

## MEASUREMENT OF PETROGLYPHS (ROCK OF ARTS) OF QOBUSTAN WITH CLOSE RANGE PHOTOGRAMMETRY

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### ABSTRACT:

Qobustan was declared a national historical landmark of Azerbaijan in an attempt to preserve the ancient carvings, relics, mud volcanoes and gas-stones in the region. The mountains Beyukdash, Kichikdash, Jingirdag, and the Yazili hill were taken under legal government protection. These mountains are located near the Caspian Sea, in southeast part of Gobustan.

In 2007 Qobustan was declared a UNESCO World Heritage Site considered to be of "outstanding universal value" for the quality and density of its rock art engravings, for the substantial evidence the collection of rock art images presents for hunting, fauna, flora and lifestyles in pre-historic times and for the cultural continuity between prehistoric and mediaeval times that the site reflects

In this study, photogrammetric evaluation of Qobustan have been completed

### 1. QOBUSTAN

Qobustan is one of the oldest known settlements and cult sites of humanity. Qobustan, which lies within the borders of Azerbaijan Republic and history of which goes back as far to BCE, consists of three regions named "Büyük Taş [Big Stone]"<sup>1</sup> "Küçük Taş [Small Stone]"<sup>2</sup>, and "Cingir Dağ [Jingir Mountain]" ("Yazılı Taş [Inscribed Stone]"<sup>3</sup>).

It is a common idea that the name Qobustan was given to the area due to its geographical features (landscape structure / rifts caused by the streams on the landscape). But the archeological excavations carried out in the area, petroglyphs and tamgas [markers], are in the quality to clearly display the connection of this name to the historical Turkish tribes (the Qobus / the Kipchaks). Some scholars sensitive to the case argued that the word Qobustan was related to the name of a Kipchak tribe called "Qobu" and rendered "the place of the Qobu", "the land of the Qobu".

### 2. PETROGLYPHS IN QOBUSTAN:

There exist approximately 7000 petroglyphs in "Büyük Taş", "Küçük Taş" and "Cingir Dağ" / "Yazılı Taş" regions of Qobustan, the majority of which are dated to the periods BC (12,000 BCE). These etroglyphs that were processed on the rocks by different methods of carving, scratching, striking, drawing and punctuating, display diversity in terms of their subject matters, too.

Some portion of the petroglyphs in Qobustan consist of depictions / drawings that express thoughts and emotions, lives, behaviors, concerns of life, fears, wishes, mutual relations of human beings. Such petroglyphs reflect the human beings' relations to the nature, its own species, and the animals which it would see as the biggest support and sine quo non to survive (mostly benefitted of their meat, milk, blood, wool, skin, and power; and sometimes mesmerized in admiration; and sometimes totemized in fear) in different aspects.

The other portion of the petroglyphs in Qobustan consists of petroglyphs based on mystic and religious themes, that depict the begging of human beings to the Deity and the mystic beings that they believed to have superior powers, their devotion to it / them and their expectations from it / them.

The petroglyphs in Qobustan are extremely important for serving as the graphical documents / proofs that exhibits the development and changing phrases of both the human beings and the living and non-living beings / species in the universe. It is still in debate that, by whom these graphical linguistic elements were done, and which society, community, nation /

<sup>1</sup> GPS: 39 361822 E 4441612 N 123 m; 40° 06.715 N 049° 22.723 E.

<sup>2</sup> GPS: 39 365677 E 44 40386 N 85 m; 40° 06.089 N 049° 25.453 E.

<sup>3</sup> GPS: 39 360563 E 44 49746 N, 43 m; 40° 11.096 N 049° 21.732 E.

nations they belonged to. Observing and evaluating in an objective way, it would be seen that a massive portion of the mentioned petroglyphs were executed in a period when the concern of a nation was established in our time's sense (even though there was / existed a participation and a collective kind of living when they were done / processed).

