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Materials of International Scientific Symposium

**THE PROBLEMS OF CONSERVATION,  
PRESERVATION OF PALAEOLITHIC PAINTINGS  
FROM THE CAVE SHULGAN-TASH  
AND THE DEVELOPMENT  
OF TOURISM INFRASTRUCTURE  
AT THE SIGHT «THE LAND OF URAL-BATYR»**

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## URANIUM-THORIUM DATING OF THE PALAEOLITHIC CAVE ART IN SHULGAN-TASH (KAPOVA) CAVE

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Analysis of the disequilibrium decay chain of natural uranium (also known as U-series or <sup>230</sup>Th method) is presently the most reliable method used for dating cave deposits (speleothems) and can be applied to dating cave art. For successful application, cave art must either be prepared on a «canvas» flowstone (in which case the dating yields the maximum age), or be overgrown by flowstone (in which case dating provides the minimum age). The shorter the hiatus between the deposition of the «canvas» flowstone and the «overgrowth» flowstone, the more precise the age of the cave art that can be obtained.

In order to determine the age of the Palaeolithic art in the Shulgan-Tash (Kapova) cave, samples were collected in 2013–2015 in chambers Kupolny (2 sampling points), Znakov (7 points) and Chaos (14 points). Most of the samples were taken as small-diameter (8 mm) cores, intersecting the overgrowth flowstone, the pigment layer, and the underlying flowstone. To minimize the visual impact of coring, the holes were patched with lime putty and then camouflaged using natural local pigments (clays).

The collected cores were cut longitudinally using a precision diamond saw. The flat surfaces were ground and polished using silicon carbide abrasive powders and water-based diamond suspensions. In some cases, the outer cylindrical core surfaces were also polished in order to reveal the curvilinear growth surfaces and help with accurate sampling for U-series dating. The dating samples were collected using a hand-held milling device in an Air Clean 600 workstation featuring forced circulation of filtered air, which prevents sample contamination.

Most of the sampling points in the cave were characterized by several U-series dates on both the «canvas» flowstone and overgrowth flowstone. The dating was performed in the Trace Metal Isotope Geochemistry Laboratory at the University of Minnesota (Minneapolis, USA) using procedures and protocols described in [Edwards *et al.*, 1987; Shen *et al.*, 2012; Cheng *et al.*, 2013] on a multi-collector inductively coupled plasma mass spectrometer Neptune (MC-ICP-MS; Thermo Finnigan). Altogether, 58 U-series dates were obtained.

### Discussion

The youngest age of «canvas» flowstone (i.e., the *maximum* age of

cave art) was determined as 36.400 yrs BP (sample ShT14b, drawing

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«Tower» in the Slot of the Chamber of Chaos, (#22–13) according to the catalogue of [Liakhnitsky *et al.*, 2013]).

The oldest age of the «overgrowth» flowstone (i.e., the *minimum* age of cave art) was measured at 14,500 yrs BP (samples ShT5, ShT6 and ShT9bis, composition «Horses of the Chamber of Chaos» and «Upper Slingshot» (#22–7) in the Slot of the Chamber of Chaos). The «time window» during which the drawings were made in the Shulgan-Tash cave is therefore 21,900 years. This result is consistent with the calibrated radio-carbon dates obtained on charcoal samples from the cultural layer of the cave published in the literature (16,300–19,600 yrs BP).

It is to be noted here that the width of the «time window» does not depend on human activity. It is determined, primarily, by the palaeoclimatic and palaeo-hydrological factors.

The closest approximation of the «true» age of the cave art is provided by the oldest age of the «overgrowth» flowstone. The oldest minimal age in the studied suite of samples was obtained at sampling points ShT–5 «Small Horse» (14,520±60 yrs BP) and ShT–9bis «Upper Slingshot» (14,520±40 yrs BP). Similar ages were obtained for other drawings in the Chamber of Chaos (Fig. 2).

