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RESEARCH PAPER

The Production Process of Lithics in Late Bronze Age at Shahrake Firouzeh Site in Neyshabur, North East of Iran

Mohammad Hossein Rezaei and Hassan Basafa

Nowadays, the study of lithics has gained a special status in prehistoric archaeology and even archaeology of later periods. Shahrake Firouzeh is one of the most important prehistoric settlements ever detected in Neyshabur Plain in Khorasan Razavi Province. In general, based on the past excavation seasons, Shahrake Firouzeh site represents the Bronze Age and probably Iron Age cultures in the region and the bulk of cultural materials indicates a culture known as BMAC (Bactria-Margiana Archaeological Complex). This paper analyzes the typology of Shahrake Firouzeh lithics, which is a key typical site related to Late Bronze Age in Northeast of Iran. The collection of stone artifacts from Shahrake Firouzeh excavations includes 66 pieces. These tools have been recovered from nine trenches in different parts of the site during four excavation seasons, all of which belong to Late Bronze Age. The majority of lithics in this site are of debitage type. In addition to producing sickle blades bearing signs of sickle gloss, the main feature of this collection is production of arrowheads retouched in two sides. It should be noted that all the stone artifacts from Shahrake Firouzeh have been made from high quality chert stone in a color range of cream, honey, and transparent with semi-glossy surface. In general, the raw material used is of good quality, although it does not seem to have large dimensions. The raw material source is unknown, and thus no data can be presented on usage patterns of raw material.

Introduction

The study of lithics has currently a special status in prehistoric archaeology and even archaeology of later periods since stone is more stable than any other archaeological material and is among the first materials maintaining the technology used in its making. It should be noted that the production of ancient stone tools has been the first human industrial activity since Paleolithic period and has played an important role in socio-economic restructuring of hunting communities to food producers in Neolithic period via developments during Epipaleolithic and Neolithic. For several years, the analysis and study of lithics was limited to archaeologists interested in gathering-hunting communities whereas archaeologists have recently realized the application importance of lithics in complex societies up to historical periods and have dealt with analysis of stone industries datasets along with materials related to industrial specialization (Sardari, 2012: 17).

The process in which the shift from a stone to a metal-based technology has been monitored is through the presence/absence and frequencies of the various lithic tool types. In the Near East, this has only been systematically attempted in the southern Levantine area of Israel (Rosen 1997). Rosen demonstrated that functional, as opposed to decorative, chipped stone tool types gradually disappear between the ends of the Chalcolithic and Iron Age. Some types disappear because of changes in subsistence (arrowheads), while others are replaced with metal types that had a corresponding function (axes). Some stone tool types disappear quickly (at or prior to the beginning of the Bronze Age—arrowheads), others disappear gradually (through the Bronze Age—axes), and some continue to be used into later periods (the Iron Age—sickles). To explain the continued use of stone (in the face of available metal tools) into later periods, Rosen suggested that until a clear improvement in efficiency emerges, the economy would perpetuate the use of the traditional material.

Production system and downward trend of artifacts is one aspect of lithics through which step by step production process can be followed. Accordingly, the production and economic processes in the past can be reconstructed beyond typology and dating. In the study of reduction processes and production systems, relying on the principle that production process continuously begins from raw material and ends in shaping, application and final disposal of tools via transitions from predictable steps, the remaining material from each of these steps can be traced in order to reconstruct the production and usage course of artifacts in different sites by identifying various stages in various places. On the other hand, due to their long life, lithics are the only remains that can help us in recognition of economic approaches and consumption patterns in stone age via detailed analysis (Jayez, 2013: 40). This paper analyzes the typology of lithics in Shahrake Firouzeh site, which is a key typical site related to Late Bronze Age in North East of Iran.

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The Location and excavations of Shahrake Firouzeh site

Shahrake Firouzeh is one of the most important prehistoric settlements ever detected in Neyshabur Plain in Khorasan Razavi Province (**Figure 1**). In terms of location, Neyshabur Plain lies in the course of East-West communication roads. In archeological terms, Great Khorasan Road was among the most important roads connecting East and West in the fourth millennium BC (Majidzadeh, 1982). Due to appropriate strategic position and location in the course of Silk Road, Great Khorasan Road had been considered by previous civilizations and bears several archaeological sites from prehistoric, historic and Islamic periods. Neyshabur Plain is quite rich in terms of water resources and is located on the slopes of Alborz Mountains and Binalud highlands. Abundance of water has resulted in to several habitats in different parts of this mountain range (**Figure 2**) (Basafa et al., 2014: 74).