And a massive portion of the petroglyphs in Qobustan is the product of the historical and mystical experiences, myths, memories and facts that are unique to societies / communities that were in the process of becoming a nation. Such petroglyphs assume the most important key role to carry the researchers to determine the identities of the societies, communities, or nations that the individuals who executed them belonged to.

Among the petroglyphs in Qobustan are there some that look largely similar or alike to the ones that were executed by the Turkish communities and tribes in different regions of Asia, Caucasus and Anatolia, regarding their concepts and production techniques. There hasn't been any private research conducted so far on the petroglyphs that the Turkish tribes and communities have created in the different periods of history and in different geographies, and the source of which is made up of the Turkish ethnic collectivity (historical experiences, myths, memories and facts that are unique to Turks).

The depictions and tamgas [markers] that are mostly considered as totems, on the archeological materials (ornaments and everyday goods), graves, tombstones, and kurgans, found in the excavations and field works carried out in Qobustan area, do prove that the majority of the petroglyphs in Qobustan were created / processed by the Turkish tribes and communities in different periods. Yet, it does not necessarily mean that all of the petroglyphs and epigraphic materials in the area would belong to the Turks / Turkish tribes. Azerbaijan's geography (and in this concept, Qobustan area), bears many epigraphic and archeological materials from different nations, for that it frequently changed hands due to its strategic position and that it lied on the Silk Road.

### 3. PHOTOGRAMMETRIC DRAWINGS OF THE PETROGLYPHS IN QOBUSTAN:

Qobustan area makes one of the open museums of Azerbaijan Republic, today. The petroglyphs in the area are taken into the World Cultural Heritage list by the UNESCO. Though the photogrammetric measures and drawings of the petroglyphs in Qobustan have not been done, and the album and the catalogues have not been prepared so far. Within the scope of the project named "Turkish Inscriptions in Southern Turkestan, Caucasus, and Europe Project (Atatürk University Scientific Research Project BAP 2007/163)" headed by Cengiz ALYILMAZ, Ph. D., the photogrammetric imaging, measuring and drawings of the petroglyphs in Qobustan were done by a professional team under the supervision of Mr. Murat YAKAR. There are several documentation techniques available (Böhler, 1999). These techniques are indispensable tools for the conservation of heritage monuments. The conservation has to be carried out prior to the buildings destruction, transformation or undertaking of any intervention. These methods are envisaged to provide the building with a co-ordinates system (X,Y,Z) (Sienz et al., 2000). The methods and equipment commonly used for the documentation and surveying of buildings are (Scherer, 2002): traditional manual methods, topographic methods, photogrammetric methods, and scanning methods.

#### 3.1 Photogrammetric Studies

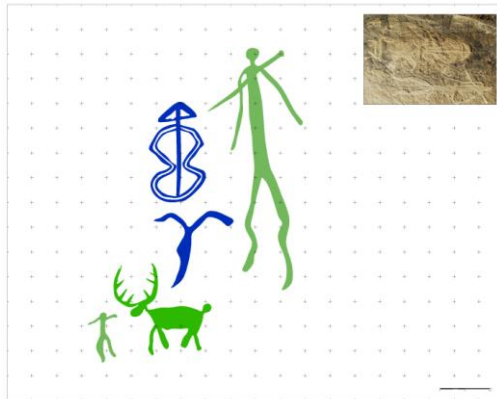
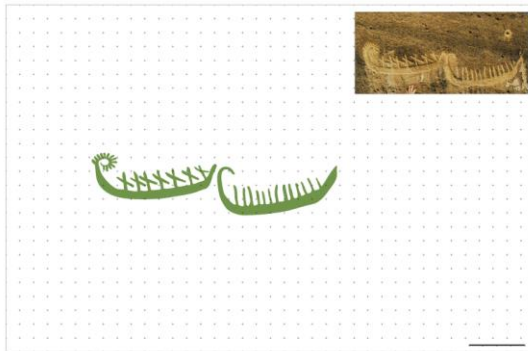
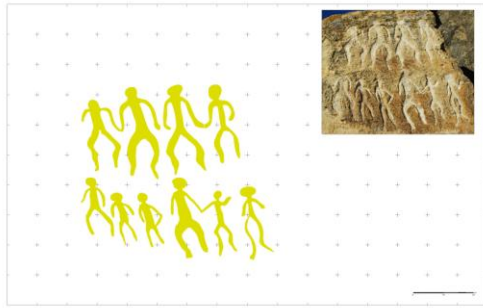
In this study; PhotoModeler software was used. PhotoModeler is a windows based photogrammetry software developed by Eos System Inc. This software has been used to accurately model and measure a physical object from digital images. In PhotoModeler, a 3-D object model consists primarily of a set of spatial points, edges, and/or curves. Surfaces and textures can later be conveniently added to the basic wire frame model to create a realistic solid model. Measurements of distances between two points, lines and points, points and surfaces, etc. can be made using the measurement tool. 3-D models can be exported in DXF format to AutoCAD, VRML format and other well-known formats.

