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Research paper

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APPLICATION OF 3D TECHNOLOGIES IN REVEALING ANTROPOMORPHIC BAS-RELIEFS ON CHUMAKI GROUP OF DOLMENS, GREATER SOCHI

Abstract. This article presents the findings of a study on a bas-relief composition adorning the facade slab of a dolmen from the Chumaki dolmen group, situated in the Tsushvadzh River basin within the Lazarevsky district of Greater Sochi. The bas-relief depicts three anthropomorphic figures engaged in a dance. The two flanking figures are depicted in symmetrical, mirror-image poses, with one arm extended toward the central figure and the other bent at the elbow and lowered. The central figure has both arms hanging downward. This compositional motif bears resemblance to the bas-reliefs of the Kapibge-1 dolmen (Greater Sochi) and to the pecked images on the blocks of the dolmen courtyard in the village of Dzhubga. Analysis of the poses of these "twins" reveals parallels with petroglyphs and engravings on dolmens across the Caucasus, as well as with Bronze Age monuments spanning a broad region from Transcaucasia to Crimea – evidence suggesting the persistence of shared mythological narratives in antiquity. This discovery augments the inventory of dolmens in the Greater Sochi region featuring anthropomorphic and geometric motifs executed in bas-relief, potentially indicative of a distinctive stylistic "signature" associated with a local "school." Identification of the composition was enabled by digital technologies, including photogrammetry and subsequent 3D modeling that leverages shadow and highlight patterns under simulated oblique illumination via gradient procedural textures. Such methods enhance the visibility of bas-relief imagery and uncover poorly preserved elements. In turn, these techniques afford novel opportunities for revealing previously undetected motifs on well-documented monuments.

Keywords: dolmen; historical and cultural heritage; bas-relief petroglyphs; anthropomorphic images; photogrammetry; 3D modelling; Black Sea coast of the Caucasus; Tsuskhvadzh River; Chumaki dolmen group

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АРХЕОЛОГИЯ

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Исследовательская статья

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АНТРОПОМОРФНЫЕ БАРЕЛЬЕФЫ НА ДОЛЬМЕНЕ В ГРУППЕ «ЧУМАКИ», БОЛЬШОЙ СОЧИ: ПРИМЕНЕНИЕ 3-D ТЕХНОЛОГИЙ ИССЛЕДОВАНИЯ

Аннотация. В статье приведены результаты исследования барельефной сюжетной композиции, изображенной на фасадной плите составного дольмена группы «Чумаки», расположенного в бассейне р. Цусхвадж Лазаревского района Большого Сочи. Барельеф состоит из трех антропоморфных фигур, изображенных в танце. Центральная фигура изображена с опущенными руками. Два крайних персонажа изображены в зеркальных позах – одна рука каждой фигуры протянута в сторону центрального изображения, вторая согнута в локте и опущена вниз. Композиция сюжетно перекликается с барельефами дольмена Капибге-1 (Большой Сочи) и с изображениями на блоках двора дольмена в Джубге, выполненных в технике пикетажа. Анализ поз «близнецов» находит параллели с петроглифами как на дольменах Кавказа, так и в памятниках эпохи бронзы от Закавказья до Крыма, что может говорить о единых мифологических сюжетах, бытовавших в древности. Находка дополнила список дольменных памятников Большого Сочи с антропоморфными и геометрическими изображениями в барельефной технике, что, возможно, является характерным «почерком» местной «школы». Обнаружение изображений стало возможным благодаря применению цифровых технологий, включающих фотограмметрию и последующую 3-D обработку с использованием теневой и бликовой картины в косых лучах виртуальных источников света с применением градиентных процедурных карт. Это позволяет четче проявить барельефные изображения и выявить плохо сохранившиеся фрагменты. Применение этой технологии открывает новые возможности обнаружения изображений на давно известных памятниках.

Ключевые слова: дольмен; историко-культурное наследие; барельефные петроглифы; антропоморфные изображения; фотограмметрия; 3D-обработка; Черноморское побережье Кавказа; р. Цусхвадж; дольменная группа «Чумаки»

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Introduction

This research constitutes part of a state assignment (No. FGRW-2024-0002; state registration No. 124022000096-2) dedicated to documenting the archaeological monuments of Greater Sochi. The initiative suggests the systematic recording of sites, coupled with the establishment of an electronic database, register, catalog, and archaeological geographic information system (GIS) for the region. At the present stage, investigations focus on the most emblematic categories of archaeological objects in the area: dolmens and medieval Christian churches. The primary objective is to develop an information resource that addresses the requirements of heritage protection authorities, governmental bodies, scientific institutions, land users, and other stakeholders. This resource will enable security protocols, oversight mechanisms, and preventive measures against site degradation amid the region's accelerated urbanization; it will further promote scholarly analysis, public dissemination, and the incorporation of select monuments into historical and cultural tourism routes. As part of this initiative, conducted in collaboration with Sochi National Park, information on previously unknown or understudied historical and cultural heritage sites is progressively integrated into scholarly discourse. Notably, between 2021 and 2023, data were published on the dolmen macrocluster of the Mizegukh Ridge, situated in the interfluve of the Makopse, Neozhidannaya, and Ashe Rivers within Sochi National Park and comprising 34 structures [1–3]. In 2023, during the preparation of cataloging materials for sites in the vicinity, a distinctive ensemble of zoomorphic and anthropomorphic bas-relief motifs was identified on a trough-shaped dolmen of the Kapibge-1 group, portraying mythological motifs that include driven-deer hunts and the dance of three paired figures [4] (Fig. 1).

The newly discovered bas-reliefs substantially supplement the limited corpus of dolmen culture artifacts bearing zoomorphic and anthropomorphic imagery. Such motifs were first documented in 2006 by the West Caucasus Expedition of the Institute of the History of Material Culture, Russian Academy of Sciences (IHMC RAS), under the leadership of V. A. Trifonov, on the enclosing blocks of a dolmen courtyard located on the grounds of the "Dzhubga Rest House." On the lower frieze block, six figures aligned in a row were identified, depicting an ancient mythological narrative; on another courtyard block, two mirror-symmetrical anthropomorphic "twins" were observed. The reverse side of this same block features a headless anthropomorphic figure, with one hand on the hip and the other extended forward [5, pp. 115–118, fig. 4].