Figure 1: Location of Neyshabur County in northeastern Iran.

Shahrake Firouzeh site, an appellation derived from newly constructed condominiums West to the modern city of Neyshabur, is located on eastern bank of Farub Ruman River with 36°12′58″N 58°47′E coordinates and an average height of 1,250 meters above sea level (**Figure 3**). This site is located in the vicinity of a seasonal river in the Western side of the site that is known as Kale Natova which emanates from Mirabad River at an approximate distance of 12 km from Southern slopes of Binalud. Due to the slope of land in this area and its flooding capacity, the site has been entirely buried under a 0.5–1.5-meter-thick layer of alluvial sand. As the most important water current of Neyshabur, Farub Ruman River originates from Binalud highlands and is considered an independent sub-basin of Dasht-e Kavir River sub-basin, which becomes flooded in the rainy season. Due to the steep slope of the plain, floods in Farub Ruman and other rives results in

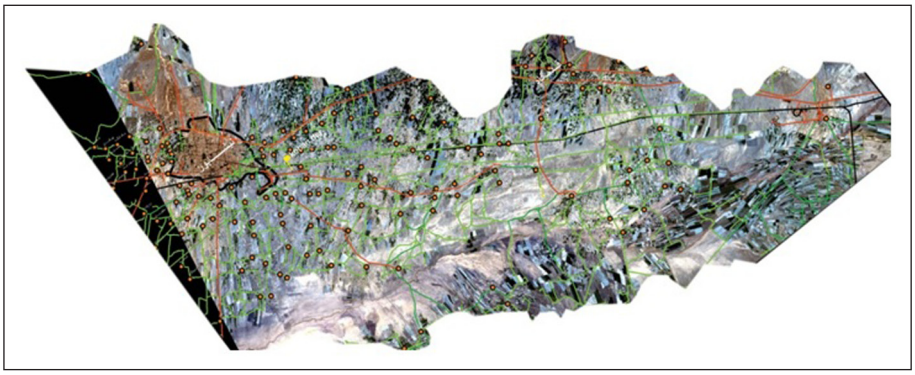

Figure 2: Neyshabur plain.

Figure 3: Location of Shahrake Firouzeh Site relative to alluvial fan.

displacement of large amounts of sediments, which are deposited with gradually decreasing slope of plain that are progressively accumulated in a long-term period (Basafa et al., 2014).

Shahrake Firouzeh site was fortuitously detected as a result of excavations conducted for construction works of Steel Company. Field operations of the team led by Mahmoud Bakhtiari began on 18.10.2008, but the full report of the excavation has not been published yet (Basafa, 2011: 9–10). Excavations of the site were conducted during four seasons from 2009 to 2014 by Hassan Basafa. Overall, based on excavations of previous sessions, Shahrake Firouzeh site reflects Bronze and probably Iron Age cultures in the region and the majority of cultural materials indicate a culture known as BMAC (Bactria-Margiana Archaeological Complex). The materials represent regional and trans-regional interactions of Shahrake Firouzeh site with neighboring areas like Merv, Balkh, Southern Iran and Turkmenistan (Basafa, 2014).

What is referred to as the Bactria-Margiana collection or culture is a collection of settlements that, during the period (2300–1500 BC), have characteristics such as pottery species, the use and production of various kinds of goods And everyday from indigenous and imported stones (lazuli, chlorite, agate, turquoise and marble), the prevalence of using bronze and precious metals (gold and silver), a collection of unique and possibly ritual objects, including marble miniature pillars, combination figurine Bactria, power sticks, ceremonial axes and, most importantly, memorial graves, in the geographic area of Turkmenistan, northeastern Iran, north of Afghanistan and parts of Tajikistan and Uzbekistan were developed. Saryanidi used the term Bactria-Margiana for the introduction of this culture and used many archaeologists such as Hibbert (Hiebert & Lemberg-Karlovsky, 1992: 2).

Methodology

In general, the study of stone artifacts can be regarded from two perspectives. On the one hand, typology and classification of these objects can shed light on their application and function, and on the other hand, study of technology and construction methods of these materials along with their typology may offer useful results (Inizan et al., 2010: 22). Documentation related to the function of lithics and stone artifacts includes the following factors (Kardulias, 2003: 85): 1) Number of stone artifact remains; 2) intra- and inter-spatial distribution patterns of stone artifacts; 3) relative errors in the shaping process; 4) Control and extraction patterns of specific rock reserves and quarries and 5) Microwear analysis to describe the application of the tool.

