

BĪŠĀPŪR AND ITS TERRITORY (FĀRS, IRAN)  
*Second Interim Report of 2013 Campaign*  
(November)

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*Introduction*

The Joint Iranian-Italian archaeological activity<sup>1</sup> continued in Bīšāpūr city (Iran, Fārs region) with a second season in November 2013<sup>2</sup>. The activities of this year were mainly devoted to the following points:

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<sup>1</sup>One takes the occasion here to express our deepest thanks to the new Director of Research Center of the Iranian Cultural Heritage, Handicraft and Tourism Organization (RC-ICTTHO), Dr Jalil Golshan for his kind interest to our activities, to Mrs Susan Cheragchi, Monir Kholgi, responsables of the office of the International affairs of RC-ICTTHO and to the new Directors of the Iranian Centre of Archaeological Research (ICAR) Dr Siamak Sarlaq and Hamideh Chubak. Special thanks are due to Qodratallah Tajbakhsh (Head of ICTTHO Shiraz), Dr Mosayyeb Amiri, co-author of this report of ICHHTO, Shiraz and Director of the Research Centre of Bīšāpūr (RCS) and new Head of ICTTHO of Fars province, both for his scientific role and the qualitative and friendly operational participation to the work activities; Mohammad Reza Moini, Director of ICHHTO, Kazerun (RCS); Mohammad Khalil Mahmoudi of ICHHTO, Bīšāpūr (RCS); Miss Battul Khosravi, ICHHTO, Bīšāpūr (RCS). The realization of the work from the Italian side, has been possible thanks to the particular availability of the Italian Ministry of Foreign Affairs (MFA), of UNO, his Rector Prof. Lida Viganoni and the staff of the Office of International Relationships, in particular Dr Mrs Marina Guidetti and Dr Mrs Nicoletta De Dominicis. The scientific and technical support has been granted by the *Centro Interdipartimentale di Servizi di Archeologia* (CISA), UNO and for that, heartfelt thanks are devoted to the new President Prof. Fabrizio Pesando, Dr Antonella Sannino, Prof. Luigi Tartaglia of the *Directive and Technical Scientific Committee* (DTSC), the colleagues Prof. Irene

1. controlling and revising GPS points of the 17 areas identified last year throughout the support of the Autocad map (Autumn 1386/2007-2008) delivered to the Italians in 2011, by M.K. Mahmoudi, Battul Khosravi, G. Maresca and E. Cocca;
2. identifying new archaeological evidences (from area 18 to area 32), especially to North-East of the city, throughout the support of the Autocad map, by M.K. Mahmoudi, Battul Khosravi, G. Maresca and E. Cocca;
3. surveying the external side of Bīšāpūr city, to West, along the irregular wavy outline of the city, following for centuries the massive and impetuous flow of the Šāpūr river, in order to detect and possibly to make a macroscopic analysis on the very high geological deposit where the city is located, including eventual tectonic fractures or karstic or *qanat* galleries<sup>3</sup>, by M.K. Mahmoudi, Battul Khosravi, B. Genito, G. Maresca;

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Bragantini and Prof. Rodolfo Fattovich of the editorial staff of the *Newsletter di Archeologia* (CISA), Dr Andrea D'Andrea (Technical Director) and Dr Rosario Valentini (technical, technical-scientific and data processing staff). A particular thank is also due to Dr Giulio Maresca (PhD) for his scientific contribution for the photographic and topographic documentation of the archaeological evidences with GPS digital camera, his help as translator and any other organizational type of support as well, to Dr Enzo Cocca (PhD candidate in Università degli Studi di Ferrara and Research Fellow of UNO) for his scientific attitude, topographic survey and 3D rendering of the main monuments of the city. Last but not least many thanks are also due to Mr Hodjjatallah Attai, Mr Behnam Askari and Mr Ali Kashkouli, and to Mr Abd al Azim Joshan, ICHHTO, Kazerun.

<sup>2</sup>This activity follows two years of long preparation (2010-2011) and one year of fruitful collaboration (2012) throughout friendly and intense contacts with Drs Hasan Fazeli Nashli, Arash Laskhari, Seyyed Mohammad Mireshkhandari, Abbas Moqaddam, Siamak Sarlaq, former directors of ICAR, the former Ambassador of Italy Alberto Bradanini, the present Luca Giansanti, the cultural attaché Prof. Carlo Cereti, a written memorandum of Understanding on *Joint Archaeological Research Collaborations and Programs* signed by Mr Ahmad Mirza Koshnevis, former director of RC-ICHHTO, and IsIAO in April 2011, and an agreement signed between RC-ICTHHO and UNO by Dr Barzgar in December 2012, which one is going to renew or to re-formulate.

<sup>3</sup>The area in which Bīšāpūr is located is, morphologically, definable as a karst area: there are, in fact, morphological zones created between the creeks which flow rivers (some underground), also realizing real water tanks. In addition to rain, water is traditionally provided by *qanats* systems, very well-known ancient use of the water in the areas of the Ancient Near East, Southwest Asia, Central Asia, China and also Mediterranean Sea.

4. processing the Autocad data and extracting information for 3D model to the realization of a DTM (Digital Terrain Model) and subdivision of the vector levels, by E. Cocca;
5. 3D rendering of the Čāhār-Tāq, the Columns area, the Madrasa, the main monumental area (Anahita Fire Temple, mosaic Court, big cruciform Hall, three-iwan Hall open to south-east) and the six rock-reliefs on the right and on the left banks of Šāpūr river, by E. Cocca.

The project in such a complex historical, geographical, archaeological, geo-morphological, and territorial area (Amiri, Genito *et alii* 2013), results necessarily complex as well, in a way that it could go only on the basis of a multidisciplinary approach with different skills to be combined each other. The whole development of the project during the next five years, within this ample perspective, will be aimed at fully understanding the real and multifaceted nature of the urban layout and its related area.

In the tradition of studies related to Bīšāpūr city many aspects of the town planning, up to now brought to light, have been considered not belonging to the ancient settlement tradition of ancient Iran, and have been supposed to reflect, instead, a western influence. The city, surrounded by an irregular and partial line of walls, remained significant until the Arab invasion in the second quarter of the 7<sup>th</sup> century, when it became an active center of the Islamic culture up to the 10<sup>th</sup> century. Although a large amount of monuments have been already identified and excavated in the city, many aspects of the layout and of the surrounded area are still to be submitted to a detailed scrutiny:

1. the Sasanian and Islamic extension of the city;
2. the pre-Sasanian chronological phases, as the supposed Elamite, Hellenistic and Parthian<sup>4</sup>;

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<sup>4</sup> The supposed pre-Sasanian chronological phases of the city, including the Elamite, the Hellenistic or the Parthian (Ghirshman 1971), are very far from having being detected. Whether any stratigraphic concrete evidence of those period have not yet been brought to light, given the particular geological situation of the landscape all around, it cannot be completely excluded.

3. the exact layout of the city, including a still uncertain outline of the walls and the four gates mentioned by Moqaddasī (433 H.)<sup>5</sup>;
4. the incumbent presence of a large castle (Qal‘a-ye Dokhtar) on the eastern edge of the mountain over the city, unfortunately today separated by a modern asphalt road running to Kazerun to East and to Nurabad to West (Fig. 1);
5. a more discrete and almost imperceptible presence of a smaller castle (Qal‘a-ye Pesar) on the eastern edge of the other side of the mountain<sup>6</sup> (Fig. 2);
6. a bridge (Pol-e Gabrī) about half way between the Tāng-e Čōwgān and the southern extremity of the city (Fig. 3)<sup>7</sup>;

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<sup>5</sup> The layout of the city wall, irregularly encircling the urban area, does not seem to have a precise functional character: defensive, territorial, administrative and official etc. According to the results of this joint activity the extension of the city is 142 circa ha wide. Previously the calculation seems to have been oscillated between the 160 and the 170 ha (Salles and Ghirshman 1936, 118). The city walls are constituted by different typological features: a. highly elevated mounds, made by stones and soil to South; b. border of the plain to the terrace above the river’s bed to West; c. iron curtain and modern stone wall delimiting a long Khandaq to East; d. a particular and rather unusual, for Sasanian Iran, system of semicircular stone towers brought to light during the Sarfaraz’ work in the 70s of last century and now restored, to North.

<sup>6</sup> The castles, although with their different sizes and complexities, whilst, clearly, do seal the entrance and the exit to and from the Tāng-e Čōwgān and the city, already also pre-announced by the six famous rock-reliefs, real masterpieces of Sasanian Art, cannot, for the moment, be anchored to a precise chronology, indicating only a generic Sasanian span time.

<sup>7</sup> The remains of this bridge, give further evidence of the Sasanian capability of managing water affairs, as the famous bridges of Šuštar (UNESCO 2008), Dezful, Isfahan and Ahwaz etc. reveal. They testify, nonetheless, to a less sophisticated technological capacity, given the clear use of foundations directly laid on the stone pebbles of the rivers deposit. Only two large rectangular shaped pillars, founded on the ancient fluvial deposit to the eastern and to western sides of the river’s bed, remain located where a probable route came from the columns area to the West (Figs. 4-5). Against the first present our impression, Rice (1935, 177) talked about a massive stone bridge with three piers still surviving, by him defined as a “magnificent structure”. The hydraulic tradition of building bridges and dams seems to go back, in the Iranian plateau, to the Achaemenid and, perhaps, pre-achaemenid times. The most documented bridges of the Sasanian period comprise the Sharestan bridge in Isfahan (the oldest bridge on Zayandeh Rud, whose foundations go back between the 3<sup>rd</sup> and the 7<sup>th</sup> century). Its top was renovated in the 10<sup>th</sup> century by the Buyids and finally, during the 11<sup>th</sup> century, the Seljuk. The Dez’ful bridge is said to go back to the Sasanian dynasty as well to the era of Sasanian king Šāpūr I, using, possibly, Roman prisoners of war. The bridge has been repaired and rebuilt over the years by the Safavid and Pahlavi

7. the system of water supply according to their different origins:
  - a. the seasonal Šāpūr river;
  - b. the two active springs of Sarab-e Ardashir to West in the Roustā' of Seyyed-Hosseini (Fig. 6), Češmeh-e Sasan (in the river's bed) (Fig. 7), and the one partially still active of Sarab-e Dokhtaran to East (Figs. 8, 9);
  - c. the artificial sub-terranean canal/river coming from Češmeh-e Sasan and called with the same name running to Bušehr;
8. the very complicated *qanat* system together with a still uncertain network of horizontal galleries crossing or less the first system and the eastern khandaq, running from North to South, along about the eastern wall or in itself constituting the same external city wall (Fig. 10).

From a strict archaeological point of view the monumental “Sasanian” area is located in the north-western quadrant of the city with also a very close madrasa of Islamic, possibly Buyd period (Fig. 11). In the centre there is the Columns area (Fig. 12) and also a palace to West of it and a so-called Bath to south of the same area, in the south-western quadrant a Čāhār Tāq (Fig. 13) and in the south-eastern quadrant there is a large stone mosque (Fig. 14). The presence within the city all-around of different types of already self-emerging remains and newly identified (see below), enrich enormously the given complex layout. Amongst these evidences one may quote: middle and large sized “tepe”, highly elevated depositional areas or mounds (Elevated Mounds, i.e., monuments or palaces) in various dimensions and shapes, sometimes delimiting small and middle sized flat area (gardens); large empty spaces (fields); elevated stone accumulations

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dynasties. Currently one may think that the bridge was built over the ruins and foundations of a much earlier bridge. It is thought that a fort would protect the strategic bridge over the river Dez, hence the name, although there is no trace remains of the castle, maybe you will find under the old part of the city, adjacent to the bridge, known as the “Qaleh”. In the middle of the river, near the bridge, there are ruins of several water mills built in 300 BC about. Most of it were still in use in the early twentieth century. After the capture of the Emperor Valerian at Edessa (in the year 260), and the subsequent defeat of the Roman legions, the Roman navy captured, the survivors seem to be employed in the reconstruction of the bridge.