The second object, designated dolmen A from the Schize IV group, features on one of its slabs an image of "dancing figures" identified in 2007 by the North Caucasus Expedition of the Institute of Archaeology, Russian Academy of Sciences [6, p. 296].

The bas-relief images on the facade of the DK155 dolmen from the Kapibge-1 group, discovered in 2023, supplement this series. A fundamental distinction of this composition lies in its execution via bas-relief technique, incorporating numerous details, whereas all preceding images were incised and rendered in schematic form.

A major practical consequence of this discovery was the widespread public response, which precipitated the monument's designation for protection and its inclusion in the Unified State Register of Objects of Cultural Heritage.

This discovery prompted a reevaluation of the design principles for dolmen main facades and the techniques employed in rendering images. It necessitated the development of a methodology for detecting partially lost shallow bas-reliefs, as well as a revision of the protocols for site inspection and documentation. Accordingly, a mandatory provision was incorporated into these protocols, stipulating a thorough examination of the dolmen's representational surfaces – primarily the main facade plane – under oblique illumination from a high-powered lamp, to identify remnants of anthropogenic relief and thereby determine the need for further detailed investigation. This technique enabled the identification of eroded zones bearing stripes and zigzags on several monuments in Greater Sochi, indicating that the decorative ornamentation of dolmens' representational surfaces was not an exceptional feature but a recurrent practice. The omission of such motifs from scholarly descriptions of dolmens stems exclusively from their severe degradation due to surface erosion. These revelations open new prospects for investigating dolmen rock art and the Bronze Age mythologies of Caucasian peoples.

The developed technique for image identification yielded further results in January 2025, with the discovery of another bas-relief composition on the facade slab of a previously documented dolmen from the Chumaki group in the Tsushvadzh River basin. This ensemble depicts three anthropomorphic figures engaged in a dance.

Materials and methods

To identify and study rock art in classical archeology, various contact-based methods have been employed since the 20th century, including pigment rubbing and casting. These techniques entail direct intervention on the study object and can accelerate surface degradation, thereby inflicting irreparable damage on the monu-

ment [7, 8]. Consequently, non-contact technologies such as laser scanning and photogrammetry have gained increasing prominence in recent years [9]. Photogrammetry, in particular, offers a significant advantage for field investigations, as it requires no sophisticated or costly equipment; moreover, provided that requisite imaging protocols are adhered to, it yields results comparable in quality to those of laser scanning.

This technology constitutes an integral component of our cataloging efforts for archaeological sites in the region, primarily employed to generate high-quality illustrations [10, 11]. Adapting this approach, informed by experiences with photogrammetry and 3D scanning in the investigation of petroglyphs across Northern, Central, and Eastern Eurasia [12–14], facilitated the development of a specialized methodology for surface analysis tailored to dolmen monuments.

The essence of the method entails an initial assessment of surface topography under oblique illumination from a high-powered lamp. Upon identification of decorative treatment traces within the shadow patterns, a comprehensive survey of the area is performed using a high-resolution camera positioned at a close range (approximately 40 cm) perpendicular to the target surface, with 60–80% overlap between frames. To maintain a consistent standoff distance from the surface and the prescribed imaging angle, the camera is mounted on a short monopod fitted with a rest, oriented toward the subject. By sliding the rest along the surface, the operator controls the imaging direction and the extent of overlap among adjacent frames. A typical image series encompasses 200–400 frames, depending on the size of the area under examination.

Further processing of the acquired material encompasses several stages:

- generation of a final 3D surface model, comprising 3–5 million polygons, via Agisoft Metashape, followed by an initial examination of the object with textures disabled and utilizing a height map;
- importation of the model into the 3DsMax three-dimensional editor; scaling of the object; configuration of artificial light sources; selection of a material (uniform texture) with defined optical properties to produce the requisite shadow and highlight patterns; and analysis of these patterns through iterative adjustments to the light source position and ray incidence angle;
- attachment of a gradient procedural map to the object; fine-tuning of its parameters to yield a scaled elevation map; derivation of a composite shadow and highlight image; and scrutiny of erosion-damaged areas for residual traces of imagery;
- interpretation and vectorization of the images.

This methodology facilitates the enhanced visualization of bas-relief motifs and the detection of poorly preserved elements.

Results and discussion

The ongoing documentation of archeological sites has facilitated the establishment of a register and an archaeological GIS, which, as of early 2025, comprises 417 dolmens across Sochi territory. As part of catalog development in 2024, the Tsushvadzh River basin was investigated.

The Tsushvadzh River basin ranks third in dolmen abundance among Greater Sochi regions, surpassed only by the Ashe and Psezuapse River valleys. It contains 67 monuments (16% of Greater Sochi's total dolmens), organized into 12 dolmen groups and 7 isolated structures, which form three macroclusters: Vinogradnoye Gorge, the middle Tsushvadzh reaches, and the Solonitsky Ridge area. Each macrocluster is distinguished by unique local attributes and typological distributions of construction variants [15, pp. 38–49] (Fig. 2).

The Vinogradnoye macrocluster was documented in 2024 [16], while fieldwork along the middle reaches of the Tsushvadzh River was conducted during 2024–2025 to acquire supplementary data. In January 2025, during an extended survey of the Chumaki group monuments in collaboration with a team of volunteers, local historian V. V. Snytko identified a prominent cross-shaped protuberance on the facade of the ruined composite dolmen DS350, which incorporates a courtyard. Preliminary examination under lamp illumination revealed a bas-relief composition depicting three anthropomorphic figures in a dancing configuration above the porthole.

The ruins of dolmen DS350 are situated 110 m east of the compact cluster comprising DP84, DP85, and DS86. The monument was first documented by M. I. Kudin and N. V. Kondryakov in 2008. It is in a dilapidated condition, with two chamber slabs, the facade slab, and a pre-portal courtyard partially preserved; additional elements may remain interred beneath the soil. The dolmen is erected on a platform of fractured stone, enclosed on three sides by a crepida of large sandstone blocks, which is most intact along the southeastern flank adjacent to the courtyard. On the western side, the crepida boundaries incorporate a low, mound-like elevation measuring 2.5 × 3 m, positioned 2 m from the dolmen (Fig. 3). The structure is oriented with its facade at an azimuth of 171°, facing downslope toward the summit of Mount Serentkh.