We reiterate, however, that the similarity of the ages obtained on the flowstone covering the cave art at different sampling points was con-

trolled by palaeo-climate. Apparently, some 14,500 yrs ago, after almost twenty thousand years of no-flow conditions, water infiltrated the Chamber of Chaos. This might have been related to the thawing of permafrost, which in turn may have been related to the overall warming at the end of the last glaciation of the Late Pleistocene. According to the data of Y. Dublyansky, obtained from caves Shulgan-Tash and Victoria, permafrost was present (possibly intermittently) in the area between 53,000 and 33,000 yrs BP. Some 33,400 yrs ago, massive ice filled the upper galleries of the cave, in particular the Brilliantovy Chamber. It should be noted that this time of ice deposition occurred during a relatively warm period of marine isotope stage 3 (MIS–3) after which, ca. 26 thousand years ago, the massive cooling of the Last Glacial Maximum began. Permafrost was widespread in Southern Ural during that time. Infiltration of water and growth of speleothems was impossible. This is confirmed by the lack of stalagmites of this age from caves in the area (Shulgan-Tash, Grioz, Kulyurtamak, Victoria; unpublished data of Y. Dublyansky).

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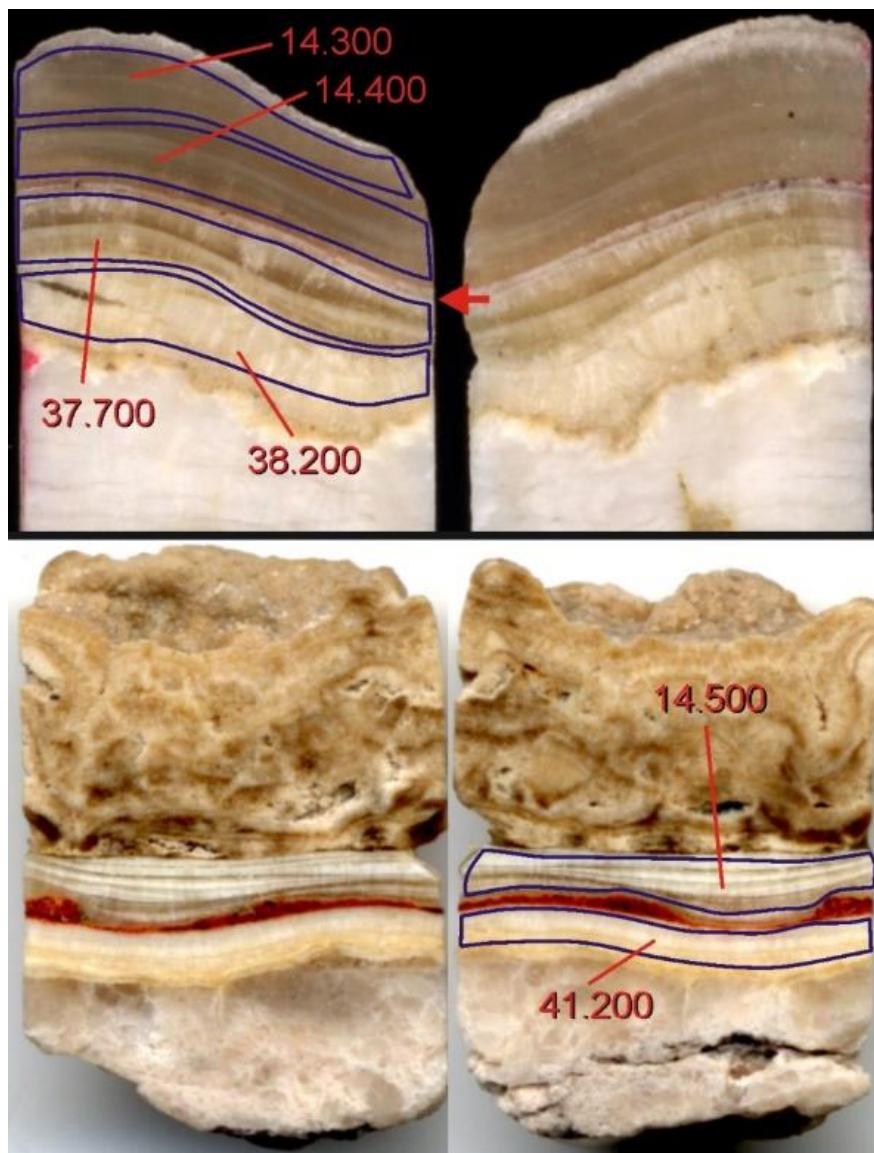


Рис. 1. Керны с красочным слоем. Показаны результаты уран-ториевого датирования (д. н.). Вверху: керн ShT6 (левее «Нового антропоморфа» (20–6) композиции «Лошадки зала Хаоса»). Внизу: ShT10bis («Нижняя рогатка» (22–12)). Красная стрелка показывает положение пигментного слоя

