New approaches and concepts in studying the of Rock Art of Azerbaijan

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Summary

Azerbaijan presents a striking example of the organization and transformation of a landscape into a ritual space, on the one hand, and on the another into a space of constant habitation, and into the landscape compositions which have remained up until the digital age and have established a solid tradition born from of the ancestors which are evident in the signs left by them in the landscape and to some degree in oral traditions. One of these complexes forms the Cultural Landscape of the Archaeological complex of Gobustan. In 2007 the cultural values of this complex have been inscribed in the UNESCO World Cultural Heritage list. In the last decades of scientific documentation in the Gobustan reserve various methods have been used. In 2004, for the purpose of recording the basic documentation of an archaeological complex for Gobustan, the first digital maps of site locations were created in Azerbaijan and in the Caucasus, which indicated the location of petroglyphs, caves, settlements, barrows and burials. In recent years 3D models have become one of the latest modern methods of documenting petroglyphs in Gobustan. From 2010, the process of dating the occupation layers of caves and shelters in Gobustan began. New methods for documentation started to be applied in studying the petroglyphs of the Absheron Peninsula, in particular in the territory of the Gala Reserve from 2016 onwards. The results of the research were unpredictable. In a complex dating the occupation layers on the basis of C14 dating and comparing this with rock art engravings and the use of 3D models enabled a view of the historical and cultural context of an archaeological complex of Azerbaijan (Gobustan, Qala) providing evidence for long historical frames.

Keywords: Azerbaijan, Archaeological complex of Gobustan, Qala, 3D model.

Riassunto

L'Azerbaigian presenta un esempio lampante di organizzazione e trasformazione del paesaggio da un lato in spazio rituale, e dall'altro in uno spazio insediativo costante. Il paesaggio, inalterato fino era digitale, si è consolido nella tradizione nata dagli antenati, evidenti nei segni incisi e, in una certa misura, nelle tradizioni orali. Il Complesso Archeologico di Gobustan è stato iscritto nella lista del Patrimonio Culturale Mondiale dell'UNESCO come Paesaggio Culturale nel 2007.

Negli ultimi decenni, la riserva di Gobustan è stata documentata utilizzando svariati strumenti. Nel 2004, sono state create le prime mappe digitali dei siti in Azerbaigian e nel Caucaso, con la georefenziazione delle incisioni rupestri, delle grotte, degli insediamenti, dei tumuli e delle sepolture. Negli ultimi anni i petroglifi del Gobustan sono stati documentati con i modelli 3D, metodo questo applicato dal 2016 in poi anche allo studio dei petroglifi della penisola di Absheron, in particolare nel territorio della Riserva di Gala.

I risultati della ricerca hanno permesso, sul sito pluristratificato della Riserva di Qala, di incrociare i dati insediativi, datati grazie all'uso della datazione al C14, le incisioni rupestri e i modelli 3D permettendo ai ricercator di visualizzare il contesto storico e culturale dell'intero complesso.

Parole chiave: Azerbaigian, Comlesso archeologico del Gobustan, Qala, modelli 3D.

In the last decades different methodologies have been used in the field of scientific documentation of rock art sites in Azerbaijan. So, the discoverer of Gobustan, archaeologist I. Jafarzadeh in 40-50-th of XX century recorded and removed

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prints from more than 3,500 rock images on tracing paper *(Джафарзаде И.М., 1958; Джафарзаде И.М. 1964г., с.11-14; Джафарзаде И.М. 1965г. с.7-10; Джафарзаде И. М. 1973г., с.5-347)*. J. Rustamov and F. Muradova by the same method were taken sketches from 2,500 images. The results of their painstaking and long-term work were reflected in published editions (Рустамов Дж., 2003год, 103 с.; Рустамов Дж., Ф.М.Мурадова. Баку, 2003 год, 118 с.; *C.Rüstəmov, F. Muradova, 2008, 316 səh.)*.

Since 1995 the Gobustan reserve has begun to use of the traditional method of documenting petroglyphs though their tracing onto clear cellophane sheets. In addition, in the laboratory, clear plastic sheets were placed onto a white background and photographic images were traced to record the images. Reduced-scale drawings were scanned and stored on an electronic database (Farajova 2005, pp. 335-336). Thus, a model of the images was obtained in an electronic format. This model could then be adjusted using different computer programmes achieving an increase in contrast and an ability to adjust and highlight various features. At present, more than 6,000 rock artefacts and 40 barrows, about 20 shelters, ancient settlements and burial sites, and about 105,000 objects of material culture have been discovered and registered in Gobustan. These contribute to the Cultural Landscape of the Archaeological Complex of Gobustan.