(monumental buildings?); slightly elevated soil and stones edges (with or without structural remains); a large number of circular shaped mouths of *qanat* (dry, active, completely full or partially full of water); long strips of soil and/or stones (routes?) with delimiting small stone walls, differently shaped; lowly elevated mounds with or without stone wall.

#### Morphology of territory

From a climatic point of view, Fars province in which Bīšāpūr is located was traditionally divided in two major areas: *Garmsīr* (“hot regions”) and *Sardsīr* (“cold regions”). The warm, moist areas correspond to those of the coastal districts, while in the mountainous regions of the interior the climate is temperate but also more arid (rainfall <300mm per year). For this reason, if one exclude the wettest peripheral areas, most of the rivers of Fārs does not have a consistent flow (it is basically a system of inland rivers often seasonal). Many of the reservoirs, also do not drain on their surface and it is not uncommon to observe evaporate deposits, mainly in the form of great salty accumulations: two of these are Mahārlū and Bakhtegān Lakes (Fig.15).

#### Nurabad area

Nurabad is the capital of the Mamasani province, one of the 27 provinces dividing Fars region. The northern and eastern part incorporate the mountainous regions of Javid and Doshman Ziari, in the West and South the hills of Mahour-e Milati and - Mahour-e Zirband lie, while the central area is dominated by four intermountain plains which, from South to North, are: Dašt-e Nurabad, Dašt -e Javid, Dašt-e Rostam-e Yek and Dašt-e Rostam-e Do (Fig.16). Of these four valleys, the highest is the Dašt-e Nurabad, which reaches 1000m above the sea level. The area of Mamasani extends for 45km from North-West to South-East and 15km from North-East to South-West (Roustaei, Alamdari, Petrie 2009, 17-20). Most of this area is not cultivated, but it is ideal for grazing, while the area of the valley is rich in water.

The central plain of the province of Mamasani, comprising the city of Nurabad is located in the *Mo'tadel* and is one of the more temperate regions of the Zagros; the northern part, however, is a *Sardsīr* area, while the southern is *Garmsīr* (Roustaei, Alamdari, Petrie 2009, 18).

The Dašt-e Nurabad has an irregular shape due to the presence of ridges and rocky outcrops that extend in the alluvial plain (Fig.17). Its maximum size is 11km from East to West and 8km from North to South, with a total area of 88km<sup>2</sup>. The city of Nurabad occupies the central and Eastern part of this area (Roustaei, Alamdari, Petrie 2009, 20).

Mamasani is a region of drainage water to the Persian Gulf, where the watershed is made up of the Western slopes of the Zagros. Here the course of the waters became very elaborate and is dominated by two major perennial rivers and by a smaller one, also perennial. In addition to these, there are many others of a seasonal nature, as well as various sources due to the karstic nature of the region. The course of the rivers is often altered by the alluvium produced from the slopes of the mountains. The main river of the Dašt-e Nurabad is Doroogh Zan, which flows from South-East and continues to the North-West across the Dašt-e Nurabad and beyond the limits of the latter through the mountains; born in the highlands South of Nurabad at an altitude of 1100m above the sea level, it has a relatively small capacity and is powered by a series of seasonal and not, streams; the most notably for the size is the Sangan-Korr, born in North-East from the source with the same name which crosses the Dasht-e Nurabad passing by the site of Tol-e Nurabad, the earliest part of the city. In the south-eastern lowland flows a sulfur stream (Roustaei, Alamdari, Petrie 2009, 21). The third outlet of the Dašt-e Nurabad leads through a series of gorges for a total length of about 20km, at Tang-e Čōwgān. It is a narrow gorge that leads, going in the direction of South-West, to Bīšāpūr, irregularly quadrilateral and North-West/South-East oriented.

Through this steep-walled gorge the Šāpūr river flows, defining the northern and north-western perimeter of the ancient Sasanian urban layout (Fig. 18).

Mamasani region is connected to the other inter-mountains valleys through a series of passes, as well as the four plains to interior of the region itself. The mountainous passes made Mamasani a region of focal importance in communication between Yasuj, Kazerun, Firuzabad and Bushehr. In particular, the pass of Yagheh Sangar, the point of transition between the Dašt-e Rostam-e Do and the Dašt-e Rostam-e Yek, has been identified by Herzfeld as the *Persian Gates* referred to by the sources of Alexander the Great within the territory of Uxiani (Herzfeld 1968, 178). The issue, nonetheless, is still controversial (Roustaei, Alamdari, Petrie 2009, 23). The

Dašt-e Nurabad leads outside through three passes: the first Baj Gah connecting to the North with the Dašt-e Javid, is relatively steep, 700m wide and 3km long and provides access to the heart of Mamasani region and to the related communication routes; the second to East connects the Buvān valley, gradually rising in altitude until reaching the Ardakan plateau (2150m) and from there, through a series of gorges, reaching Tang-e Khollar; the third, going toward South, leads to Kazerun through Bīšāpūr, and then continues to Shiraz, Firuzabad and Bushehr, through routes used since ancient times (with the exception of that crossing Shiraz, capital of current Fars, connected by a newly constructed route) (Roustaei, Alamdari, Petrie 2009, 22-24).

#### Kazerun area

Kazerun is located less than twenty kilometers South-East of Bīšāpūr, in a flat area at an altitude of about 800m above the sea level bounded to the East and to the West by two ridges that rise over 1500m above the sea level (Fig. 19). From a structural and hydrogeological point of view, the Kazerun area is divided into seven karst sub-aquifer<sup>8</sup> and five alluvial sub-aquifer, interconnected between them and forming a single complex geological entity. The intense tectonic activity, however, has recently shocked the geology of the area, creating, thus, a partial separation of aquifers in different structural units.

The geology of the geotectonic Zagros unit in the Kazerun and Bīšāpūr area is characterized by long, smooth anticlines (the ridges) and synclinal folds (the plains and valleys). The high-altitude karst basins are composed of the sub-aquifers Rejan and Sasan, whose waters flow to the surface area of the Tang-e Čōwgān and form the river Šāpūr. These two karst sub-aquifers, along with two other alluvial, form an hydrogeological unit, while another unit is formed by the karst sub-aquifer Daštak, Sarvak, Parishan, Sarbalesh and Dadin, while five have developed in the alluvial sub-aquifer synclinal valleys: Šāpūr, Kazerun, Famour - Parishan and Čenar Šahijan.

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<sup>8</sup> For sub-aquifer one means an aquifer in which the water comes almost to the surface. The aquifer is made from a solid phase (rock) underground in which a liquid phase (water) and a gaseous phase (air) circulate. The flap instead is the water that circulates in the subsurface and is said groundwater when there is a natural access to the outside.



The karst sub-aquifer Sasan is, as already stated, the most important water reservoir of the whole area and its hydrological characteristics are the result of a slow long formative process, which is still in place: the succession of tectonic movements to a certain extent has caused the fracture of plates into smaller chunks, promoting, thus, the processes of karst erosion by water.

Two important water reservoirs of the Kazerun area are the Aržan and the Parishan lakes, respectively located at an altitude of 1990m and 850m above the sea level. The Aržan lake is a karst basin seasonally flooded, fueled mainly by a source of the same name, and the level of water is between 3 and 4 meters. At the base of the lake basin is a ponor, i.e. a vertical sinkhole, a large circular karstic depression 10-15m wide, and 10m deep, and it is conceivable that the water through it reaches the area of Kazerun. The sub-aquifer Parishan, is a complex hydrogeological unit characterized by the close correlation between the ground and the surface waters: the bottom of the lake Parishan (also seasonal) is located at the base of the erosion of the sub-aquifer Parishan and, despite the surrounding limestone rocks are affected by karst phenomena, the groundwater flows in only one direction, from the aquifer towards the lake.

In 1974, the area of the Aržan and Parishan lakes was recognized by UNESCO as one of the most important ecosystems on the planet, and today is, in fact, a protected area (Fig. 20). It houses, in fact, many animal and plant species at risk of extinction, like the gray pelican and the white-headed duck, and it is also important seasonal destination for some species of migratory birds. Up to 70,000 years ago, the forest that stood between the two lakes was also the habitat of the Persian lion, now found only in some parts of Africa, who disappeared from this area probably due to an over-exploitation of the resources.

#### Lakes, Rivers and *Qanats*

Such a landscape, should have always, contributed to transform the territory around in a very rich area full of water and of life possibilities, since the proto-historic times as well, although those periods are not completely archaeologically documented. Clear evidence of this is the very deep deposit (circa 10m) of the Šāpūr river flood, which can be observed

along the whole western limit of the city, and which, with alternating layers of pebbles, architectonic stones and soil accumulations, indicates a long depositional and longlasting sediment (Figs. 21-22).

This whole area, including the southern area near Kazerun, is affected by karst phenomena. The intense tectonic activity that affected the Zagros and which is still in progress has, indeed, fractured blocks of limestone, and the water has behaved the same way as an acid, dissolving the rock and forming channels, depressions and holes on Asmari limestone, geological formation dominant in this region. In this way, the whole Kazerun-Bīšāpūr area is dotted with sub-aquifers connected together to form a complex hydrogeological unit (this makes the water flow very balanced, but also leads to a deterioration in water quality).

The hydro-geological complexity is clearly further evidenced by the presence of a typical, stream-like and seasonal river with periodical big flood, at least three springs and many canals (partly subterranean and partly open air) and a, still under scrutiny, *qanat* system mostly, right now, related to the Rusta' (villages) of Eslamabad to South, Panj-mahal and Chamran to East (Figs. 23-24), but once, most probably, serving the centre of the city.

The presence of running water inside these subterranean canals coming both from the river and the water springs, and that of many dry *qanats* (ancient and modern), make the situation quite difficult and complex, whose geo-territorial reasons are not easy to explain; it seems rather plausible that the running water inside the *qanats* is coming from the subterranean canal named Rud-e Cheshmeh-e Sasan running to Busher, probably made in ancient times and still today active.

The sewage and water channels of the city are expressions of the highest level of technology characterized by outstanding efficiency.

## Lakes

Fars is relatively rich in water and there are many rivers, springs, waterfalls and lakes.

In addition to the Bakhtegan Lake, the others are those of Maharlu, Parishan/Famur (Fig. 25), and Aržan (Fig. 26). With regard to the lakes, in the last decades, extensive studies have been carried out on the characteristics of very high saline degree of the waters of this area, through

sampling and biochemical analyzes, which showed specific characters far removed from those of the other lake areas.

All this made the flora and fauna in the area of particular interest for their capability to adapt and, in particular several studies have emphasized the particularity of some medicinal plants.

Parishan lake is the largest in Fars; even if it receives a low intake of water from its tributaries is one of the most important for the procurement of the aquifer and the entire surrounding ecosystem.