In typological analysis of lithics, archaeologists consider several aspects, including Frank Hole's method, which is to classify the lithic industry in Deh Luran plains, characteristics of removal type, measure and location of removal, and sometimes the shape and size of finished product (Hole, 1961: 1). In an overall classification, the stone industries are divided into two groups. The first group includes shaping products and remnants, including shaping waste in cores, blades and cortex. The second group includes tools upon which retouching and used signs are visible, which are classified in blades and Bladelets, arrowheads, awls, curved knives, etc (Rafi Far et al., 2008: 115).

In addition, in preparation of natural rocks and their conversion into instruments, which is the main objective of producers, a set of practices and techniques are applied known as *Chaîne opératoire*, (Grace 1997) which include a variety of methods implemented one after another according to predetermined programs with high precision by artisans using different instruments in certain scenarios to achieve the final objective (Rafi Far, 2010: 278). Therefore, cores are important lithics commonly found in various modes and shapes in archaeological sites, presenting useful information concerning the technology used to create them. In this paper, lithics of Shahrake Firouzeh have been divided into two general groups of retouched and debitage. The collection of lithics from excavations of Shahrake Firouzeh includes 66 pieces. These data have been derived from nine trenches in different parts of the site during four excavations seasons, all of which are related to late bronze age. The preliminary survey of morphological and technological characteristics of the set of lithics from Shahrake Firouzeh will be presented in this paper.

Results

All the lithics from excavations were encoded in a database in Microsoft Excel, which was designed to record the characteristics of these lithics, and their individual features were then recorded. After recording all the features of lithics, it was attempted to draw conclusions on typology and technology of Shahrake Firouzeh lithics using statistical analysis of different characteristics. The results of statistical analysis are presented in the following.

Debitage form the majority of tools in the collection of lithics of this site. **Tables 1, 2** and **Figure 4** show the configuration of tools in Shahrake Firouzeh collection. In addition to production of sickle blades with signs of sickle gloss, the main feature of this collection is the production of arrowheads that have been retouched in two sides. One of these arrowheads is of hepatic colored chert stone and only part of its tip and the end of its arrow have been cracked and vestiges of integrated retouching can be seen on both sides (**Figure 4**, no. 1082) and the other arrow is made of semi-translucent cream-colored chert stone with a fracture in the middle with unified retouching on both sides (**Figure 4**, no. 1040). Instruments such as arrowhead indicate usage during hunting campaigns confirmed by zoological studies in the site.

Table 1: Configuration of tools in the Lithics collection of Shahrake Firouzeh).

Tool	Number
Arrow	2
Denticulate	1
Retouched	2
Sickle Element	1
Sum	6

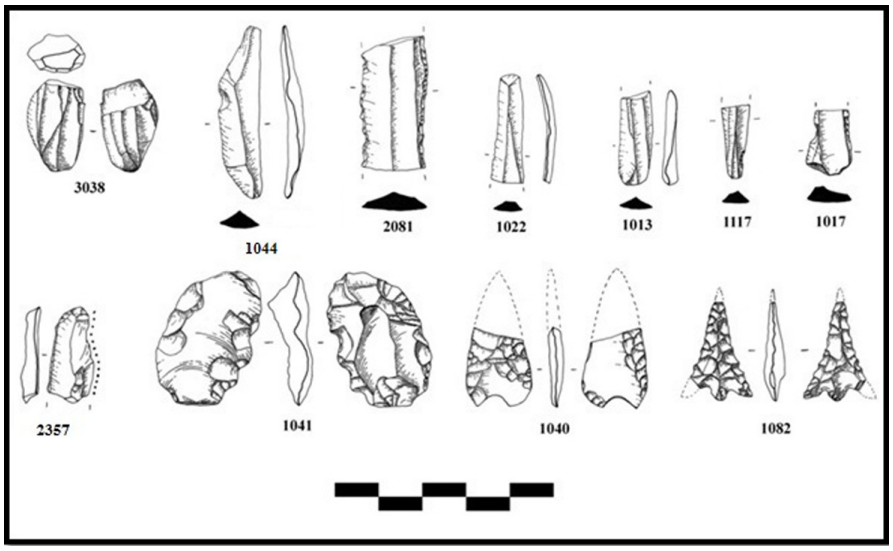

Figure 4: Lithics Sketch Of Shahrake Firouzeh Site (Sketch by Mojgan Jayez).