In 2007, the following cultural values of this complex were included in the UNESCO World Heritage List:

- Over 6,000 petroglyphs
- Caves, shelters, ancient settlements and burial sites
- places of worship –sanctuaries
- research from many caves and shelters of different periods are evidence of the consistent use of these places for 14 000 years.

Thus, we are faced the tasks of documenting the state of conservation of the sites not only at the time of survey, but also recording subsequent changes.

For the first time, the "Framework of documentation of the locations of petroglyphs" was presented in 2001 at the international scientific seminar "Petroglyphs of Central Asia" in Cholpon-Ata (Kyrgyzstan) (A.E. Rogodzinski, E. Kh.Khorosh, L.F.Charlina 2004, pp. 156-161). In order to study and protect rock art sites, in 2002, with the assistance of UNESCO and the Directorate of Cultural Heritage of Norway, the CARAD (Central Asia Rock Art Database) project was developed resulting in the creation of a database of rock art sites for Central Asia (A. S. Hygen 2004, pp. 8-10). In 2004, with the support of UNESCO's Moscow Office and the Ministry of Culture of the Republic of Azerbaijan, a practical-scientific workshop seminar was organized at the Gobustan Reserve in Baku. The purpose of the workshop was to improve the practice of researching and documenting rock art sites. Specialists from Azerbaijan, Georgia, Kazakhstan, Norway and Russia participated in the discussion of common problems for protection, research and documentation of petroglyphs. The seminar participants also had the opportunity on the spot to familiarize themselves with a new technique for recording rock images at that time - night photographic recording, demonstrated by Norwegian specialists. The effectiveness of this method was that of using light and shadow, it was possible to identify an image on a rock that is practically invisible in daylight. The method of scientific photography was first demonstrated by the afore-

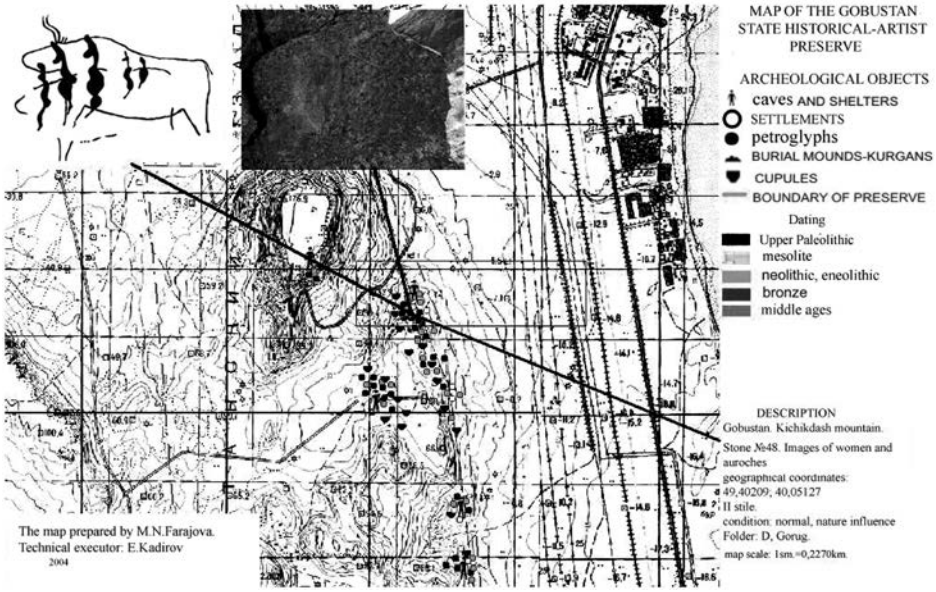

Fig. 1 - The Gobustan model of the digital database with MapInfo. Beyukdash Mountain. 2004

mentioned Norwegian scientist from the Tromsø at the UNESCO international seminar in 2003 in Kazakhstan at the Tamgaly site.