The facade slab is substantially tilted toward the courtyard, and is accessible for examination solely from the frontal side. It protrudes from the ground to a height of 70 cm, with a width of 78 cm along the upper edge,

expanding to 1 m at ground level. The slab exhibits a lenticular cross-section, achieving a maximum thickness of 20 cm at the upper edge level; it tapers to 12 cm toward the lateral edges, terminating on both sides in a 7–8 cm wide rib that projects 3.5 cm.

Situated 50 cm below the slab's top edge is a porthole measuring 33 cm in diameter, with its lower portion embedded in the soil. The porthole lacks sharply defined margins; rather, a gradual transition occurs along the perimeter from the facade plane into the opening.

The chamber's bounding walls comprise a fragment of the eastern slab and two slabs on the western side, featuring grooves for securing the facade slab.

The capstone is fractured into multiple fragments. The area immediately anterior to the facade is partially enclosed by a modest courtyard, measuring 0.9 m in length and 0.95–0.83 m in width, narrowing toward the front. In 2008, the anterior boundary of the courtyard was sealed by a stone block, which is presently situated along the western perimeter of the courtyard. Approximately 1.2 m from the southern edge of the courtyard, the earthen embankment is delimited by crepida blocks.

A bas-relief composition portraying three anthropomorphic figures engaged in a dance adorns the anterior surface of the facade slab, positioned 23 cm above the upper edge of the porthole (Fig. 4).

The central figure measures 18 cm in height, while the flanking figures attain 19 cm (eastern) and 18.5 cm (western). The bas-relief reaches a maximum elevation of 23 mm. All figures feature short legs, elongated torsos, and rounded heads. Within the grasp of the outermost figures, facing inward, remnants of three-dimensional objects – potentially cups or headdresses – are discernible, although their identification is precluded by the bas-relief's poor preservation. Beneath these figures, the surface is smoothed and exhibits pecked marks. The composition measures 41.5 cm in width and occupies an area of approximately 0.08 m².

The two flanking figures are depicted in mirror-image poses: one arm extends toward the central figure and the other bent at the elbow and lowered. In contrast, the central figure has both arms lowered, with contours discernible only up to the elbows; below this, they are effaced by erosion. Three-dimensional image processing revealed that the line of the left arm at elbow level integrates with an indeterminate eroded feature, thereby leaving unresolved the orientation of the forearm – whether it extended symmetrically to the right, toward the waist, or diverged downward (Fig. 5).

Compositional analysis suggests that the scene may represent a dance involving two male figures and a female, paralleling the extant traditions of indigenous Caucasian peoples, in which the woman serves as the focal point of the choreographic narrative. The mirror-symmetrical postures of the flanking figures – one arm extended laterally toward the center, the other bent at the elbow and lowered to the waist – align with recurrent motifs in paired anthropomorphic imagery across the Caucasus and contiguous regions, dating from the Early Bronze Age onward [4] (Fig. 6).

In addition to paired motifs, solitary headless figures adopting the same characteristic "mirror" or "twin" posture – one hand on the hip, the other extended laterally – appear at dolmen sites, including the Dzhubga dolmen courtyard [5, p. 118] (Fig. 6.2) and the megalithic tomb from mound no. 28, burial no. 1, near Novosvobodnaya village in the Klady tract [17, p. 206] (Fig. 6.1). On occasion, twin figures integrate into a triadic composition, oriented toward a third, central element:

1. Tree: motifs on a vessel of the Maikop-Novosvobodnaya cultural community from the Pshish River [18, p. 70, fig. 4.1]; petroglyphs in the Geghama Mountains (Armenia) [19, fig. 16].

2. Deer: motifs in the Geghama Mountains (Armenia) [19, pp. 67–68, fig. 18] (Fig. 6.11).

3. Human: dolmen slab A of the Shize IV group [6, p. 296, fig. 2] (Fig. 6.10) and the composition under discussion from the Chumaki dolmen group (Fig. 6.12).

Interpretations of the narrative and semantic content of this composition remain provisional, informed by the symbolism of analogous configurations featuring symmetrically disposed anthropomorphic figures across diverse regions and ancient cultures.

A. Golan, in his analysis of these motifs, convincingly demonstrated that the central figure in such triadic compositions is invariably linked to the Great Goddess, even when supplanted by her symbolic equivalents: the world axis/center, the Tree of Life, or a column [20, p. 160].

Without dwelling on the detailed analysis of the semantics of the imagery, the bas-relief's placement within the monument's architectural schema allows for certain conclusions. The dancing twin figures, depicted on the principal facade wall that partitions the dolmen chamber (the domain of the dead) from the living world, demarcate the liminal boundary between realms. A defining attribute of twin myths across cultures is their association with distinct ontological spheres [21, p. 67]. This suggests that these images, positioned in the liminal zone above the porthole, likely served as psychopomps and apotropaics.

It is noteworthy that anthropomorphic imagery on dolmen monuments was rendered through a variety of techniques, including polychrome painting (Novosvobodnaya), engraving (Dzhubga Dolmen, Shize IV), and bas-relief (Kapibge-1, Chumaki).

A. Golan observed the extraordinary persistence of the triadic composition, comprising a central female figure flanked by two males, and its attendant sacred symbolism [20, p. 159]. This motif's permanence manifests in fine details as well, particularly the postures of the mirrored male figures, which recur even in artifacts separated by millennia. Such exemplars include the bronze figurines of the Dioscuri recovered from a shipwreck off Haifa [22, pp. 46–47, fig. 13c] and the bas-relief depictions of twins on the dolmen-like mausoleum along the Kyafar River [23, p. 130, ill. 16].

Thus, the similarity of anthropomorphic motifs across Bronze Age monuments from Transcaucasia to Crimea lends further credence to V. A. Trifonov's hypothesis that, during this era, the mountainous Crimea and the Caucasus likely constituted a unified cultural province [5, p. 124].

Conclusion

In conclusion, it's worth asking: how common are these kinds of imagery, and what are the chances of finding more dolmens with decorative ornamentation?