This lake is saline and up to the 70s the water levels were very low which increased over time, giving rise to a dense vegetation that manages to originate, despite the salinity; the water is also important for the pharmaceutical properties. Like most of the lakes and in particular in Fars, it dries up in the summer, and this leads to a fundamental change in the cyclical nature of the neighboring plants and animals.

Along with the Dast-e Aržan it joined in 1976 to form part of a protected area, covering 59,784 ha. The latter is a narrow mountain basin located at 1500m above thesea level, which extends from a higher angle to the East, where it has been supposed to feed the Parishan lake.

Located in an area protected by mountains on both sides, now sits on an important route of communication between North and South in the vicinity of the centers of Shiraz, Nurabad and Kazerun. It is a seasonal lake which, even after rainy winters reaches 2200 ha and which during periods of drought becomes muddy. Over time it proved to be crucial for the predominantly agricultural economy of Fars. This basin in all the ages, has been crucial for grazing and cultivation, ensuring important products, particularly almonds.

## Rivers

The most important river is Kor which empties into the Bakhtegan Lake. Also important are the Foruz Abad, Qare Amaj and Fahlian originating from the mountains of the region and spill in the Persian Gulf.

The river Šāpūr was born in the mountains around the lake Aržan (Fig. 27) and empties into the Persian Gulf, about 25km from the road between Shiraz and Kazerun. This runs through a narrow gorge called Tang-e Čōwgān, and then continuing to the South reaching Bīšāpūr city. The river divides into two orographic pads through, and a bridge near the city was

built. Formerly, the river flowed out of the city and also reached the inside, probably artificially diverted in order to supply its aquifer. Together with Dalaky is a saline river. Satellite image traces the path of Šāpūr river from its source to the site. The river is also verifiable by clear signs of its passage present on the cliffs near the town where they were found six Sassanid rock reliefs, which show evidence of rising water levels in the past<sup>9</sup>.

At the Tang-e Čōwgān the river forms a ford, used since ancient times (Rice 1935, 177, fig. 6). In this area the river is fed by underground water reserves, which also promote agriculture than it is as a very fertile area (Ghirshman 1971, 22). The sub-aquifer of Sasan, the history of the formation of which is witnessed by a stratigraphic sequence outcropping in the North-West of the Tang-e Čōwgān, sends its waters to that of Renjan, located at the highest elevation (920m above the sea level): this occurs when the precipitation exceeds 30mm in 24 hours, which causes an abrupt and rapid change in pressure in the aquifer (Milanovic, Aghili 1990, 163, 165-167; 169).

### *Qanats*

Almost all the ancient Iranian settlements are located near the so-called *Qanat* (Arab) or *Karez* (from Persian), real technological pivot which revolves around the creation and dissemination of well-known gardens and arable land. The water system of *qanats* drainage is a particular technology for the exploitation of water resources in semi-arid and desert regions, already developed in very ancient times.

In Bīšāpūr there is a large number of *qanat* (Fig. 28), and only a few points with the greatest presence of water, for the better understanding of the aquifer exploitation of the site. The system is based on the construction

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<sup>9</sup> These have considerable size (10/15m) and are located respectively four on the right and two on the left. In addition to the findings is to be mentioned, near the river in the cave Mudan 300m approx. high, the discovery of the imposing statue of Šāpūr I 7m high approx. Šāpūr's cave, karst in origin, has formed due to the erosion of the base of Tang-e Čōwgān by the river Šāpūr, which reached as a lower level. The cave in question is famous as it houses a monumental mutilated statue of the king Šāpūr I, son of Ardashir I, first ruler of the Sassanian dynasty, 7m high and carved from a rocky pillar of the cave; the statue was to portray the king standing, with his right arm resting on the other side and perhaps on the sword; the bearded head with long whiskers is framed by voluminous wavy hair, posing on which the crenellated crown.

of underground horizontal drainage tunnels, provided with vertical wells, capable of receiving waters of an aquifer. The underground tunnel is connected to the surface through the wells with vertical ventilation: it is constituted by an active part draining upstream, namely the one that penetrates in the hydrogeological levels, and a part normally functioning as adductor that reaches up to the points of distribution of waters, agricultural areas, or inhabited more downstream. It is a little questionable on the state of our knowledge the near-eastern origin of this system, which has seen, however, a spread, albeit reduced, in the European areas such as Spain, southern Italy, and also North Africa, Arab peninsula, Central Asia and China. In Iran there are about 22,000 modern *qanat* which include more than 300,000 km of underground channels. The system provides the 75% of all the water used in the country, not only for irrigation but also for domestic purposes. Just think for example, that until a few years ago (before the construction of the Karaj dam) the inhabitants of Tehran city depended for their entire water supply by a system of *qanats* providing to draw water from the hills at the foot of the Elbruz mountains. The work of construction of *qanats* begins with a thorough inspection of the ground by an expert hired by the organizers.

A system of *qanats* is usually dug into the slope of a mountain or in the hilly part where the material dragged along the slope forms an alluvial deposit. The charge of exploration carefully examines these alluvial formations, generally during the autumn, seeking traces of seeping into surface or slight variations in vegetation that may suggest the presence of hidden water sources in the hilly part. Two diggers, called *muqanni* fix a winch on the surface to lift the material digging through buckets of leather and proceed to dig a vertical shaft about a meter in diameter; a man working with a hoe, and the other with a short-handled spade, while two other workers on the excavation ensure the continuation of the work. When they arrive at the moist layer of a potential water table, a hole is dug, so you then decide to continue or not and to direct the *qanat* to a certain place.

*Field Activities in 2013 (by G. Maresca)*

The joint Iranian/Italian team worked at points 1, 2, 3 indicated above (*infra*, 124), following the usual approach of a “landscape archaeology”, where the territory (physical, geological and human) is considered as a unitary element to be investigated as a whole, including the archaeological evidences.

The digital photographic documentation is correlated to GPS points (geo-tagged), and is going to be displayed and queried in a GIS system. These activities are both usable for mapping the different archaeological evidences (for a better understanding of the topographic layout), and a future sharing of data which can be exploited for a scientific and touristic management of the cultural heritage.

The very rich territorial complexity of the Bīšāpūr area is clearly evidenced through the presence of different factors whose interpretation (in our opinion) could help very much the general understanding of the city layout. Many low lying depositional area (LLDA), mostly spreading over the western and the southern side of the city and clearly full of water visible from the aerial photos of the 30s, suggest the possibility of the presence of agricultural fields. Other LLDA close to possibly areas of buildings should still to be correctly evidenced and interpreted according to the urban complexity of such a large city.

List of the Surveyed Evidences

**Area 1**

*Location:* immediately at North-West of the Columns area;

*WGS84 Coordinates:* the centre of the area is approximately DD 29.778415 (lat.) 51.57063333 (long.);

*Typology:* mound-like strip of soil, possibly with residual soil from secondary deposit;

*Morphology:* high-elevated mound with a sub-circular shape, a quite regular perimeter and a slightly convex profile (rather flat on its top), sloping to the south-western side;

*Description:* partly unexcavated soil, with one sufficiently long open section to the east, with scarce vegetation on the rather plain top; an ample vegetation area is found at North-West around the very badly preserved remains of a quadrangular room; large amount of middle and big sized stone

are seemingly used to contain the northern and partially the eastern sides of the area;

*Scatter of ceramic material:* low-density scatter of pottery fragments (mostly un-diagnostic and unglazed potsherds).

### **Area 2**

*Location:* immediately East of Area 1 and from this divided by a small street running with an East-West axis;

*WGS84 Coordinates:* the centre of the area is approximately DD 29.7789366 (lat.) 51.57094167 (long.);

*Typology:* mound-like strip of soil, possibly with residual soil from secondary deposit;

*Morphology:* high-elevated mound with a sub-rectangular shape, a quite regular perimeter and a rather flat top;

*Description:* partly unexcavated soil with one sufficiently long open section to the west, with scarce vegetation on the rather plain top; vegetation is largely found all around at south and at north, where it leaves visible a large settled area; a large amount of middle and big-sized stones (Area 3, see *infra*) was used to retain the eastern side of the area; moreover, many quadrangular shaped rooms are detectable at both the lower sides of the area, all around;

*Scatter of ceramic material:* medium-density scatter of pottery fragments (mostly un-diagnostic and unglazed potsherds, even if some diagnostic and glazed potsherds are also found).

### **Area 3**

*Location:* immediately East of Area 2;

*WGS84 Coordinates:* the centre of the area is approximately DD 29.7790333 (lat.) 51.571 (long.);

*Typology:* regular and probably artificial (from secondary deposit) accumulation of stones;

*Morphology:* high-elevated accumulation of stones with a sub-rectangular shape, a quite regular perimeter and a rather flat top;

*Description:* diaphragm of middle and big-sized stones between Area 2 and Area 4 (see *infra*), retaining both archaeological and not archaeological remains;

*Scatter of ceramic material:* there seems to be no scatter of pottery fragments.

#### **Area 4**

*Location:* north-eastern extension of Area 3, which from this turns northwards;

*WGS84 Coordinates:* the centre of the area is approximately DD 29.779 (lat.) 51.57094 (long.);

*Typology:* mound-like strip of soil, possibly with residual soil from secondary deposit;

*Morphology:* high-elevated mound with a sub-rectangular shape, a quite regular perimeter and a rather flat top;

*Description:* partly unexcavated soil, with a large amount of vegetation on the rather plain top, whose surface is characterised by the presence of potsherds and a major density of small stones and/or pebbles; the eastern side of the area is retained by a large amount of middle and big sized stones (Area 3). In the north-eastern corner large quantities of middle and large-sized stones are present possibly to contain the sides of the Area. The western side slopes towards a nearby urbanized area where structural remains are located, in particular, a quadrangular shaped room is detectable at the lower part of the north-western corner;

*Scatter of ceramic material:* medium-density scatter of pottery fragments (mostly un-diagnostic and unglazed potsherds, even if some diagnostic and glazed potsherds are also found, including some pottery disks).

#### **Area 5.1**

*Location:* in the north-western corner of the city, along the western limit of the site and not very far from the house of the Mission;

*WGS84 Coordinates:* the centre of the area is approximately DD 29.7831 (lat.) 51.56920333 (long.);

*Typology:* mound-like strip of soil;

*Morphology:* high-elevated mound with a narrow sub-rectangular/elliptical shape, a rather irregular perimeter and an essentially convex profile even if with a rather flat top;

*Description:* area with ample vegetation and a medium-low concentration of stones (especially on the top and of small dimensions); two benchmarks are located on the rather flat top. At the side there are unsettled low-lying flat



depositional areas. The area seems to be interpretable as a portion of the external urban wall;

*Scatter of ceramic material*: low-density scatter of pottery fragments.

### **Area 5.2**

*Location*: in the north-western corner of the city, along the western limit of the site and very close to Area 5.1 (to North), not very far from the house of the Mission;

*WGS84 Coordinates*: the centre of the area is approximately DD 29.7828 (lat.) 51.56868833 (long.);

*Typology*: mound-like strip of soil;

*Morphology*: high-elevated mound with a narrow sub-rectangular/elliptical shape, a rather irregular perimeter and an essentially convex profile even if with a rather flat top;

*Description*: area with ample vegetation and a medium-low concentration of stones (especially on the top and of small dimensions). At the side there are unsettled low-lying flat depositional areas. The area seems to be interpretable as a portion of the external urban wall;

*Scatter of ceramic material*: very low-density scatter of pottery fragments.