Fig. 1. Cores with pigment layer. Numbers indicate U-series dates (yrs BP). Above: core ShT6 (near the «New Antropomorph» (#20–6) of the composition «Horses of the Chamber of Chaos»). Below: ShT10bis («Lower Slingshot»; #22–12). Red arrow points at pigment layer

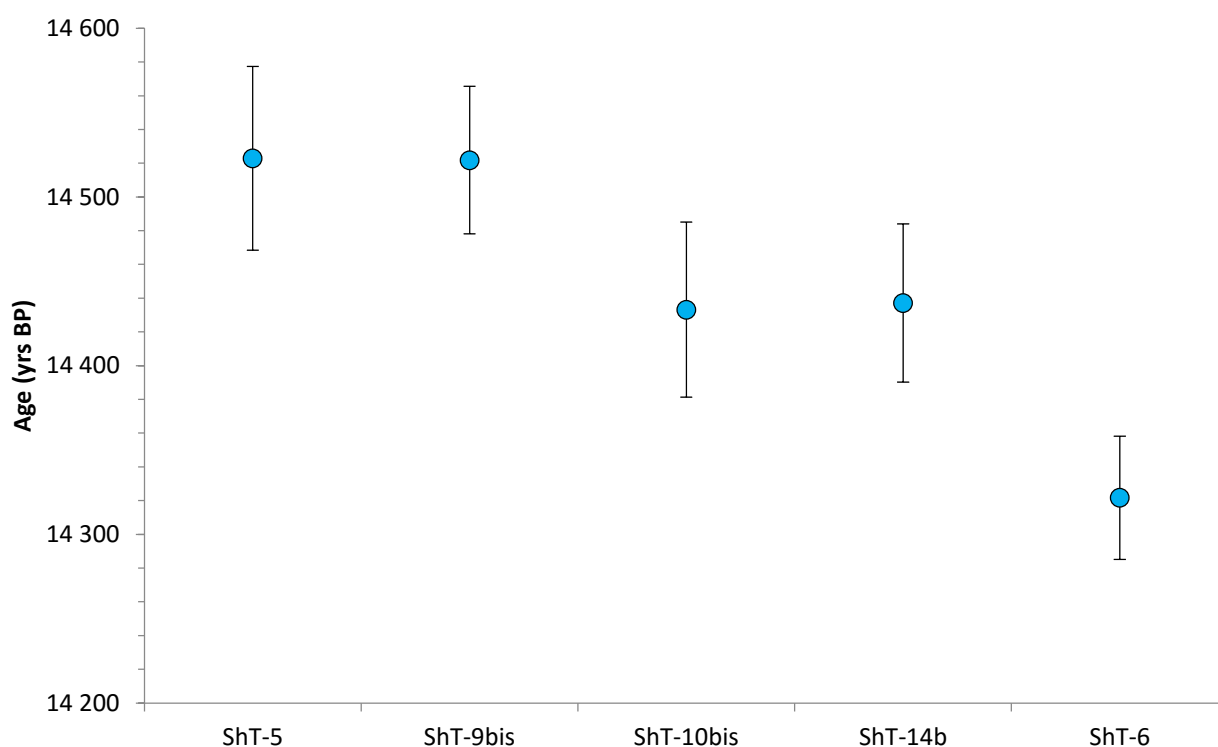


Рис. 2. Наиболее древние возрасты перекрывающего натёка  
(минимальные возрасты рисунков)

Fig. 2. The oldest ages of the overgrowing flowstone (minimum ages of drawings). Uncertainties are  $2\sigma$

## ПЕЩЕРНОЕ ИСКУССТВО, АРХЕОЛОГИЧЕСКИЙ КОНТЕКСТ И СОВРЕМЕННОЕ ВЫТАПТЫВАНИЕ В КАПОВОЙ ПЕЩЕРЕ (ЮЖНЫЙ УРАЛ)

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Капова пещера находится в Бурзянском районе Башкортостана, на правом берегу р. Белая, на территории природного заповедника «Шульган-Таш» и представляет собой систему залов и галерей, расположенных на трех уровнях, нижний из которых занят р. Подземный Шульган. В 1959 г. в пещере были выявлены настенные изображения верхнепалеолитического возраста, археологическое изучение началось в 1960 г.

[Бадер, 1965]. На сегодняшний день выявлены следы посещения пещеры в разные исторические эпохи – от палеолита до этнографической современности [Житенев и др., 2015; Щелинский, 1996].

Для массового туристического посещения на сегодняшний день открыта только входная часть памятника, отделы с настенными изобра-

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