An analysis of the discovery contexts for the bas-relief images on the Kapibge-1 and Chumaki dolmen groups indicates that, in both cases, the structures had been long documented, yet the images went unnoticed due to their faint visibility, shallow relief, and additional concealment by lichen encrustations. Both compositions were revealed through deliberate examination of the facade surface topography under oblique illumination from a high-powered lamp. Thus, the apparent rarity of such artifacts may partly stem from the historical lack of systematic investigative protocols.

Within the ongoing cataloging of dolmen monuments in Greater Sochi, the inspection of surfaces under oblique illumination from a lamp has become a mandatory component of the site evaluation protocol. At the first indication of potential decorative elements, photogrammetric surveying is undertaken, followed by 3D processing. The application of these advanced digital technologies permits the analysis of even subtle topographic irregularities and the detection of areas with nearly lost imagery. This methodology has already disclosed several sites bearing traces of ornamentation, including bas-reliefs, thereby suggesting that such embellishments were a widespread feature of dolmen visual arts during the period.

Another contributing factor to the scarcity of discovered imagery is surface erosion. It is crucial to recognize that the sandstone composing the majority of Greater Sochi dolmens possesses heterogeneous surface and internal microstructures. Upon completion of facade preparation, image application, and final abrasion, oxidative processes generate a crystallized, resilient patina – a thin outer layer – superimposed on a more friable underlying structure. Moisture infiltration through microcracks in this exterior "crust," intensified by repeated freeze-thaw cycles, precipitates delamination of the surface layer, thereby effacing the monument's decorative motifs. In the instance of the bas-reliefs on dolmen DK155 of the Kapibge-1 group, the imagery was safeguarded by the capstone's projection, whereas on dolmen DS350 of the Chumaki group, preservation resulted from the facade slab's acute forward tilt.

Erosion processes can be evaluated using monuments with precisely documented dates of surface exposure. For instance, in the Verhnaya Mamedka dolmen group within the Psezuapse River basin, the lower facade portion was cleared of landslide overburden in 2004, enabling quantification of atmospheric erosion impacts on both exposed and subterranean surfaces (Fig. 7).

Thus, discoveries of decorative imagery may be anticipated beneath the overhanging capstones of intact dolmens, on ruined monuments where facade slabs lie face-down, or within burial mound structures. Given that only 20–30% of dolmens persist in relatively preserved states to the present day [24, p. 4], it is these dilapidated monuments that hold the greatest potential for new findings. The systematic examination of such sites, deemed architecturally banal and unviable for further study, assumes heightened significance amid emerging technologies. Deployment of the devised identification and 3D processing opens up substantial opportunities for exploring decorative motifs and mythological narratives prevalent during the Bronze Age.

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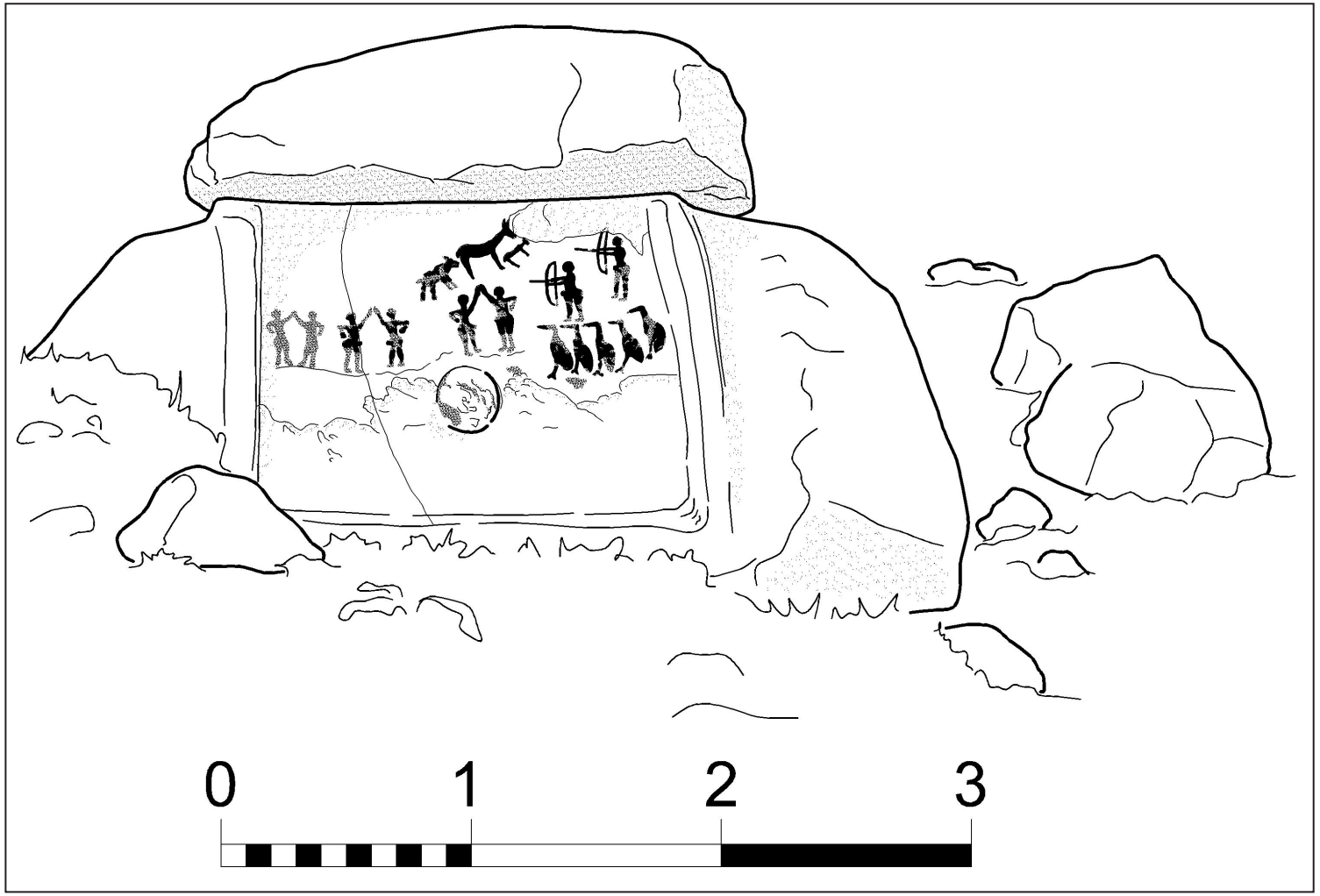