To use of the digital cameras at photogrammetric evaluation procedures; calibration of camera should be completed. In this study, calibration process was completed with using photomodeler calibration module. A simple procedure is used in PhotoModeler to carry out a camera calibration by analyzing a grid of targets. A total of eight images are needed for calibration purposes. Processing of the eight photographs in PhotoModeler produces the following camera parameters: principal point coordinates (the intersection of the optical axis with the image sensor); principal distance (the distance from the center of the lens to the principal point); lens distortion characteristics (radial and tangential); and sensor format size (pixel size and number of pixels).

6 basic steps were needed to create the 3D-model out of the photographs.

1. Photo-Import, i.e. the photographs had to be scanned
2. Marking of object points: Every object point, which would build the 3D model, had to be marked in every photograph.
3. Identify and reference the identical marked object points.
4. Calculation of the camera positions and orientations. During the same procedure, also the 3D coordinates of every marked and referenced object point are calculated. The result is the basic 3D-model with estimates of errors for every point.
5. Adjustment and Scaling the model: this is done by telling the program the real distance between two object points, which was measured during the recording procedure (in our case the measured target points were used).
6. Export of the data to other CAD packages to render the model, produce animations. dxf (2D ve 3D), 3D studio, Wavefront OBJ, VRML (1 ve 2), Raw ve Microsoft DirectX etc

In this study photogrammetric evaluation was completed by photomodeler survey. Firstly camera calibration procedures have been completed, later photogrammetric evaluation and drawings have been completed. because of the flat area, only known horizontal measurement used to obtain scale and original lengths of object.



**Figure 1 Photogrammetric evaluation of Qobustan petroglyphs**

#### 4. CONCLUSION

Petroglyphs are images created by removing part of a rock surfaces by incising, pecking, carving, and abrading. The word comes from the Greek words petros meaning "stone" and glyphein meaning "to carve" (it was originally coined in French as pétroglphe).

Carved, forged or engraved petroglyphs are transforming the sights, which is placed on the area, to the natural museums. According to experts, petroglyphs are qualifying "expression resource", "mass medium" even "writings" of the times which is created date. In the portraits which are showing the praise god and complete dedication, generally, shamans, khans,

comanders have placed on the top. Besides all religion themed and ritual petroglyphs, there are also a very kind of petroglyphs which are treated everyday lifes, hunting, war scenes and ordinary events.

Close range photogrammetry technology in a way that provides good results for the petroglyphs. An efficient and effective method of recording petroglyphs and pictographs using digital photogrammetry has been presented. In this study Qobustan – AZARBAYCAN petroglyphs have been measured and drawn with close range photogrammetric Methods.