In 2004, the first digital database for petroglyphs, caves, settlements, burial grounds and burial sites was established in Azerbaijan and the Caucasus in order to document the archaeological complex in Gobustan. In the Map-info programme, a map of the Gobustan Reserve was compiled with petroglyph site locations recorded using GPS. Coordinates were taken and stones were recorded photographically. An effective method of night-time photography of petroglyphs was also used. Using this interactive programme, you were able to obtain information about the site: geographical coordinates, location, and a description of the state of conservation of the site. When applying this programme to rock art images, a drawing, and photographs taken both at night and during the day are uploaded to the database (M. FARAJOVA 2005, pp. 335-336) (Fig. 1). In 2004 at the Baku seminar, digital documentation techniques using the Norwegian model were presented. Norwegian researchers have long been using a comprehensive digital database (TROND, KLUNGSETH, LODOEN 2010).

In addition, methods for duplicating the rock art images through paper rubbings were tested using the Norwegian method of mica-coated paper for rubbing, according to the methodology of Siberian specialists. In addition the direct recording of rock art using cellophane sheets was tested on the Gobustan petroglyphs. The large size of the stones, the uneven surface of the rock and the deep contours of the petroglyphs created difficulties in the detailed rock art recording according using the methodology of foreign experts. Since 2004, there has been the use of night photography to document the rock art sites in Gobustan. The first night photography was undertaken on the upper terrace of the Boyukdash

mountain, in the cave of Ana Zaga (rock number 65) and at the Ovchular cave. In the following years, photographic recording was also launched at the Firuz 2 shelter on the Kichikdash Mountain. Mostly, most of the works have been done on the rocks that have already been recorded. This was mainly done to compare the previous drawings with the new recording techniques. This resulted in the discovery of new images, apart from the aurochs and deer images recorded on rock number 65 on the upper terrace of the Beyukdash Mountain, new female and male images were discovered. In the broad composition of these images, it appears that female figures were escaping the aurochs, while the male figure raised his hands and drove him away. The images were processed with Photoshop and an electronic sketch of the image was drawn. As a result, it was determined that the images of women, men, and aurochs on rock number 65 dates back by the same period (Fig. 2). Despite the use of new techniques in documenting petroglyphs, especially during the recording of the images, I continued to apply the traditional methods. It should be noted that, while using different methods of documentation, the site and landscape features were taken into account and recorded, as well as the location. In 2014, a drawing of rock number 19 was taken during field work at the Firuz-2 site on the Kichikdash Mountain. On several occasions, attempts were made to record the images directly onto cellophane paper. Given that the rock art images are located on a large rock surface with significant height, attaching the cellophane paper was too much of a challenge given the the surface of the stone. Additionally, the presence of strong winds in this area made it very difficult to carry out the work. As such, I began to look for new ways to trace petroglyphs. One of the best methods at that time was using the experience of American archaeologist Prof. Loendorf (Lawrence, Loendorf 2001, pp. 55-80). According to this method, the surface of the stone is divided into small squares, and the square images are copied to the paper. Using this method, we made a sketch of 7 new boats in 2014 on the east side of rock 19 on the Kichikdash Mountain (Fig. 3). For comparison, night photography was undertaken on rock 19 that same year. As a result, 10 new unregistered images of boats were discovered (Fig. 4).

Rock art is a worldwide phenomenon that poses many similar tasks to its explorers. The creation of an improved digital database, which included the entire database of the Gobustan archaeological complex, made the study of this site much easier. It provided an opportunity to explore the natural and archaeological landscape that has undergone changes over time, including in the areas of rock art. Accordingly, rock art images, compositions, and landscape have become part of a whole history. In this regard, in 2007, the Gobustan database model was created, which was compiled using the MapInfo programme. With the improvement of new information systems and programmes, there was a real opportunity to create a new database, a special documentation framework for the preservation, study, documentation and management of the unique monument of Gobustan. Given that the MapInfo programme was professional, it was difficult for a non-specialist to use it. Over time, the programme became obsolete and needed to be regularly updated. With the development of the latest mapping technologies, in 2010 the idea arose to create a new database using the Google Earth programme.