Fig. 1. Facade of the Kapibge-1 group dolmen featuring a bas-relief composition

Рис. 1. Фасад дольмена группы Капибге-1 с барельефной композицией

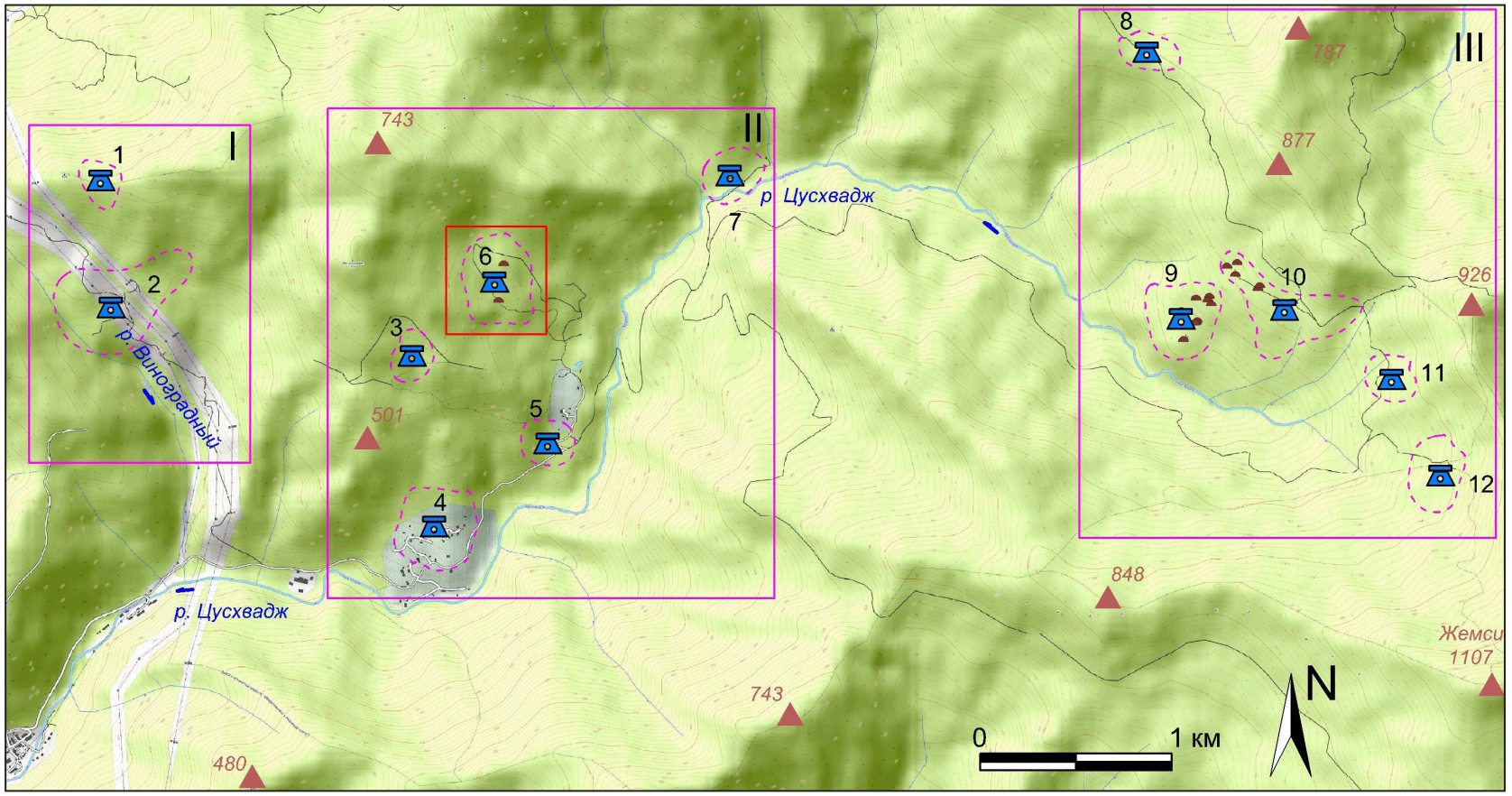

Fig. 2. Map of dolmen monuments in the Tsushvadzh river valley.
Dolmen macroclusters: I – Vinogradnoe Gorge; II – middle reaches of the Tsushvadzh River; III – Solonitsky Ridge.
Dolmen groups: 1 – *Landishi*; 2 – *Vinogradnoe*; 3 – *Bianki*; 4 – *Pervyi Dachnyi*; 5 – isolated *Vtoroyi Dachnyi*; 6 – *Chumaki*; 7 – *Paseka Kotenko*; 8 – isolated *Solonitsky Ridge*; 9 – *Group 14*; 10 – *Solonitsky Ridge* – 1, 2, 3, 4; 11 – isolated *Doroga*; 12 – *Gazoprovod*

Рис. 2. Карта дольменных памятников бассейна реки Цусхвадж.
Дольменные макроансамбли: I – Виноградное ущелье; II – среднее течение р. Цусхвадж; III – Солоницкий хребет. Дольменные группы: 1 – «Ландыши»; 2 – «Виноградное»; 3 – «Бианки»; 4 – «1-й дачный»; 5 – одиночный «2-й дачный»; 6 – «Чумаки»; 7 –«Пасека Котенко»; 8 – одиночный «Солоницкий хребет»; 9 – «группа 14»; 10 – группы «Солоницкий хребет – 1, 2, 3, 4»; 11 – одиночный «Дорога»; 12 – «Газопровод»