### **Area 5.3**

*Location*: in the north-western corner of the city, along the western limit of the site and very close to Area 5.2 (to North), not very far from the house of the Mission;

*Typology*: mound-like strip of soil;

*Morphology*: high-elevated mound with a narrow sub-rectangular/elliptical shape, a rather irregular perimeter and an essentially convex profile even if with a rather flat top;

*Description*: area with ample vegetation and a medium-low concentration of stones (especially on the top and of small dimensions). At the side there are unsettled low-lying flat depositional areas. The area seems to be interpretable as a portion of the external urban wall;

*Scatter of ceramic material*: very low-density scatter of pottery fragments.

### **Area 6**

*Location:* behind the house of the Mission, along the western limit of the site;

*WGS84 Coordinates:* the centre of the area is approximately DD 29.7832816 (lat.) 51.570335 (long.);

*Typology:* mound-like strip of soil;

*Morphology:* high-elevated mound with a narrow sub-rectangular/elliptical shape, a rather irregular perimeter and an essentially convex profile even if with a rather flat top;

*Description:* area with ample vegetation and a medium-low concentration of stones (especially on the top and of small dimensions). At the side there are unsettled low-lying flat depositional areas. The area seems to be interpretable as a portion of the external urban wall;

*Scatter of ceramic material:* very low-density scatter of pottery fragments.

### **Area 7**

*Location:* just behind the house of the Mission, along the western limit of the site;

*WGS84 Coordinates:* the centre of the area is approximately DD 29.7829616 (lat.) 51.57137 (long.);

*Typology:* mound-like strip of soil;

*Morphology:* high-elevated mound with a narrow sub-rectangular/elliptical shape, a rather irregular perimeter and an essentially convex profile even if with a rather flat top;

*Description:* area with ample vegetation and a medium-low concentration of stones (especially on the top and of small dimensions). At the side there are unsettled low-lying flat depositional areas. The area seems to be interpretable as a portion of the external urban wall;

*Scatter of ceramic material:* there seems to be no scatter of pottery fragments.

### **Area 8**

*Location:* north of the bridge, along the western limit of the site;

*WGS84 Coordinates:* traces of the evidence can be detected at list from DD 29.7800 (lat.) 51.56662 (long.) and until DD 29.7794516 (lat.) 51.567475 (long.);

*Typology:* delimitation of terraced fields;

*Morphology*: large extended area, terraced soil with large vegetation remains, above the level of the low lying depositional area distributed in the portion of the site around the house of the Mission and along the river;

*Description*: two or three terraced levels are marked by the presence of small an low-elevated walled lines running from west to east; at the top, more to east, some structural remains are located (small walls “A” and “B”) with the first running up, more or less regularly, to the top where a quadrangular and a circular alignment of stones are remarkably located; the first level is the one of the plain low lying depositional areas; the second level goes along the probably prolongation of the small wall “A” running in a curvilinear line to the third level with the structural remains;

*Scatter of ceramic material*: very low-density scatter of pottery fragments.

### **Area 9**

*Location*: westwards of the F1 static point;

*WGS84 Coordinates*: entering the site from South, the evidence is detectable from approximately DD 29.77163 (lat.) 51.56696167 (long.); approximately at DD 29.77278 (lat.) 51.56839667 (long.), the evidence turns westwards an can be detected until DD 29.773466 (lat.) 51.56783667 (long.)

*Typology*: long and regular strip of soil flanked by straight alignments of stones (street);

*Morphology*: very shallow and quite long accumulation of soil with a linear, straight and elongated shape and a slightly convex profile, running at first with a North-East-South-West axis, then turning westwards;

*Description*: a straight alignment of stones is present, turning eastwards with a 90° angle. It seems the eastern limit of a street running further, with a South-East-North-West axis, after overstepping a sort of crossroad. The eastern limit of the street is more detectable. Furthermore the alignment is flanked on its western side by a quite regular squared room accurately delimited by stones and whose central part presents an evident depression. The alignment is flanked on its eastern side by a circular structure; it, then eventually turns westwards with a 90° angle towards the Mosque where it forms the outer limit of a sort of a “L” shaped platform probably ending with a square room at a few meters of distance from the Mosque itself and surrounded by small, irregular and low elevated mounds probably related to the excavations;

*Scatter of ceramic material*: very low-density scatter of pottery fragments.

### **Area 10**

*Location:* North-East of area 9, at some meters of distance from the north-eastern angle of the Mosque;

*WGS84 Coordinates:* the south-eastern corner of the northern mound “A” is approximately DD 29.7732566 (lat.) 51.56844833000001 (long.), the south-western corner of the southern mound “B” is approximately 29.7730333 (lat.) 51.56854833 (long.);

*Typology:* shallow quadrangular mounds;

*Morphology:* small low-elevated (average heights about 1 meter) mounds: “A” and “B”, with a quadrangular shape, a very regular perimeter and an extremely slightly convex profile with a flat surface;

*Description:* couple of very similar shallow quadrangular mounds separated each other by a few metres of terrain and not located on the same axis. The perimeter of each mound is marked by regular alignment of stones at the four sides and by a quite high concentration of collapsed stones; on the flat surfaces of each mound, instead, stones are almost totally lacking. At the present stage is very difficult to formulate hypotheses about their function;

*Scatter of ceramic material:* medium/low-density scatter of pottery fragments.

### **Area 11**

*Location:* about 30 meters North-East of Mound “B” of area 10;

*WGS84 Coordinates:* the centre of the area is approximately DD 29.7738233 (lat.) 51.56878667 (long.);

*Typology:* mound-like strip of soil;

*Morphology:* low-elevated mound, very irregular in its profile and surface;

*Description:* the surface of the area is marked by the presence of a quite high concentration of stones of medium dimensions. The mound, with a very variable height between 0,40 and 2 meters, seems to be located within an essentially unsettled low-lying flat depositional area and is surrounded only by long and regular strips of soil flanked by straight alignments of stones;

*Scatter of ceramic material:* low-density scatter of pottery fragments.

### **Area 12**

*Location:* near the south-eastern wall of the Mosque;

*WGS84 Coordinates:* the north-easternmost limit of the area is approximately DD 29.7730 (lat.) 51.56678 (long.)

*Typology:* mound-like accumulation of soil, possibly with residual soil from secondary deposit;

*Morphology:* low-elevated mound with a slightly quadrangular shape, a rather irregular perimeter and an extremely slightly convex profile with a flat even if irregular surface;

*Description:* the surface of the area is irregularly spotted by vegetations and several accumulations of stones of different dimensions; the characteristics of the soil and the general aspect of the mound, with a shallow depression in its centre, seem to indicate that it is formed by material resulting from the excavations carried out in the nearby Mosque.

*Scatter of ceramic material:* medium/low-density scatter of pottery fragments.

### **Area 13**

*Location:* stand just against the *qibli* wall of the Mosque;

*WGS84 Coordinates:* the centre of the area is approximately DD 29.7733166 (lat.) 51.566571669999988 (long.);

*Typology:* mound-like accumulation of soil, possibly with residual soil from secondary deposit;

*Morphology:* medium/high-elevated mound with a slightly quadrangular shape, a rather irregular perimeter and an extremely slightly convex profile with a flat even if irregular surface;

*Description:* the surface of the area is irregularly spotted by vegetations and several quite large accumulations of stones of different dimensions; the characteristics of the soil, the peculiar location of the mound (just against a wall) and its general aspect seem to indicate that it is formed by material resulting from the excavations carried out in the adjacent Mosque;

*Scatter of ceramic material:* medium/low-density scatter of pottery fragments.

### **Area 14**

*Location:* behind Area 13 and also on its western part, in the area where the southern wall of the site seems to show another interruption;

*WGS84 Coordinates:* the centre of the area is approximately DD 29.7736033 (lat.) 51.56672167 (long.);

*Typology*: wide flat area with traces of modern agricultural activities;

*Morphology*: nearly quadrangular shaped;

*Description*: quite large-extended area covering the portion of the site located around the south-western corner of the Mosque, stretching towards the southern city wall. The area, which seems to be interpretable as an unsettled low-lying flat depositional area (with a very low density of stones on its surface), shows evident traces of modern agricultural activities as ploughings and some small canals;

*Scatter of ceramic material*: quite high-density scatter of pottery fragments.

### **Area 15**

*Location*: South of Area 14;

*WGS84 Coordinates*: the most noticeable portion of the area is located between DD 29.772798 (lat.) 51.56577833 (long.) and DD 29.7730116 (lat.) 51.56601333 (long.);

*Typology*: quite long and regular strip of soil flanked by straight alignments of stones (street);

*Morphology*: very shallow and quite long accumulation of soil with a linear, straight and elongated shape and a slightly convex profile, running with a North-East-South-Western axis;

*Description*: the evidence is characterised by a high concentration of sparse stones both on its surface and flanking its course; some of its portions, moreover, reveals the presence (often on both sides) of regular and straight alignments of stones at its margins, representing its original limits (each alignment is constituted by two parallel rows of slightly bigger stones). The evidence, which reveals some traces of damages probably due to the modern agricultural activities clearly attested also at the nearby Area 14, seems to be interpretable as a street entering the site from south and going towards the south-western angle of the Mosque;

*Scatter of ceramic material*: quite high-density scatter of pottery fragments.

### **Area 16**

*Location*: against the western wall of the Mosque;

*WGS84 Coordinates*: the centre of the area is approximately DD 29.7737016 (lat.) 51.56681167 (long.);

*Typology*: mound-like strip of soil, possibly with residual soil from secondary deposit;

*Morphology*: high-elevated mound with an irregular elongated and slightly sub-rectangular shape, an irregular perimeter and an essentially convex profile, even if with some considerable rather flat portions;

*Description*: it seems to be made up by two distinct superimposed smaller mounds (the one on top with a semicircular profile), forming a slope descending from the Mosque wall at a height of approximately 4 meters to about 0,30 meters to the west; its surface is spotted by at least three assemblages of concentric rows of stones (of very uncertain interpretation);

*Scatter of ceramic material*: medium/low-density scatter of pottery fragments.

### **Area 17**

*Location*: North-East of Area 16

*WGS84 Coordinates*: the centre of the area is approximately DD 29.773 (lat.) 51.57233333 (long.);

*Typology*: mound-like strip of soil;

*Morphology*: high-elevated mound with a narrow sub-rectangular/elliptical shape, a rather irregular perimeter and an irregular profile (essentially convex but with several rather flat portions on its top);

*Description*: indication of the presence of an ancient wall (probably the eastern city wall) and related structures are at first very lightly traceable and then are clearly recognizable on the top of the Area, testified by several straight or circular alignments of stones or by small and badly preserved walls delimitating several rooms;

*Scatter of ceramic material*: low-density scatter of pottery fragments (most of which diagnostic).

### **Area 18 (Fig. 29)**

*Location*: stretching along the north-western portion of the site;

*WGS84 Coordinates*: the evidence is detectable approximately from DD 29.77726074084862 (lat.) 51.56441017985344 (long.) to DD 29.7808616 (lat.) 51.569695 (long.)