#### References

- Alyılmaz, C., Yakar, M., Yılmaz, H. M. Drawing of Petroglyphs in Mongolia by Close Range Photogrammetry, CIPA 2009 Symposium, Kyoto Japonya.
- Alyılmaz, Cengiz (2002), Gobi Çölünde ve Altay Dağlarında Kaya Üstü Tasvirler, Yeni Türkiye Dergisi, No. 46, Ankara, 613-615.
- Alyılmaz, Cengiz (2007), (Kök)türk Harfli Yazıtların İzinde, Ankara.
- Budagov, Budag E., (1994), Türk Uluslarının Yer Yaddası, Baku.
- Castagné, Joseph (1921), Le Tamgas Des Kirghizes (Kazaks), Revue du Monde Musulman, Tom: Quarante-Septième, pp.30-59.
- Ceferzade, İ. M. (1999), Qobustan Gaya Üstü Resimler Qobustan Petroglyphs Qobustan Naskal'nie İzobrajeniya, Baku.
- Geybullaev, Giyaseddin A. (1991), K etnogenezu azerbaydjantsev, Baku.
- Karataev, Olcobay Kubatbekoviç (2002), Türk Boylarında Tamgalar ve Eski Kırgız-Oğuz Etnik Bağlantıları, Türkler, Vol. II, Ankara, 386-390.
- Karataev, Olcobay Kubatbekoviç (2003), Kırgız Etnonimder Sözdüğü, Bishkek.
- Kereytov, Ramazan Husinoviç (1999), Etničeskaya İstoriya Nogaytsev (k probleme etnogenetičeskih svyazey Nogaytsev), Stavropol'.
- Kırzioğlu, M. Fahrettin (1992), Yukarı-Kür ve Çoruk Boyları'nda Kıpçaklar İlk Kıpçaklar (M.Ö. VII. - M.S. VI. yy) ve Son Kıpçaklar (1118, 1195) ile Ortodoks –Kıpçak Atabekler Hükümeti (1267-1578) (Ahıska / Çıldır Eyâleti Tarihi'nden), Ankara.
- Kosswig, L. (1974), Eigentumszeichen (Damga) in Anatolien, Oriens, XXIII-XXIV, 332-405.
- Memmedov, Nadir G. (2007), Toponomika, Baku.
- Mert, Osman (2009), Saahar Tepesi ve Bölgede Bulunan Kaya Üstü Tasvir, Damga, Yazıt ve Kurganlar, Atatürk Üniversitesi Türkiyat Araştırmaları Enstitüsü Dergisi, No. 40, Erzurum, 1-24.
- Muradova, F. M. (1979), Gobustan Tunc Dövründe, Baku.
- Perlee, H. (1976), Mongol Tümnii Garlıg Tamgaar Haij Sudlah N', Ulaanbaatar.
- Rinçen, Emhetgev (1968), Les Dessigns Pictographiques Et Les Inscriptions Sur Les Rochers Et Sur Les Steles En Mongolie

(Mongol Nutag Dah' Hadnı Bıçees Gerelt HöSöönii Züil),  
Ulaanbaatar.

Rüstemov, Cefergulu – Muradova, F. M. (2003), Gobustan  
Petroglifleri I, Baku.

Rüstemov, Cefergulu (2006), Gobustan Azərbaycanın Gedim  
Medeniyet Ocağı Gobustan The Ancient Centre of Azerbaijan  
Culture, Baku.

Böhler W, G. Heinz, (1999), 'Documentation, surveying,  
photogrammetry', XVII CIPA Symposium. Recife, Olind,  
Brazil

Sienz, J., Szarvasy, I., Hinton, E., Andrade, M.L., (2000)  
'Computational modeling of 3D objects by using fitting  
techniques and subsequent mesh generation', Computer  
Structure 78, pp 397–413.

Scherer, M., (2002), 'About the synthesis of different methods  
in surveying', XVIII International Symposium of CIPA,  
Potsdam, Germany, pp 423–429.