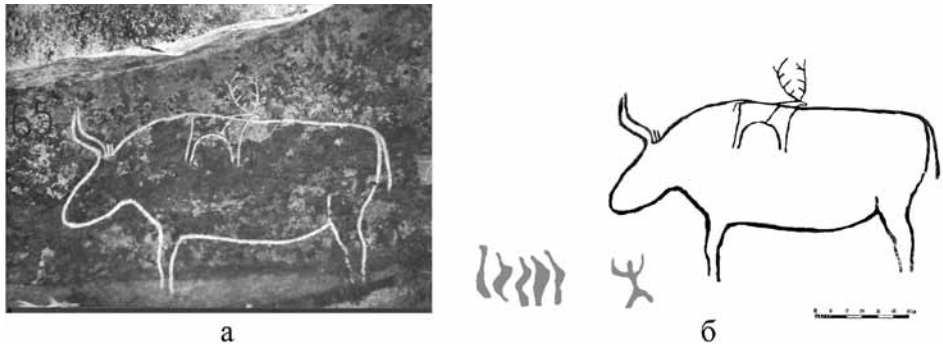

Fig. 2 - Gobustan. Upper terrace of the Beyukdash Mountain, drawing of rock 65: a –Jafarzade 1973; 2 –Farajova 2005

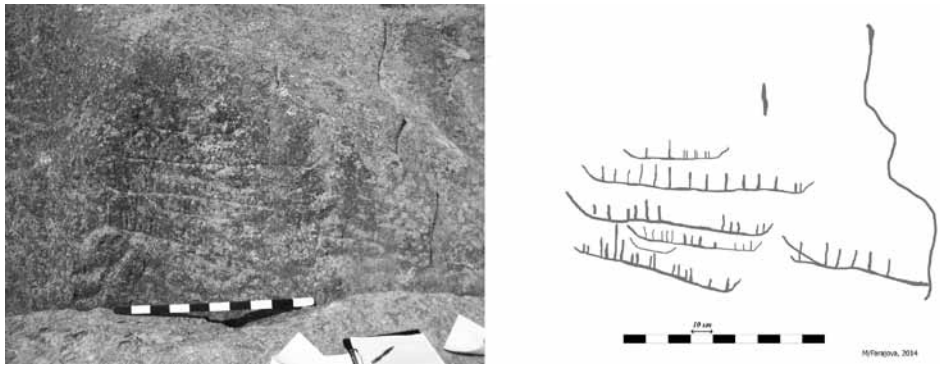

Fig. 3 - Mount Kichikdash, east side of rock 19 of the Firuz 2 site. Newly discovered images of 7 boats (Farajova 2014)

Fig. 4 - Mount Kichikdash, northeast side of rock 19 of the Firuz 2 site. Newly discovered images of 10 boats (Farajova 2014)

Working with this new programme was much easier. Using the same technology, a map of the reserve was compiled with the introduction of GPS coordinates and information. An interactive map showed the range of distribution of rock art images, settlements, burial grounds and other artifacts within Gobustan and by historical periods.

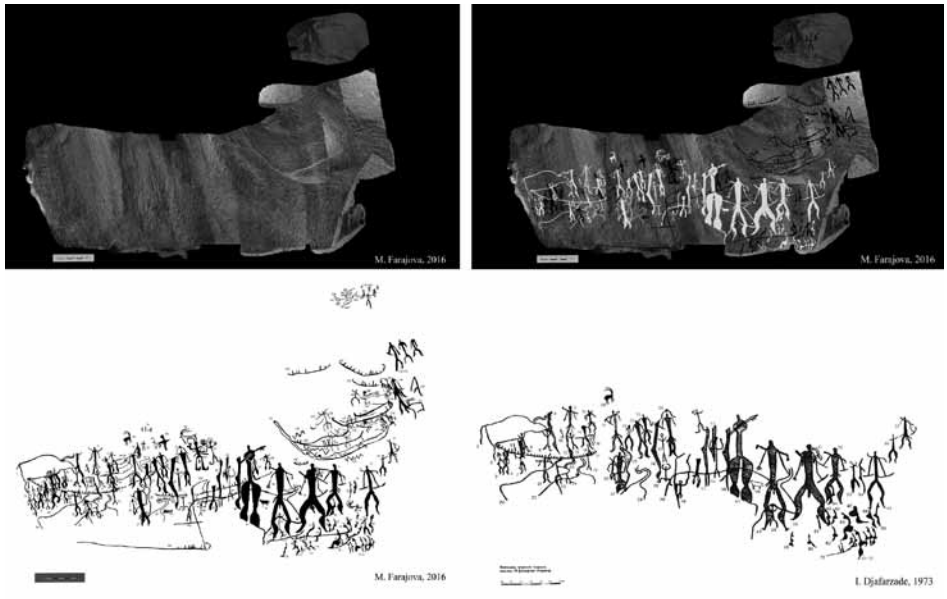

Fig. 5 - Ana zaga cave, stone 29 (North side): a – Jafarzade 1973; b – new rock art images Farajova 2014