*Typology*: long and regular strip of soil flanked by straight alignments of stones (street);

*Morphology*: very shallow and long accumulation of soil with a linear, straight and elongated shape and a slightly convex profile, running with a North-East-South-West axis;

*Description:* the evidence is characterised by a high concentration of sparse stones both on its surface and flanking its course; several portions of it, moreover, reveals the presence (often on both sides) of regular and straight alignments of stones at its margins, representing its original limits (each alignment is constituted by two parallel rows of slightly bigger stones). The evidence is quite clearly detectable on the ground, starting just a few metres east of a water channel (which runs with an approximately South-East-North-West orientation towards the slope of the city) in the north-western portion of the site, until it seems to find an end in correspondence of the mound with structural architectural remains listed as Area 28 (see *infra*). Before reaching the aforementioned mound, the evidence is cut by a *qanat* approximately at DD 29.7782777777777777 (lat.) 51.5658888888888885 (long.), by an agricultural canal (which leaves partially visible its section) at DD 29.7786666666666666 (lat) 51.5664722222222224 (long.) and is also interrupted by the old railway utilised by the French team headed by Roman Ghirshman approximately at DD 29.7803 (lat.) 51.56897667 (long.). From the evidence, moreover, some other similar ones spread with different orientations;

*Scatter of ceramic material:* there seems to be no scatter of pottery fragments.

#### **Area 19 (Fig. 30)**

*Location:* along a portion of Area 18, flanking its eastern side;

*WGS84 Coordinates:* the centre of the area is approximately DD 29.7793611111111111 (lat.) 51.5673333333333334 (long.);

*Typology:* well (?);

*Morphology:* extremely shallow accumulation of soil with a somewhat sub-circular shape and a pit at its centre;

*Description:* the evidence is surrounded by a medium concentration of stones (probably to be related to the nearby Area 18); at its centre a quite regular, rectangular-shaped pit is cut, delimited by a series of stones and partially filled by soil and vegetation. As the pit is not surrounded by other similar evidences, it could be interpreted as an isolated well rather than a *qanat*;

*Scatter of ceramic material:* there seems to be no scatter of pottery fragments.



**Area 20** (Fig. 31)

*Location:* between a portion of Area 18 and the bridge, a few metres north-east to the railway utilised by the French team headed by R. Ghirshman;

*WGS84 Coordinates:* the centre of the area is approximately DD 29.7813133 (lat.) 51.568595 (long.);

*Typology:* shallow mound;

*Morphology:* low-elevated mound with an essentially rectangular shape, a quite regular perimeter and a slightly convex profile;

*Description:* the surface of the evidence, quite isolated in the western portion of the site, is characterised by the presence of a medium-high concentration of stones and a particularly high concentration of pottery fragments;

*Scatter of ceramic material:* high-density scatter of pottery fragments (some of them can be considered as slags).

**Area 21** (Fig. 32)

*Location:* South-West of the Čahār Tāq;

*WGS84 Coordinates:* the centre of the area is approximately DD 29.7760166 (lat.) 51.56541167 (long.);

*Typology:* mound;

*Morphology:* medium/high-elevated mound with a sub-circular shape, a quite regular perimeter and an essentially convex profile (slightly flat on its top);

*Description:* the perimeter of the evidence is marked by the presence of a medium-low concentration of collapsed stones; at its basis, evident accumulations of stones seem to be interpretable as the fillings of previously existing *qanats*; very close to the eastern limit of the evidence, moreover, there is the running water canal representing the outcome of a *qanats* line starting hundred metres northwards;

*Scatter of ceramic material:* low-density scatter of pottery fragments.

**Area 22** (Fig. 33)

*Location:* surrounding the bridge, on the western side of the site;

*WGS84 Coordinates:* the centre of the area is approximately DD 29.7822266 (lat.) 51.56773333 (long.);

*Typology:* architectural remains (several walls of small and medium dimensions);

*Morphology*: straight and regular alignments of stones;

*Description*: some of the walls could be interpreted as the limits of the street leading to the bridge and the limits marking the western edge of the site; other walls, instead, are more probably related to rooms flanking the aforementioned street leading to the bridge;

*Scatter of ceramic material*: there seems to be no scatter of pottery fragments.

### **Area 23** (Fig. 34)

*Location*: South the so-called “Valerian’s Prison”;

*WGS84 Coordinates*: the centre of the area is approximately DD 29.778954621002324 (lat.) 51.57685965299606 (long.);

*Typology*: wide flat area surrounded by high-elevated mounds with structural architectural remains;

*Morphology*: unsettled low-lying flat depositional area with an irregular perimeter and a slightly rectangular shape;

*Description*: in the middle of the area, beside a topographic benchmark, at least ten *qanats* of different dimensions are visible; some of them are partially filled by soil, stones and vegetation. *Qanats* are also present on some of the surrounding mounds, whose height reaches about 5-6 metres from the level of the low-lying central area. From this area, anyway, despite the height of the surrounding mounds, some of the excavated monumental buildings of the city and the Qal’a-ye Dokhtar are clearly visible. The area could be interpreted as a wide - even if quite irregularly shaped - unsettled open space (an “open courtyard”?, a “garden”?) surrounded by buildings possibly somewhat “monumental” in character;

*Scatter of ceramic material*: very low-density scatter of pottery fragments at the centre, increasing towards the surrounding mounds.

### **Area 24** (Fig. 35)

*Location*: immediately South-West of Area 23;

*WGS84 Coordinates*: the centre of the area is approximately DD 29.778443386906112 (lat.) 51.57620921730995 (long.);

*Typology*: wide flat area surrounded by high-elevated mounds with structural architectural remains;

*Morphology*: unsettled low-lying flat depositional area with an irregular perimeter and a slightly quadrangular shape;

*Description:* in the middle of the area several long and regular strip of soil covered by stones are visible, together with few *qanats* of different dimensions (some of which partially filled by soil, stones and vegetation). More numerous are, instead, the *qanats* located on the top of the surrounding mounds, whose height reaches about 5-6 metres from the level of the low-lying central area. The area could be interpreted as a wide - even if quite irregularly shaped - unsettled open space (an “open courtyard”?, a “garden”?) surrounded by buildings possibly somewhat “monumental” in character;

*Scatter of ceramic material:* very low-density scatter of pottery fragments at the centre, increasing towards the surrounding mounds.

**Area 25** (Fig. 36)

*Location:* immediately South-West of Area 24;

*WGS84 Coordinates:* the centre of the area can be considered approximately DD 29.777956827522456 (lat.) 51.57557621598244 (long.)

*Typology:* wide flat area surrounded by high-elevated mounds with structural architectural remains;

*Morphology:* unsettled low-lying flat depositional area, slightly “L”-shaped and with an irregular perimeter;

*Description:* two modern football fields are visible in the middle of the area, delimited by regular rows of stones and utilised by young boys living in the nearby villages. The eastern delimitation of the area is represented by a medium-elevated mound connected with Area 24; its western and southern limits are represented by some high-elevated mounds and its northern limit by a medium/high elevated mound. *Qanats* of different dimensions (some of which partially filled by soil, stones and vegetation) are located on the top and on the flanks of some of these surrounding mounds. The area could be interpreted as a wide - even if quite irregularly shaped - unsettled open space (an “open courtyard”?, a “garden”?) surrounded by buildings possibly somewhat “monumental” in character;

*Scatter of ceramic material:* very low-density scatter of pottery fragments at the centre, increasing towards the surrounding mounds.

**Area 26** (Fig. 37)

*Location:* East of Area 25;

*WGS84 Coordinates:* the centre of the area is approximately DD 29.77698137359877 (lat.) 51.576396971940994 (long.)

*Typology:* wide flat area surrounded by high-elevated mounds with structural architectural remains;

*Morphology:* unsettled low-lying flat depositional area with an irregular perimeter and a slightly quadrangular shape;

*Description:* on its eastern side, the area is delimited by a high-elevated mound located along the same line as the one on which the Area 17 lays. This eastern mound is characterised by the presence of architectural remains (square rooms) on its surface and is probably to be identified as a portion of the eastern city wall. The western limit of the area, instead, is marked by the presence of a rectangular building (possibly already partially excavated), whose perimeter is clearly detectable by virtue of the presence of two or three superimposed rows of accurately cut stone blocks pertaining its external wall. The internal layout of this building, instead, due to its very bad state of preservation, is very difficult to establish.

The area could be interpreted as a wide - even if quite irregularly shaped - unsettled open space (an “open courtyard”?, a “garden”?) surrounded by buildings possibly somewhat “monumental” in character;

*Scatter of ceramic material:* very low-density scatter of pottery fragments at the centre, increasing towards the surrounding mounds.

#### **Area 27 (Fig. 38)**

*Location:* contiguous to Area 23, in the vicinity of the so-called “Valerian’s Prison”;

*WGS84 Coordinates:* the centre of the area is approximately DD 29.77967956303134 (lat.) 51.57734379172325 (long.)

*Typology:* wide flat area surrounded by high-elevated mounds with structural architectural remains;

*Morphology:* unsettled low-lying flat depositional area with an irregular perimeter and a slightly quadrangular shape;

*Description:* Several *qanats* (of different dimensions) are attested both in the central portion of the area and on the top of the surrounding eastern and southern mounds; some of them are partially filled by soil, stones and vegetation. The area could be interpreted as a wide - even if quite irregularly shaped - unsettled open space (an “open courtyard”?, a “garden”?) surrounded by buildings possibly somewhat “monumental” in character;

*Scatter of ceramic material:* very low-density scatter of pottery fragments at the centre, increasing towards the surrounding mounds.

**Area 28** (Fig. 39)

*Location:* along a portion of Area 18, on its eastern side;

*WGS84 Coordinates:* the centre of the area is approximately DD 29.78110 (lat.) 51.570235 (long);

*Typology:* mound with structural architectural remains;

*Morphology:* medium-elevated mound with a rectangular shape, a quite regular perimeter and a basically convex profile (more flat on its top);

*Description:* the perimeter of the evidence is marked by the presence of a medium-low concentration of collapsed stones; on its top, regular alignments of stones are probably related to rooms of a building in a very bad state of preservation and whose plan is very difficult to argue. The evidence, moreover, seems to mark an end for the long and regular strip of soil flanked by straight alignments of stones listed as Area 18;

*Scatter of ceramic material:* low-density scatter of pottery fragments.

**Area 29** (Fig. 40)

*Location:* East of the course of Area 18 and probably in some connection to this;

*WGS84 Coordinates:* the centre of the area is approximately DD 29.78099 (lat.) 51.57110667 (long);

*Typology:* mound-like strip of soil;

*Morphology:* medium-elevated soil deposit with a basically elongated rectangular/elliptical shape, an irregular perimeter and a quite irregular profile, somewhat flat in some points, more convex elsewhere;

*Description:* the perimeter of the evidence is marked by the presence of a medium-low concentration of collapsed stones; on its top, evident accumulations of stones are to be interpreted as the fillings of at least three previously existing *qanats*

*Scatter of ceramic material:* low/medium-density scatter of pottery fragments.

**Area 30** (Fig. 41)

*Location:* North-West of Area 29;

*WGS84 Coordinates:* the centre of the area is approximately DD 29.7814866 (lat.) 51.57119167 (long);

*Typology:* mound with some traces of structural architectural remains;

*Morphology:* medium-elevated mound with a basically quadrangular shape, an irregular perimeter and a quite irregular profile with a rather flat top;

*Description:* the perimeter of the mound (especially on its southern side) is marked by the presence of a medium concentration of collapsed stones. On its top, some rather regular alignments of stones could be related to the presence of some architectural features, while another evident, probably artificial, accumulation of stones is to be interpreted as the filling of a previously existing *qanat*;

*Scatter of ceramic material:* low/medium-density scatter of pottery fragments.