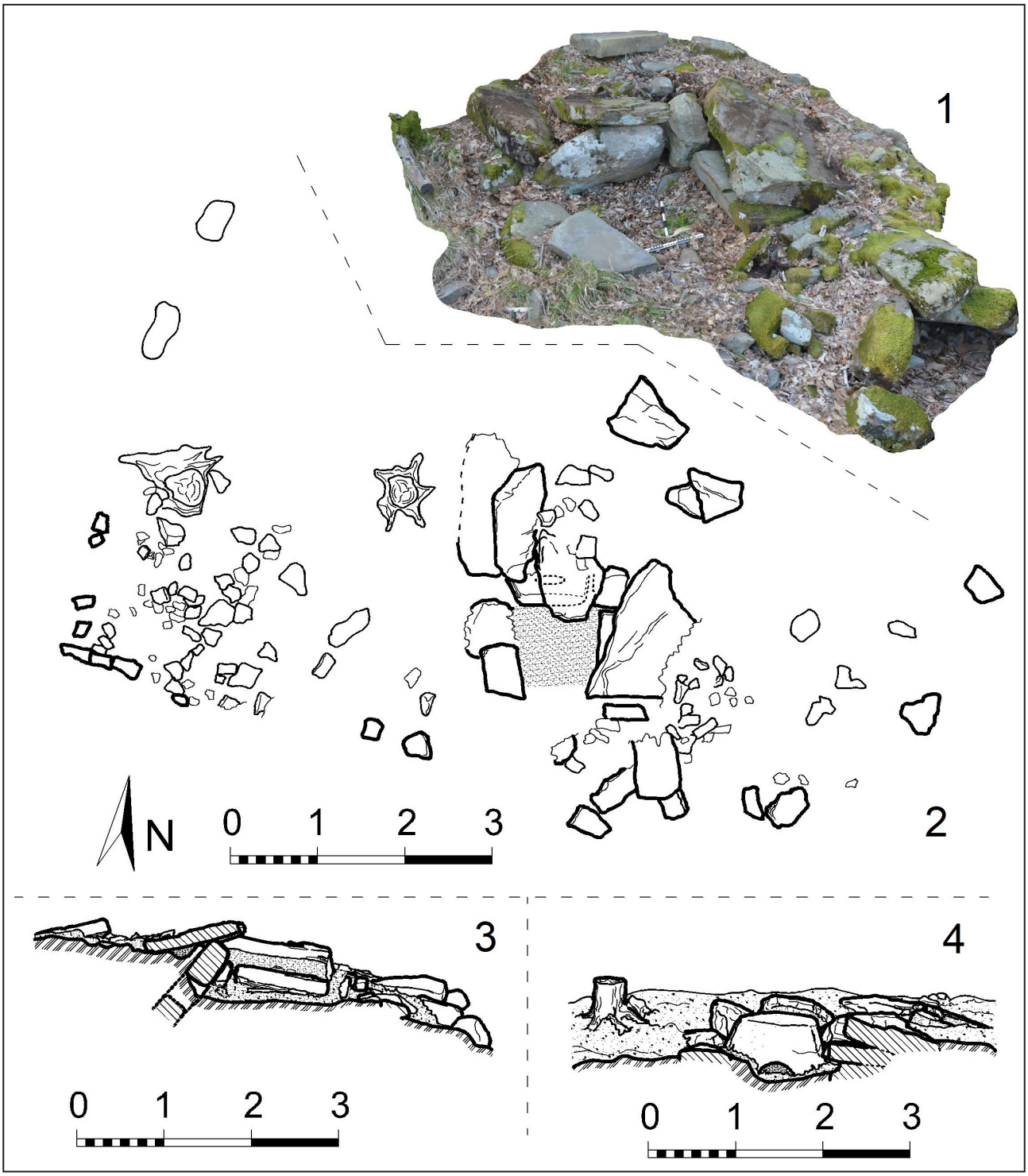

Fig. 3. Composite dolmen DS155 of the Chumaki dolmen group. 1 – general view; 2 – site plan; 3 – longitudinal section; 4 – facade projection.

Рис. 3. Составной дольмен DS350 дольменной группы «Чумаки».
1 – общий вид; 2 – план памятника; 3 – продольный разрез; 4 – фасадная проекция