In recent years, one of the most modern methods for documenting rock art images in Gobustan has been that of 3D modelling. The 3D method, unlike traditional methods, allows for faster and more accurate documentation. With the help of the corresponding programme, numerous photographs of the surface are layered on top of each other and are analysed and the resulting 3D model is constructed and used to study the object or surface. Many computer programmes are available to create 3D models. To create a 3D model for rock art images of Gobustan, the Agisoft programme was used. Agisoft PhotoScan Professional is a programme designed to process aerial photographic material and obtain orthophotos and digital models of the terrain. Based on the Agisoft programme, work on documenting landscape areas began in 2015 (Fig. 5).

One of the main stages in the development of photographic materials is the adaptation of photographs. At this stage, the following tasks are performed: searching for common points in the images, identifying the relative orientation of the images, and creating a baseline model with common points. The use of this documentation method in the Agisoft programme made it possible to create a 3D model of the surfaces of the walls in the Ana Zaga cave: Rock 29 on the north side, including images of pregnant women and aurochs in the western chamber of the cave. It should be noted that in 2007, 2D and 3D modelling programmes were used to compile a detailed landscape model database of the southern coast of the Doggerland region of the Mesolithic period (Thomson and Fitch 2007, pp. 23-31). The authors also mentioned some shortcomings of this programme.

Some researchers believe that dealing with the large amounts of data (100,000 points) is still a problem (Haines and McCarthy 2006, p. 36). They note that the

database is too extensive and not portable. This also creates difficulties in presenting information to a wider audience. The same can be observed with the Gobustan database. For an average of 100,000 points, we need a very powerful processing system. Accordingly, this affects the end result, reducing the ability to proficiently research a specific object or panel. It should be noted that in this programme the images on the small stones have more clarity. In terms of exploring and explaining the meaning of rock art, in 2015, I started working with the 3D Studio Max programme, which allows me to explore the landscape and interpret petroglyphs. It is worth noting that while studying the rock art of Gobustan I encountered great difficulties in reading the drawings: the layering of petroglyphs of different-time periods on top of each other and the poor visibility during daylight photography, created a number of obstacles. For these reasons, the main task of accurate documentation of petroglyphs in Gobustan is to investigate and solve a number of issues in a parallel and integrated way:

- Taking samples from the cultural layers of caves and shelters in Gobustan, including C14 dating.
- Given the discrepancy of the dating of the rocks within the cultural layers, it is necessary to use results of C14 and AMS-dating, which link the obtained data with petroglyphs on separate rocks. It is also important to take into account when researching, that separate rocks with petroglyphs in time precede the cultural layer and are accordingly made before the formation of this cultural layer.
- Analyse and compare petroglyphs on separate stones and images on the walls of caves and shelters in Gobustan.
- The use of night photography for capturing petroglyph images.
- Explore panels with 3D modelling using 3D Studio Max, trying to understand and interpret petroglyphs. Thus, for example, during the digital documentation and 3D modelling work on the north side of rock number 29 in the Ana Zaga cave, a whole composition scene was discovered: along with numerous female figures, images of unregistered boats, aurochs, and hunters (Fig. 5). If archaeologists has so far recorded 87 images up until the late 20th century, thanks to 3D modelling, the number of petroglyphs discovered on rock number 29 has increased to 200. Petroglyphs are drawn on the walls and over the top of each other's, making it difficult to determine their time periods. Classifying Gobustan petroglyphs in terms of style and periods are a very complex and difficult process. To do this, petroglyphs have first to be divided according to their style and technique. In this direction, we obtained interesting and important information using night photography and 3D modelling. Using these methods, it was possible to discover new petroglyphs on rock number 30, on the south, north and east sides of rock 29, and on the west side of rock 30 at the Ana Zaga cave. Numerous images were found on the north side of rock number 29: female figures, hunters, boats, aurochs, goats and gazelles; images of hunters and aurochs on the south side; on the east, a number of lines were discovered, with hunters, aurochs and various lines of ritual-magical purpose (Fig. 6). In addition, using the technique of night photography a photo of a hunter was also located in 29A, as well as the 5th pregnant woman figure, which was followed by three female figures which were distinct from the tattoo figure.