### **Area 31 (Fig. 42)**

*Location:* immediately East of Area 30;

*WGS84 Coordinates:* the centre of the area is approximately DD 29.78090 (lat.) 51.57165 (long);

*Typology:* mound with traces of structural architectural remains;

*Morphology:* medium-elevated mound with a quadrangular shape, a quite regular perimeter and an essentially convex profile;

*Description:* the perimeter of the mound is marked by the presence of a medium concentration of collapsed stones (especially on its eastern and northern sides). At its basis, some regular alignments of stones can be clearly related to the presence of some architectural features;

*Scatter of ceramic material:* low/medium-density scatter of pottery fragments.

### **Area 32 (Fig. 43)**

*Location:* between A31 (to North, separated by a series of *qanats*) and Area 4 (to South);

*WGS84 Coordinates:* the centre of the area is approximately DD 29.779166666666665 (lat.) 51.57072222222222 (long);

*Typology:* shallow mound with remains of a building;

*Morphology:* low-elevated mound with a basically quadrangular shape and a quite irregular perimeter; its profile it's irregular due to the presence of architectural remains on its rather flat top;

*Description:* the perimeter of the mound is marked by the presence of a quite high concentration of collapsed stones. The architectural remains on its top clearly reveal the plan of a nearly quadrangular building in a bad state of preservation, constituted by a row of several small and narrow rooms (some of which clearly provided with a vaulted roofing) located along its main sides and divided by means of a large central corridor;

*Scatter of ceramic material:* low/medium-density scatter of pottery fragments.



Table 1 - The 32 archaeological evidences (“Areas”) recognized and mapped during the survey campaigns in 2012 and 2013 (digital elaboration by E. Cocca and G. Maresca)

#### *Laboratory Activities (by E. Cocca)*

The aspects of the laboratory activities relating to points 4, 5 and 6 indicated above (*infra*, 125) specified above are divided into 4 different groups of work:

- a. converting digital cartography on the size of the map of the city and the surrounding area from DWG to Shapefile format;
- b. overlapping and geo-referencing of the converted map of the city on the satellite image (Geo-eye with resolution to 50cm), obtained during the 2012 season;
- c. manipulating and querying vector data geo-referred for the creation of a DTM (Digital Terrain Model) which will be used for the analysis and reconstruction of the morphology of the landscape;
- d. creating 3D models of some important architectural monuments and rock.

With regard to the point “a”, conversion from CAD in Shapefile was performed using proprietary software (ESRI ArcGIS®). In this first stage of processing the Shapefile format was used because this format is standardized for the interchange of data. The next steps involve the processing of spatial data in a spatial DBMS (Data Base Management System) such as PostGIS or Sqlite. The use of these databases allows one to maintain the integrity of the data and also a more profitable use of GIS in spatial analysis. Vector data available are composed of elements point, line and polygon that make up the digital cartography at 1:20,000 scale of 625km<sup>2</sup>. This mapping includes the surrounding area (Fig. 44) to the city of Bīšāpūr, while a more detailed digital maps at a scale of 1:500 (Fig. 45) includes the entire city of Bīšāpūr. With regard to the scale 1:20,000 mapping data include the contour lines and orography of the territory in question, while the data vector digital maps in scale 1:500 include the contour lines, the monumental areas, internal orography to the site of *qanat* and control point for measurements leveling. The DWG format standard provides a series of attributes that in the conversion into Shapefile are manipulated and are deleted to make lighter and readable file. We have preserved only the affected attributes. With regard to the point “b” converted data were geo-referenced by satellite Geo-EYE ortho-rectified purchased in the previous year survey. The georeferencing was made by identifying the control points are easily recognizable in the satellite image, such as the corners of the house or street crossings (which are obviously visible in the map itself). Both digital maps have been geo-referred with the same procedure using for each a number of control points (Fig 46). The spatial reference system adopted for the geo-referencing was the



UTMWGS84 - 39N. Regarding the point “c” the creation of a DTM presents problems. The DTMs are constructed by interpolation of contour lines and reproduces outline of the geodesic surface. In the absence of a complete GPS survey, which allows us to have a series of points for the modeling of contour lines, it has begun to draw vector data mentioned above. As has been stated previously the converted data each are constituted by a series of geometries point, line and polygon containing each of these various attributes. Unfortunately, the elevation attribute in linear elements (elements that constitute the contour lines) do not have this attribute type. The elevation attribute resides in a type of geometric element on time. To take advantage of this attribute in linear elements you started the transfer with a manual procedure. Therefore, the phase implementation of the DTM is working in progress.

Regarding the point “d” about 3000 photos were taken on the following monuments: Čāhār-Tāq, the area of the Columns, Temple of Anahita, Iwan palace with mosaics, three-iwan building, cruciform building, madrasa and the rock-reliefs on the right and left side of Šāpūr river. Through the technique already known of Structure From Motion (Moulon, Bezzi 2011; Callieri *et alii* 2011; Bigliardi *et alii* 2013) 3D models of these monuments (Figs. 47-56) have created. These 3D models will be took advantage to study the architectural and sculptural monuments of the city of Bīšāpūr. In fact, these models are measured and can be integrated both in technologies that webmapping exported to 3D PDF for consultation.

#### *Final Considerations*

During the 2013 season, the work activities have consisted in a second partial, though systematic and comprehensive survey of different areas of the site aimed at recognising the most noticeable landscape, geomorphological, archaeological and architectural features. Together with the two team leaders Bruno Genito and Mosayyeb Amiri, the survey was undertook with the helpful presence of G. Maresca, E. Cocca, M.K. Mahmoudi and Miss. B. Khosrawi.

After a preliminary study on some of the features of the site carried out by means of a geo-referenced satellite photograph, new areas were

selected to be surveyed in order to obtain a major understanding of the key-points regarding the following relationships in the ancient city between:

1. the documented excavated monumental areas and the still un-excavated surrounding space;
2. the very large amount of *qanats* and the extant archaeological and monumental evidences;
3. the ancient settled areas and the surrounding wide open spaces clearly detectable from the photo-satellite;
4. the un-excavated original mounds to be still detected and interpreted and the artificial mounds, partially formed by the material resulting from the earlier excavation activities carried out on the site.

For these reasons, the survey has been aimed at continuously detecting any kind of morphological anomalies on the ground, or at trying to trace recurrent patterns in the distribution of empty spaces (fields-gardens)<sup>10</sup>, monumental buildings, streets (with or without structural

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<sup>10</sup> Since early times the gardens have constituted an integral part of the Persian architecture. Besides the historical sources, archaeological evidence of Achaemenid gardens exists at Pasargadae, Persepolis, Susa, and other sites (Xenophon, *Oeconomicus* 4.20-25; Arrian, *Anabasis* 5.29.4-5; Sāmī 1956, 75-77; Stronach, 1978, 107-12; Pinder-Wilson 1976, 85; Yamauchi 1990, 332, and n. 55). The Achaemenid sovereigns had a particular interest in the horticulture and agriculture and seemingly greatly encouraged the agronomy, arboriculture, and irrigation. Numerous varieties of plants were introduced throughout the empire (Xenophon, *Oeconomicus* 4.8.10-12; Moynihan 1979, 11, 25); beside the practical aspects of the garden and its sensual pleasures, royal gardens also contained political, philosophical, and religious symbolism. The idea of a king creating a fertile garden out of barren land, bringing symmetry and order out of chaos, and duplicating the divine paradise on earth, constituted a powerful statement symbolizing authority, fertility, and legitimacy (Eliade 1961, 59-72; Moynihan 1979, 20; Faqīh 1991, 566; Stronach, 1990, 171-80). The great wealth required then to finance the acquisition, development, and maintenance of formal gardens, especially in the Persian arid landscape, made this type of holding a symbol of power and prosperity. From the time of the Achaemenid empire the idea of an earthly paradise spread over the literature and languages of other cultures. Although the concept of a paradise may be traced back to the Sumerian epic of Gilgamesh (Kramer 1963, 147-49), it seems that the idea existed independently in the Indo-Iranian tradition, where one may find references in the sacred book of Avesta (*Yt.* 22.15). The Avestan word *pairidaēza-*, Old Persian *\*paridaida-*, Median *\*paridaiza-* (walled-around, i.e., a walled garden), was transliterated into the Greek *paradeisoi*, then rendered into the Latin *paradisus*, and from there entering into the European languages (Yamauchi 1990, 332). The word entered

remain), *qanat*, elevated mounds (EM) (constructions, palaces?) in various dimensions shapes, strips of soil and/or stones, small stone-walls encircling, with different shapes, lowly elevated mounds. Some interesting issues can be preliminarily emphasized amongst those related to the topographical layout of the city.

The presence of ample portions of the city area seemingly free from any kind of structural remains, e.g. area 14, or areas beyond the bridge area 22 to East, or around area 30 (to identify in front of the house), to West, and around areas 10N, 10S, 11, is without doubt a very noteworthy urban aspect, even whether these observations still represent, but working hypotheses. This particular aspect easily led one to think over the investments, the territorial and social changes occurred in the plain of city and relating to the necessary land use and water supply in order to let the area to be formed and developed as urban. The future researches will certainly give confirmation of the correctness of these hypotheses, and of the possibility that part of the urban area at Bīšāpūr was mainly devoted to agricultural and horticultural activities; this characteristic would be of extreme historical-economical importance. By now it is still difficult to assume that a portion of the city, mostly the western, remained actually ever free from buildings and from any kind of architectural features; the vicinity to the river having, however, always exposed this area to the great risk of its recurrent flooding activities. An appropriate choice to keep a fertile riverside large piece of land for agriculture and horticulture could have ensured the sufficient “urban” and “internal” water supply to be managed by the political rule. It should also be taken into the due account the hypothesis that open spaces facing the river to West, and amongst architectural buildings to North-East would have been devoted to a somehow form of pleasure and leisure for the inhabitants. Archaeological and historical evidence for this possibility at Bīšāpūr are, unfortunately, poorly documented in the scientific literature; the archaeology of Sasanian period in the plateau as well, do not offer by now

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Semitic languages as well: Akkadian *pardesu*, Hebrew *pardes* (*Nehemiah* 2:8; *Ecclesiastes* 2:5; *Song of Solomon* 4:13), and Arabic *ferdaws* (Koran 18.107, 23.11).

much evidence for that<sup>11</sup>; this ground of interest will be deeply investigated during the next campaigns at the site.

Of great interest, moreover, are also the evidences interpreted as traces of streets (or small elevated mound delimited by stone walls) entering the site from South (areas 9 and 15, and 18). Even though there is little indication by now regarding the period during which those streets were actually in use<sup>12</sup>; the fact is quite significant because they provided the city with a southern access. While the presence of a road entering from North is quite unquestionable and the access from West was guaranteed by means of the well-known bridge crossing the river, it is also noteworthy that during this campaigns no traces of an eastern access were identified during the random survey there effected. It is, nonetheless, possible that the *khandaq* bordering actually the eastern limit of the site was an ancient feature of the settlement. It is quite intriguing at this regard, moreover, to consider that the presence of the aforementioned *khandaq* might have “concrete” connections with the topography of the site, and especially with the steep slope of the hill where the so-called “Qal‘e-ye Dokhtar” lies. One cannot exclude that this *khandaq* could have been a feature located at the eastern limit of the city as a sort of barrier protecting the site from any possible alluvial deposits flowing down from the northern hills. The most destructive effect for the urban landscape and the city were, nonetheless, the documented continuous floods still now occurring every 50 years c.<sup>13</sup>, and which has consistently corroded the same embankment and deviated the course of the river as well.

