape, karst cavity and panels with Palaeolithic images represent a digital image of the site. Comparison of the cavity model with the surface relief pattern reveals several regularities important for analysing the behaviour of ground waters that affect rock carvings. The preliminary results of the work were presented in the Shulgan-Tash booklet (in Russian, English and French) (Svoyski et al. 2018).

The second largest cave with rock art and cultural deposits dated to the Upper Palaeolithic is the Ignatievka Cave, located in the North of the Chelyabinsk region. While the paintings in the Kapova Cave are made with red paint, images in the Ignatievka are primarily drawn with charcoal. Direct AMS dating of three paintings resulted in the range of dates between 7040–4650 cal BC (Steelman et al. 2002). However, the obtained Holocene dates contrast with the results of bones and charcoal dating from the cultural layer and the depictions of Ice Age animals (Shirokov 2018b).

The review of several South Ural sites with found mineral pigments reveals that these are primarily present in the Upper Palaeolithic layers. As it is also true for the Ignatievka Cave, this might be indirect evidence of the Upper Palaeolithic age of its artistic ensemble (Zhitenev 2016).

To obtain independent dating of the cave art in Ignatievka Cave, uranium-thorium dating of calcite deposits was performed. Three dates were received about the incrustations overlapping red and black paintings; these dates show that the minimum age of the paintings is 9720, 9220, and 8910 BP. The results suggest a systemic error in directly dating charcoal images (Dublyansky et al. 2019).

Unlike the Kapova Cave, located in the protected reserve with its painted Chambers currently closed to the public, the Ignatievka Cave remains exposed. Photographs of paintings made in recent years make it evident that the images are being destructed, which is a consequence of uncontrolled visits, subsequent microclimate changes and pollution of the Cave. An interdisciplinary group of scientists developed a program for examining and preserving the Cave and proposed it to the regional authorities (Shirokov 2019).

3 Far East

The Lower Amur and Ussuri rock art provinces unite a group of rock art sites on the Russia-China border. These are the sites Sikachi-Alyan, Sheremetyevo, Kiya and Kalinovka. The petroglyphs of the Lower Amur and Ussuri can be dated from the Epi-Palaeolithic/Neolithic era (from the 10th millennium BC) to the early Middle Ages

(IV – XIII centuries AD). The complete description of the sites is published by A.P. Okladnikov, E.G. Devlet and A.R. Laskin (Okladnikov 1971; Devlet 2016; Devlet and Laskin 2016; Devlet and Laskin 2017; Laskin et al. 2018).

Sikachi-Alyan is the largest cluster of petroglyphs in the Far East. It is located on basalt boulders and rocky outcrops on the right bank of the Amur River 60 km South of Khabarovsk. It has 438 rock engravings in six locations (Devlet 2019). In 2003, it was placed on the UNESCO Tentative World Heritage Site List. In 2014, when the water level in Sikachi-Alyan was abnormally low, five new stones with petroglyphs were recorded at point 1 (Devlet and Laskin 2015; Laskin et al. 2019a).

The Sheremetyevo petroglyphs are located on the right bank of the Ussuri River on the border with China, 140 km from Khabarovsk. There are three known locations of petroglyphs on rock surfaces (points 1–3), while Sheremetyevo locations 4–8 are separate boulders (Laskin et al. 2019b). In 2019, a sixth boulder was found.

Since 2014, the petroglyphs of the Amur-Ussuri province of rock art have been monitored by the Institute of Archaeology of the Russian Academy of Sciences, the Khabarovsk Regional Centre for Monuments Protection and the Remote Sensing and Spatial Data Analysis Laboratory (Moscow). The project was triggered by the observed deterioration of sites of Amur valley, affected both by the pressure of increased touristic activities and periodical flooding of boulders with petroglyphs, especially during the catastrophic flood of 2013 (Devlet, Laskin and Pakhunov 2018c).

Field works over Far Eastern sites during 2014–2019 were aimed at accurate mapping and documenting sites and surfaces by aerial photography of unmanned aerial vehicles, ground photography, laser scanning and photogrammetric processing of digital photographs. The GIS-based dataset of 3D models of stones and surfaces with petroglyphs was developed for each site. This resulted in finding the carvings described by A.P. Okladnikov with no exact referencing, which were considered lost, and discovering new, unpublished surfaces and images. To date, a total of 113 boulders and surfaces with rock carvings have been documented, including 15 previously undocumented boulders on the bank of the Amur River (Sikachi-Alyan, locations 1 and 2), the Ussuri river (Sheremetyevo, locations 4–8). Simultaneously 18 sections of vertical rock surfaces with petroglyphs (Sheremetyevo, locations 1–3; Kiya were mapped and documented (Levanova et al. 2019a).

Analysis of collected data performed in 2017–2021 allowed to identify of carvings that had not been observed after the expedition by Okladnikov for more than 40 years and corrected numerous errors of previous efforts of documenting the engravings by contact methods. For example, seven images were identified at Sheremetyevo (point 2) (face masks, boats, geometric ornaments).

One of the most important results of the 3D-modeling project is identifying previously unknown rock images by applying mathematical visualisation algorithms to the model surface. This allowed us to identify over 30 previously unknown petroglyphs and to refine significantly the outlines of most of the already published images (Levanova, Romanenko and Konakova 2019).

4 Conclusions

Recent research results have shown that the quantitative and qualitative resource of rock art in Russia is far from exhausted. The establishment of new documentation and study methods widens the research capabilities of the scholars and helps them find new art and locations.

Significant efforts were made in 2015–2021 to promote rock art sites as cultural heritage and to prepare Russian rock art sites for several nominations to the UNESCO World Heritage List (Devlet et al. 2015). The Preliminary UNESCO World Heritage List included the Sikachi-Alyan site (2003), the Oglakhty mountain range (2016), and the Kapova Cave (Shulgan-Tash) (2018). As a result of these nominations, scholars can review the old material and work on current research projects since there are now additional resources to do it. This work also allows researchers to draw the attention of regional and federal authorities to the issues of the preservation of the site and the tourist flows limiting and arrangement of the tourist flow.

In 2021–2022, the Palaeo Art Centre of the Institute of Archaeology of the Russian Academy of Science started work on the project "Database of the rock art of Russia". This project aims at multilevel research and structuring information about rock art sites, as well as their landscape and cultural context, to create a holistic image of the areas of rock art in the regions of Russia.

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