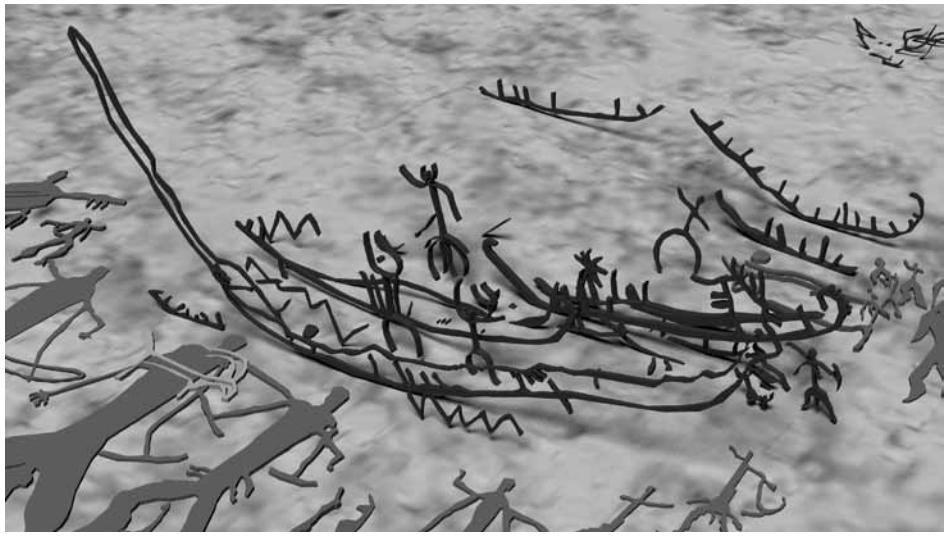

Fig. 6 - Enhanced 3D model of rock art images. Mount Beyukdash, upper terrace, rock 29 (Farajova 2015)

For a comprehensive and detailed study of the petroglyphs of Gobustan it was necessary to determine the date of cultural layers of the caves by C14 analysis. To this end, in 2010, work was started on the Ana Zaga, Okuzler, Ovchular, Maral caves and Daire settlement on Beyukdash Mountain and the Gaya arasy, Firuz 2 sites on the Kichikdash Mountain. After receiving C14 results (AMS-dating) and CN analyses from three different laboratories, I started working on a chronological classification of rock art images. About 50 samples from Gobustan caves were sent to 3 laboratories ("Marzeev IHME AMS Radiation Monitoring Laboratory", Kiev, January 26, 2010; The Waykato University, Hamilton, New Zealand, 04/13/2010, 02/23/2011; BETA Analytic INC., Miami, Florida, USA, 09/01/2011, 09/23/2011, 07/30/2014). The earliest date was measured at being 13,700 years ago, 350 sm depth at the Gaya arasy shelter. Further investigations do not exclude the possibility of an older date emerging.

Given that the images on the panels contain different patterns layered on top of each other, the study of Gobustan petroglyphs was a very challenging task. As a result of research and searches for new methods, the 3D Studio Max programme began to be used. The resulting drawings began to reveal the periods. The engraving details and quantity were revealed and built a chronological order for the compositions. An animation is created using the Render function and a video is created. The first test was performed on the rock number 65 on the Beyukdash mountain. With the help of 3D animation, it was possible to understand and delve into the meaning of the depicted figures and their inextricable connection with each other. So, for example, stone 65 depicts petroglyphs from different-time periods. If you enhance images of one period in 3D format, you can read an entire narrative. This method of interpretation made it easier to understand the meaning of many cave panels, such as on rock 68. In the same way,

I tried to read one of the most complex panels of Gobustan on Mount Beyukdash on the north side of the rock 29 (Fig. 6).

The results of the studies were unpredictable. In the archaeological complex, through the dating cultural layers based on C14 dating and comparing this with rock art images and then applying 3D modelling, I received a clear picture of the historical and cultural context of the Gobustan archaeological complex over aextensive historical frames.

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