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<sup>11</sup>Little is known about the form of the Persian garden before the Islamic period, but its existence at that time and its importance as both a symbol of power and resource for pleasure is widely acknowledged (Pinder-Wilson 1976, 71-73).

<sup>12</sup>It is important in this regard, however, to stress that at least one of them seems to be related with the Mosque.

<sup>13</sup> Personal communication of M. Amiri.

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## FIGURES



Fig. 1 - Qal 'a-ye Dokhtar as seen from the city plain, after MAI



Fig. 2 - Qal'a-ye Pesar as seen from the city plain, after MAI



Fig. 3 - The bridge Pol-e Gabrī, as seen from right bank of the river, after MAI



Fig. 4 - The eastern pylon of the bridge Pol-e Gabrī, as seen from left bank of the river, after MAI





Fig. 5 - The western pilon of the bridge Pol-e Gabrī, as seen from right bank of the river, after MAI



Fig. 6 - Sarab-e Ardašir in the Rousta' of Seyyed-Hosseini, after Google earth 2014



Fig. 7 - Češmeš-e Sasan in the bed of the Šāpūr river, after Google earth 2014





Fig. 8 - Sarab-e Dokhtaran, after Google earth 2014



Fig. 9 - The localization of the three springs, after Google earth 2014



Fig. 10 - A general picture of the *Qanats*, after the photo-satellite Geo-Eye



Fig. 11 - Monumental Sasanian Area, north-eastern quadrant of the city, after the photo-satellite Geo-Eye



Fig. 12 - Columns Area, in the center of the city, after the photo-satellite Geo-Eye

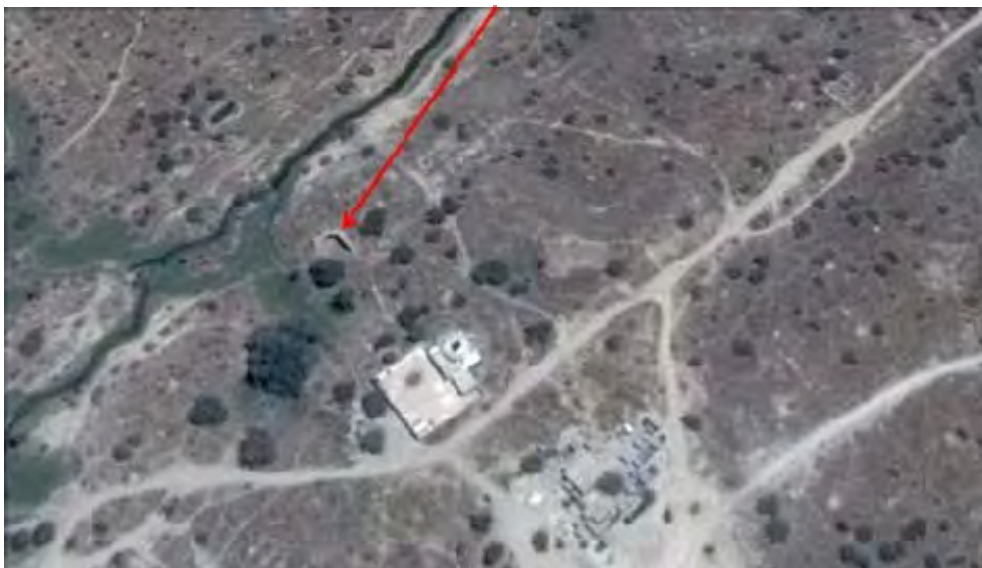


Fig. 13 - ČāhārTāq, south-western quadrant of the city, after the photo-satellite Geo-Eye





Fig. 14 - Mosque in the south-eastern quadrant of the city, after the photo-satellite Geo-Eye



Fig. 15 - Great salty accumulations in Fars: Mahārū and Bakhtegān Lakes, after Google earth 2014



Fig. 16 - Intermountain plains in the Nurabad area, from South to North: Dašt-e Nurabad, Dašt-e Javid, Dašt -e Rostam-e Yek and Dašt-e Rostam-e Do, after Google earth 2014



Fig. 17 - Dašt-e Nurabad with an irregular shape due to the ridges and rocky outcrops extending in the alluvial plain, after Google earth 2014





Fig. 18 - Steep-walled gorge where the river Šāpūr flows, defining the northern and north-western perimeter of Bīšāpūr, after Google earth 2014



Fig. 19 - The flat area of Kazerun, less than twenty kilometers south - East of Bīšāpūr, an altitude of about 800m above the sea level bounded to the East and to the West by two ridges that rise over 1500m above sea level, after Google earth 2014



Fig. 20 - the protected area of the Aržan and Parishan lakes recognized by UNESCO as one of the most important ecosystems on the planet, after Wikipedia



Fig. 21 - Alternating layers of pebbles, architectonic stones and soil accumulations, along the north-western side of the city, after MAI



Fig. 22 - Alternating layers of pebbles, architectonic stones and soil accumulations, along the north-western side of the city, after MAI



Fig. 23 - Rusta' (villages) of Eslamabad to South, after the Geo eye photo-satellite





Fig. 24 - Rusta' (villages) of Panj-mahal and Čamran to East, after the Geo eye photo-satellite



Fig. 25 - The Parishan lake, after Google earth 2014



Fig. 26 - The Aržan lake, after Google earth 2014



Fig. 27 - The course of the river Šāpūr, born in the mountains around the lake Aržan empties into the Persian Gulf, about 25Km from the road between Shiraz and Kazerun, after Google earth 2014





Fig. 28 - The layout of *Qanats* in the central area, after Geo eye photo satellite, after MAI



Fig. 29 - Area 18: A portion of the long and low-elevated strip of soil flanked by rows of stones, after MAI



Fig. 30 - Area 19: The regular pit probably to be interpreted as a well, after MAI



Fig. 31 - Area 20: The mound characterised by the presence of fragments of pottery slags on its top, after MAI



Fig. 32 - Area 21: The mound detected South-West of the ČahārTāq, after MAI



Fig. 33 - Area 22: Structures clearly visible around the bridge, on the western side of the city, after MAI





Fig. 34 - Area 23: The wide flat zone surrounded by mounds in the vicinity of the so-called “Valerian’s Prison”, after MAI



Fig. 35 - Area 24: The wide flat zone surrounded by mounds located immediately South of area 23, after MAI



Fig.36 - Area 25: The “L”-shaped flat zone located immediately South of area 24, after MAI



Fig. 37 - Area 26: The wide flat zone located East of area 25; clearly visible on the right the remains of a rectangular building, after MAI



Fig. 38- Area 27: The wide flat zone located close to the “Valerian’s Prison” and next to area 23, after MAI



Fig. 39 - Area 28: Remains of a building on the top of the mound, after MAI





Fig. 40 - Area 29: Detailed view of one of the irregular mounds characterising the evidence, after MAI



Fig. 41 - Area 30: The elevated mound located North-West of area 29, after MAI



Fig. 42 - Area 31: The mound located East of area 30; structural remains are clearly visible at its basis, after MAI



Fig. 43 - Area 32: Remains of a building between area 31 and area 4, after MAI

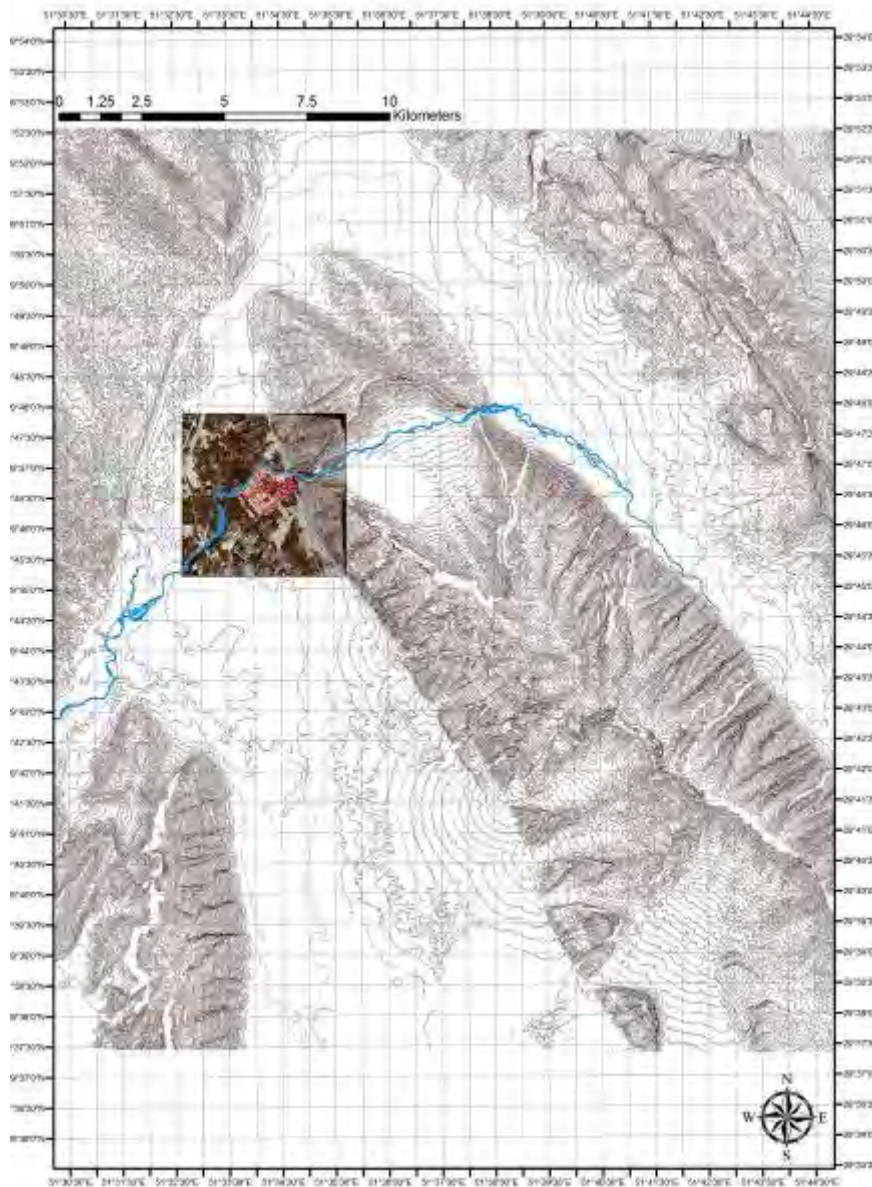


Fig. 44 - Digital cartography geo-referenced of the landscape around Bišāpūr to scale 1:20,000. Image modify by E. Cocca, after AUTOCAD map from CRS (Bišāpūr of Research Center)





Fig. 45 - Digital cartography geo-referenced of the landscape around Bīšāpūr to scale 1:500; are visible the *qanats* (yellow layer) and the water places (blue layer) like river and artificial canals. Image modify by E. Cocca, after AUTOCAD map from CRS (Bīšāpūr of Research Center)