Table 2: Description of Figure 4.

Reference Number	Trench	Context	Description
3038	IX	VIII	Bladelet Core
1044	V	VIII	Bladelet
2081	XI	V	Middle of Blade
1022	IV	IV	Distal of Bladelet
1013	I	I	Proximal of Bladelet
1117	IV	VIII	Proximal of Bladelet
1017	IV	IV	Proximal of Bladelet
2357	XI	I	Distal of Bladelet with sickle gloss
1041	II	V	Denticulate Flake
1040	II	V	Broken Arrow
1082	III	XII	Arrow

It should be noted that in this report only samples bearing sickle gloss have been considered as sickle elements and other bladelets fragments not bearing sickle gloss are classified as blanks. Some of these finds show signs of crack and abrasion on the edges that are visible to the naked eye, but given that it is not possible to distinguishing between the effects of used on the edge of tools from the effect of corrosion is not feasible without edge abrasion tests, this category has not been regarded as tools (**Figure 4**, no. 2081).

Raw material

Availability of raw materials as well as their quality and quantity is a factor influencing technological aspects as well as production and use of stone tools. To understand the source of raw materials used in lithics, in the first place we need different fingerprinting tests such as XRF and SEM or petrography techniques and neutron activation analysis (Odell, 2003: 31). The extent to which the artifacts originate from local resources or have been imported requires detailed assessments in the region. Knowledge of the geological context of raw stone and its scarcity or abundance is extremely important. Therefore, the appropriate environment for such contexts can be found in outcrops, geological veins, alluvial fans and alluvial terraces, which are the conditions encountered in Neyshabur Plain. Neyshabur Plain is located between alluvial fans up to Kalshur and Shahrake Firouzeh site is located South to one of these alluvial fans. Overall, alluvial fans in many parts of the world have provided a good opportunity for human settlement from prehistoric times up to now due to conditions such as the presence of water-rich aquifers, gentle slopes of alluvial fans, fertility due to sedimentation by flows from upstream basins as well as meandering streams and channels on alluvial fans providing water for drinking, agriculture and industry (pottery) (Gillmore et al., 2009, 2011).

It should be noted that all of the Shahrake Firouzeh lithics are made of chert. Chert is of high quality transparent type of cream, honey, hepatic and glass colors with a semi-glossy surface (**Figures 5–7**). Transparent glass chert has been used more frequently than other types; for example, 11 out of 17 lithics recovered from trench IV is of this type. In general, the raw material used is of good quality, although it does not seem to be bulky. The raw material source is unknown and therefore we cannot provide information on usage patterns of raw material.

Discussion and analysis

The Binford couple (1966) were the first scientists who distinguished between extraction and maintenance locations. Extraction location means mining and manufacturing workshops in which manufacturers gain raw material and perform the production process. Maintenance locations are places where anything gained and produced in extraction locations is used, maintained and repaired. Naturally, the technological structure of lithics remaining in the above-mentioned two types of sites are different and in many cases both are seen simultaneously observed in the same place.