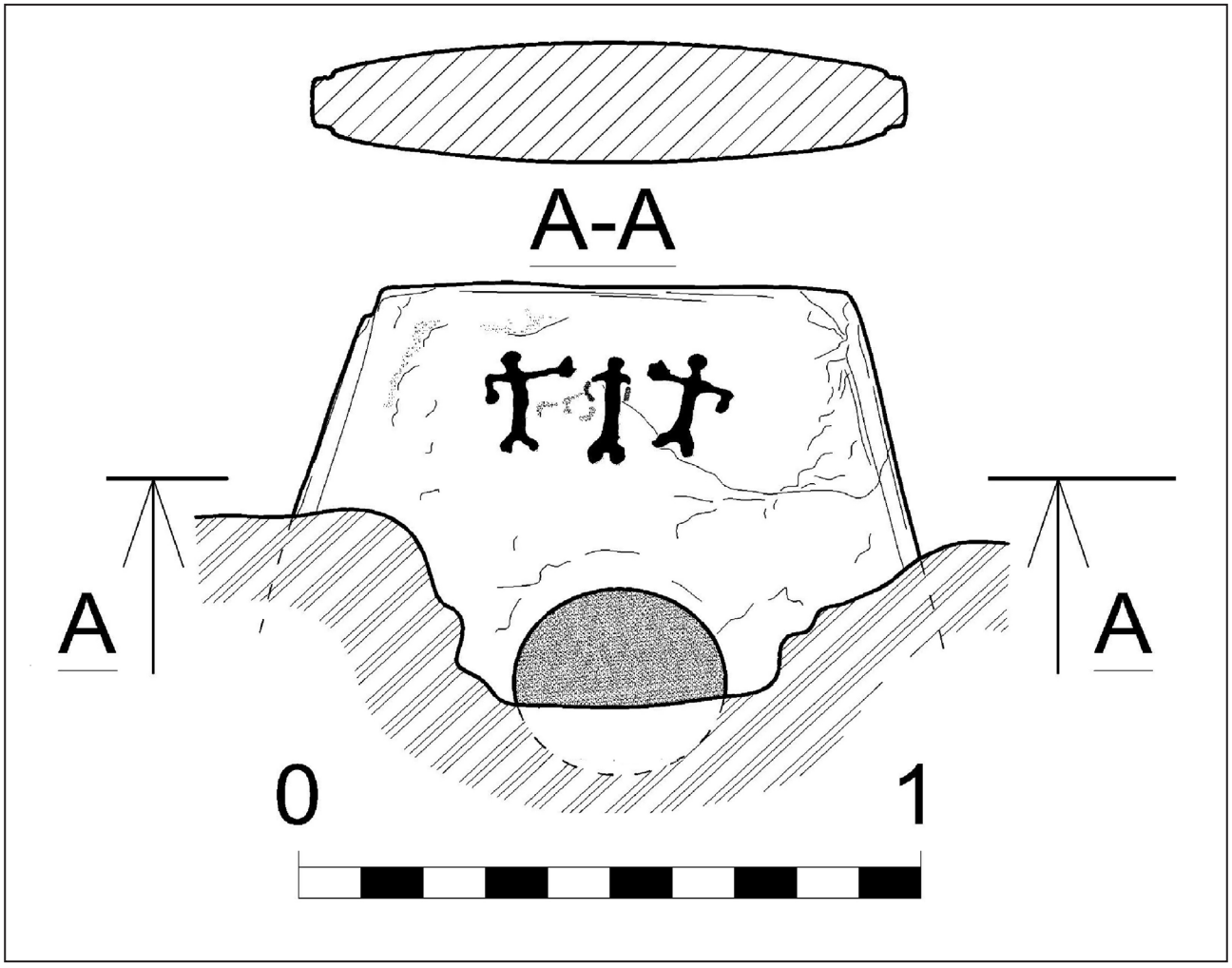

Fig. 4. Composite dolmen DS350 of the Chumaki dolmen group. General view of the facade with a bas-relief composition

Рис. 4. Составной дольмен DS350 дольменной группы «Чумаки». Общий вид фасада с барельефной композицией

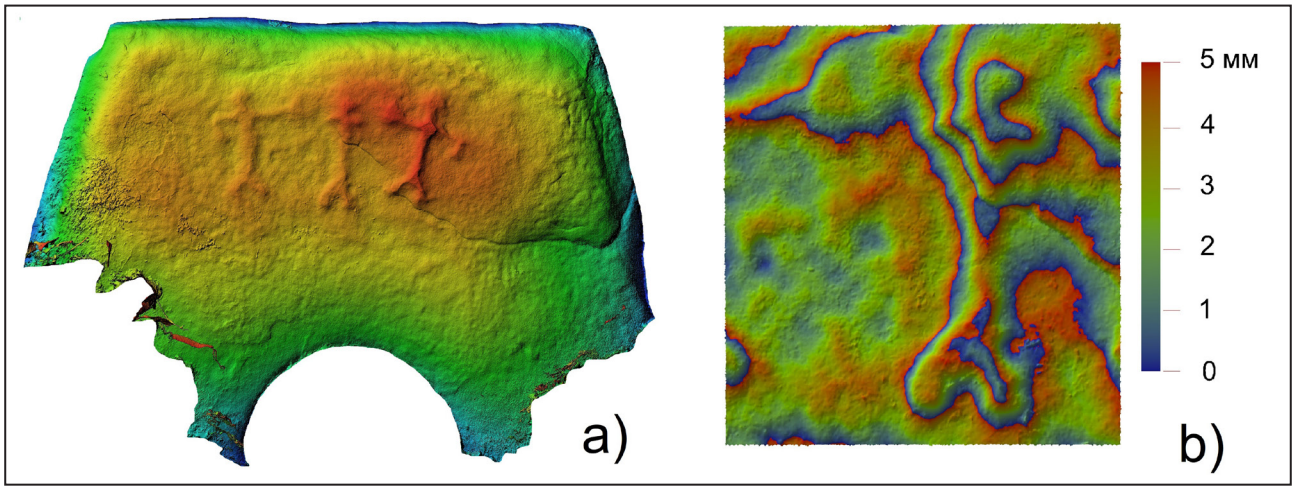

Fig. 5. 3D processing of the bas–relief composition on the facade slab of the DS350 dolmen.
a – processing via height map, b – processing via procedural gradient map.

Рис. 5. 3-D обработка барельефной композиции на фасадной плите дольмена DS350. a – обработка при помощи карты высот, b – обработка с помощью процедурной градиентной карты