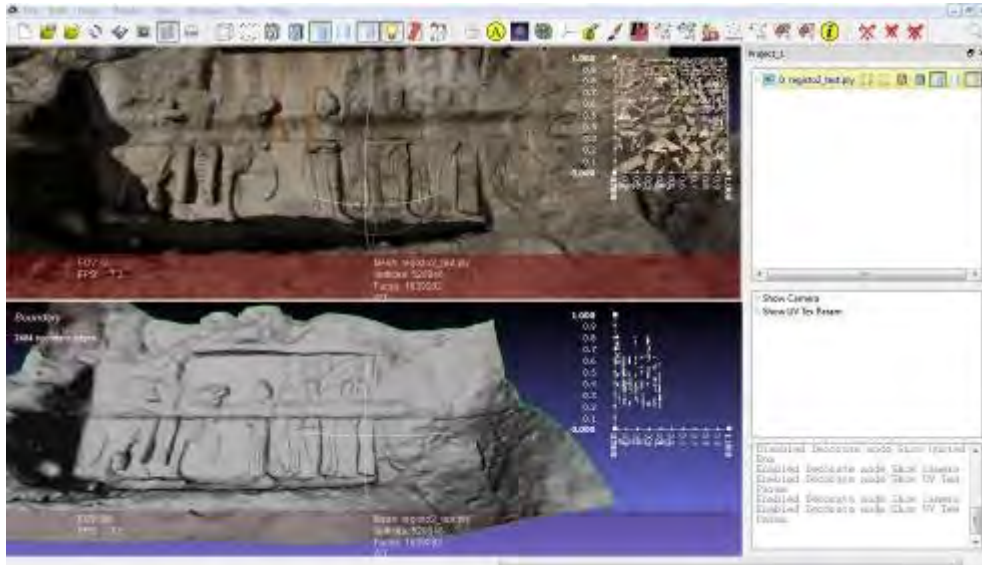


Fig. 48 - Elaboration 3D to *Rock-cut relief* (Bahram and the Arab delegation, second relief on right side river-south direction), by E. Cocca, after MAI



Fig. 49 - Graphic rendering second relief on right side river-south direction, by E. Cocca, after MAI



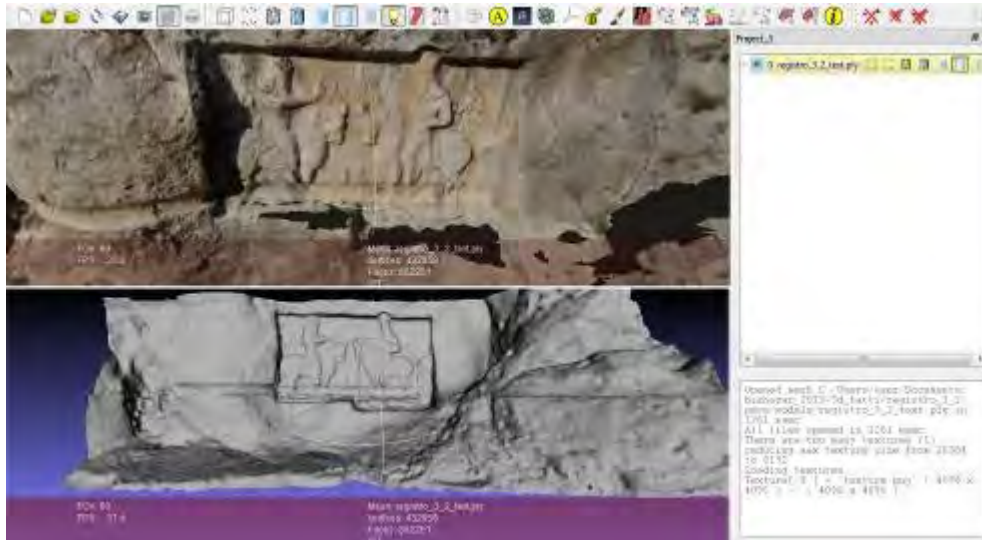


Fig. 50 - Elaboration 3D to *Rock-cut relief* (Bahram investiture scene, third relief on right side river-south direction), by E. Cocca, after MAI



Fig. 51 - Graphic rendering third relief-cut on right side river-south direction, by E. Cocca, after MAI

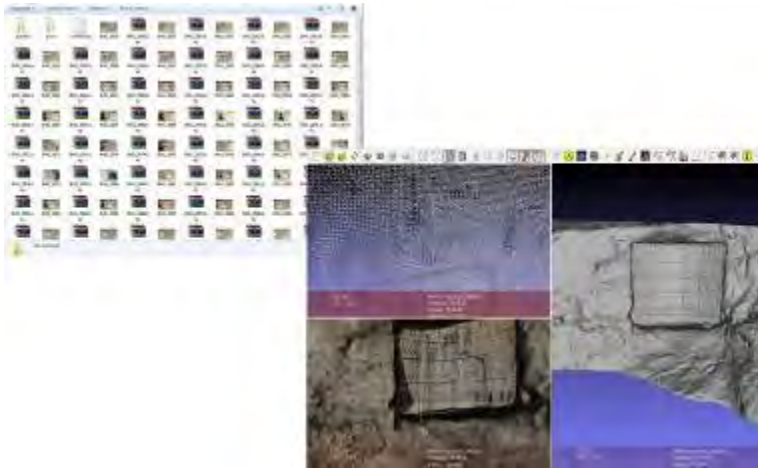


Fig. 52 - Example process of elaboration phase of 3D (Shahpur Triumph, first relief on right side river-south direction), by E. Cocca, after MAI



Fig. 53 - Graphic rendering of Shahpur Triumph, first relief on right side river-south direction, by E. Cocca, after MAI



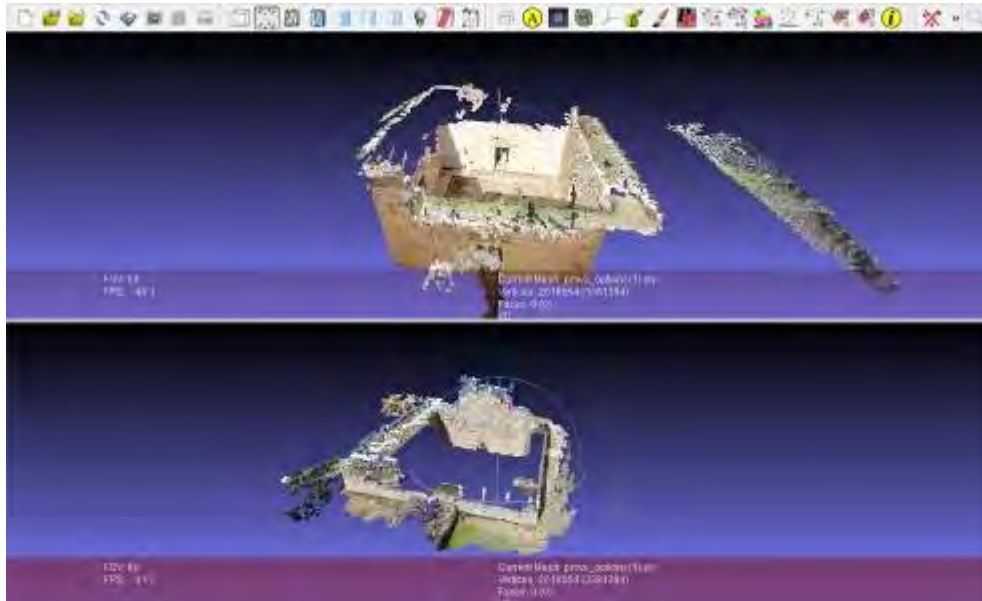


Fig. 54 - Elaboration 3D to *Temple of Anahita*, by E. Cocca, after MAI

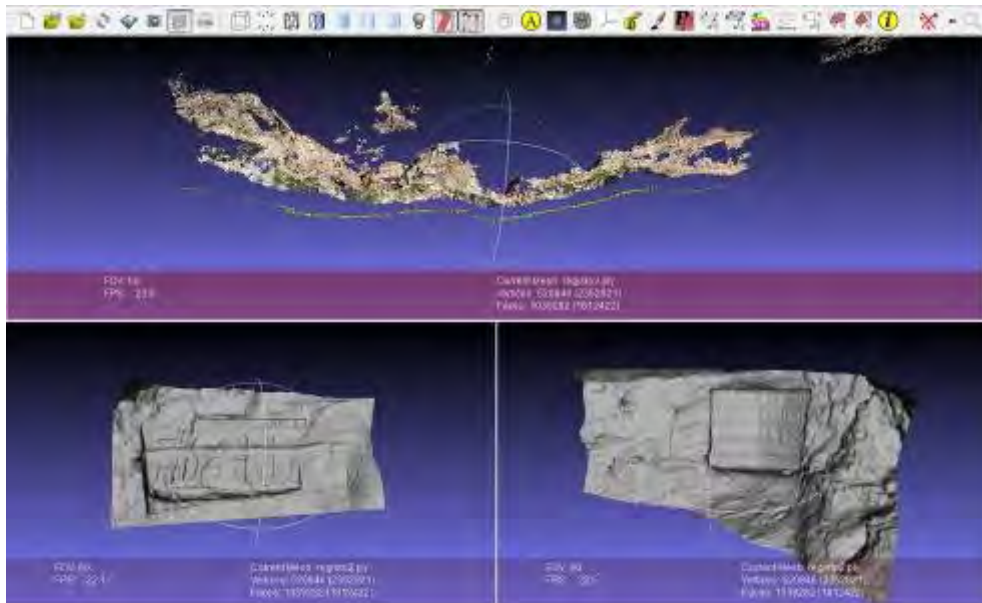


Fig. 55 - Reconstruction and assemblages of the whole set of rock-cut relief of right side south direction, by E. Cocca, after MAI

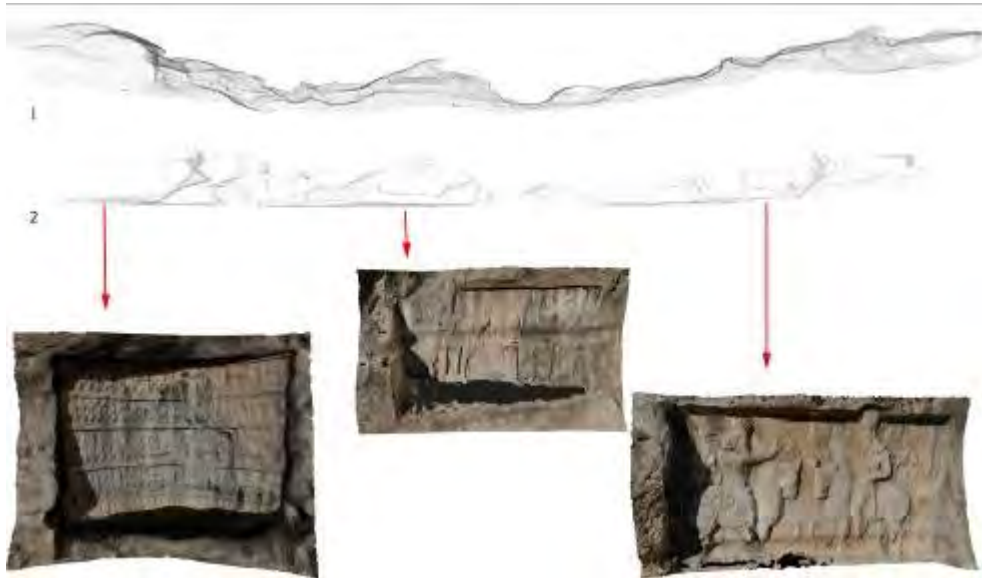


Fig. 56 -The whole profile of the rock on the right side river: 1) top view; 2) front view, and localization of same rock-cut, by E. Cocca, after MAI