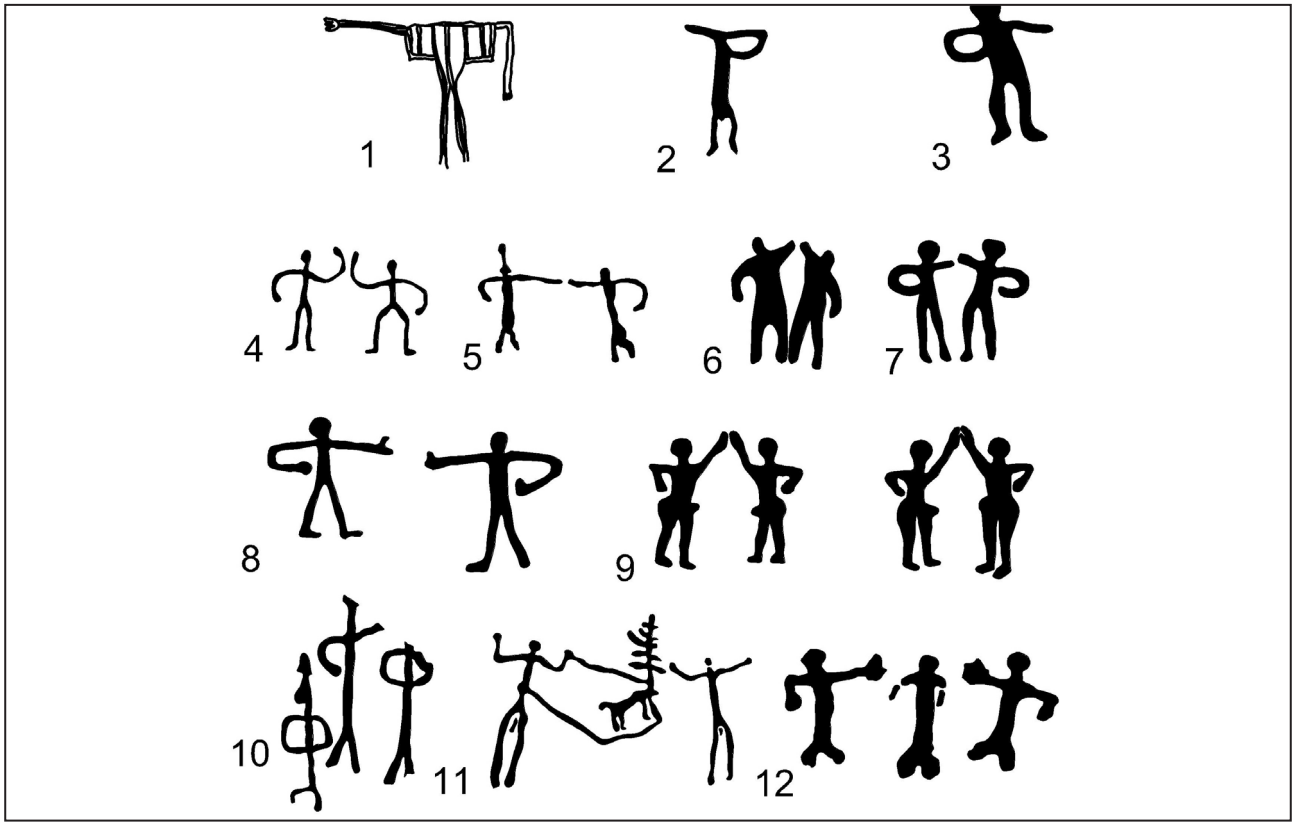

Fig. 6. Compositional and stylistic analogies in the poses of anthropomorphic figures from Bronze Age monuments spanning the South Caucasus to Crimea: 1–3 – solitary figures, 4–9 – paired figures, 10–12 – paired figures with a central element: 1 – tomb No. 28 from the Klady tract polychrome painting [17, p. 206]; 2, 3 – blocks of the dolmen courtyard in Dzhubga, engraving [5, p. 118]; 4, 5 – rock carvings, Gegham Mountains, engraving [19, p. 68, fig. 1.5]; 6, 7 – anthropomorphic steles, Ak-Chokrak, Verkhorechye, mountainous Crimea, bas-reliefs [5, p. 121, Fig. 5.2, 5.3.]; 8 – frieze of the courtyard block of the dolmen in Dzhubga, engraving [5, p. 117, fig. 4]; 9 – facade of the dolmen of the Kapibge-1 group, bas-relief [4, p. 351, Fig. 5], block of dolmen A of the Schize IV group, engraving [6, p. 296, fig. 2]; 11 – rock carvings, Gegham Mountains, engraving [19, p. 68, fig. 16], facade slab of the composite dolmen of the Chumaki group, bas-relief

Рис. 6. Композиционные и стилистические аналогии в позах антропоморфных фигур с различных памятников эпохи бронзы от Закавказья до Крыма: 1–3 – одиночные фигуры, 4–9 – парные фигуры, 10–12 – парные фигуры с центральным элементом: 1 – гробница №28 из урочища Клады, полихромная роспись [17, с. 206]; 2, 3 – блоки дворика дольмена в Джубге, гравировка [5, с. 118]; 4, 5 – наскальные изображения, Гегамские горы, гравировка [19, с. 68, рис. 1, 5], 6, 7 – антропоморфные стелы, Ак-Чокрак, Верхоречье, горный Крым, барельефы [5, с. 121, рис. 5, 2, 5, 3.], 8 – фриз блока дворика дольмена в Джубге, гравировка [5, с. 117, рис. 4], 9 – фасад дольмена группы Капибге-1, барельеф [4, с. 351, рис. 5], блок дольмена А группы Шизе IV, гравировка [6, с. 296, рис. 2], 11 – наскальные изображения, Гегамские горы, гравировка [19, с. 68, рис. 16], фасадная плита составного дольмена группы Чумаки, барельеф

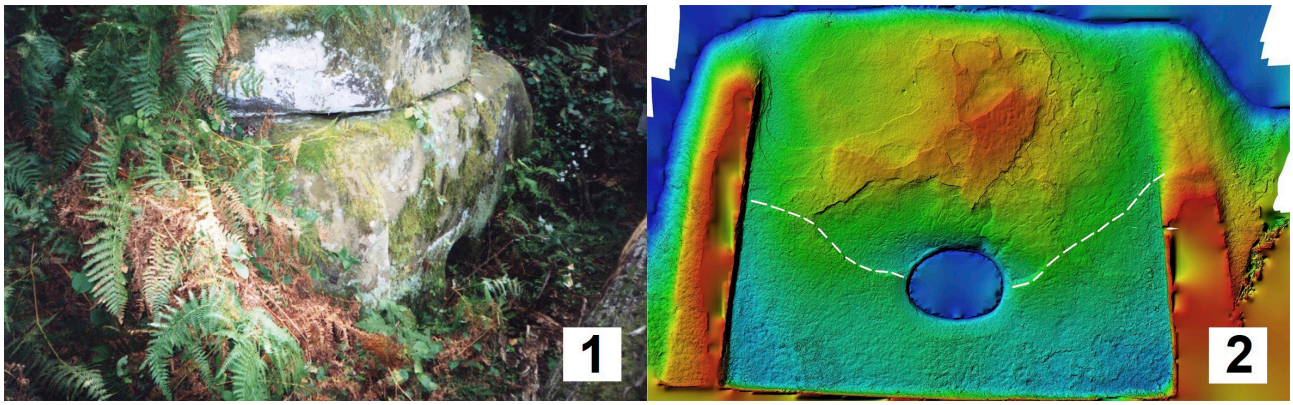

Fig. 7. Erosion patterns on exposed and buried sections of the facade of the Verkhnyaya Mamedka dolmen (Kuapse River valley, Sochi): 1 – ground level prior to clearance (photograph from 2003); 2 – contrast in the condition of erosion-affected surfaces (above the dotted line) and those preserved subsurface (below the dotted line)

Рис. 7. Эрозия открытых и закрытых участков поверхности фасада дольмена группы «Верхняя Мамедка» (долина р. Куапсе, г. Сочи): 1 – уровень земли до расчистки (фото 2003 г.); 2 – различие состояния поверхностей, подверженной эрозии (над пунктиром) и законсервированной под землей (под пунктиром)

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