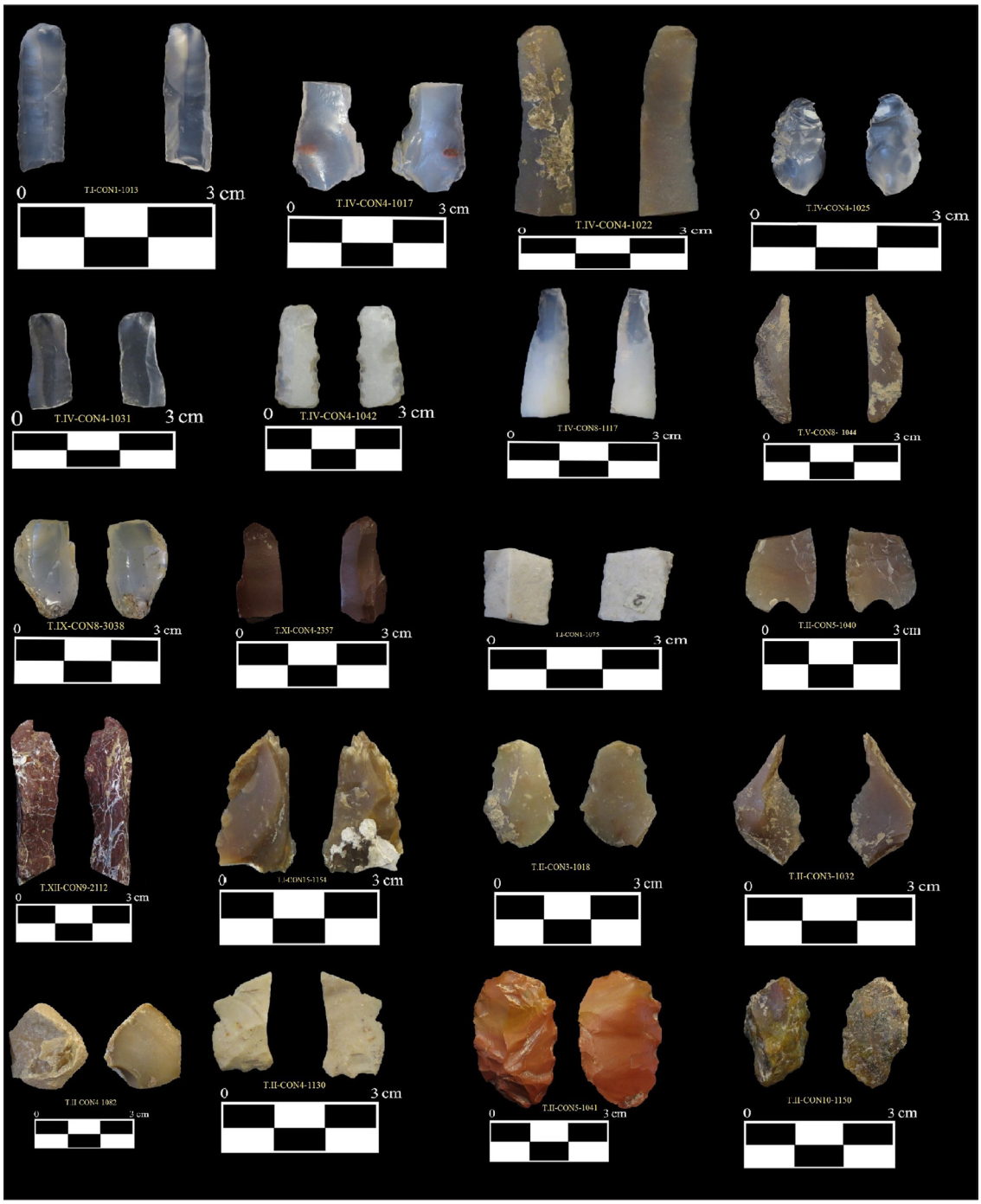

Figure 5: Lithics of Shahrake Firouzeh Site.

The function of sites and activities conducted in them is currently under discussion. It was already mentioned that two different types of activities can be distinguished: resource extraction and consumption/maintenance. Extraction activities are concerned with direct procurement of economic goods or raw materials. Maintenance activities are related to preparation and distribution of economic goods and levelling of instruments. It is expected to observe different distributions in the position of extraction and maintenance activities, which is of course dependent upon the availability of raw material. Accordingly, two types of sites have been recognized: base camp and work camp (Binford and Binford, 1966: 268–269). abrasion-edge analysis of tools is essential to determine exactly what was done in each site. Given that only one core has been found in Shahrake Firouzeh site, it can be inferred that handmade tools were used or perhaps maintained in them, and the site can be regarded a maintenance site. The quantity of lithics collection of Shahrake Firouzeh is presented in **Table 3**. The high percentage of fragments in this collection is striking. As can be seen, the majority of fragments are related to debitage. The technology distribution of lithics collection of Shahrake Firouzeh site does not represent a single purpose site in production chain of lithics and shows the same distribution in a variety of types. The remains of lithics from production to consumption are thus observed in this collection. With respect to construction technique of the set of tools in

Figure 6: Lithics of Shahrake Firouzeh Site.

Table 3: Technology Structure in lithics collection of Shahrake Firouzeh Site.

Table	Core and Element	Debitage		Tool	Debri	Debitage	Sum
		Intact	Fragment				
Number	1	15	26	6	6	12	66
Percentage	1.51	22.72	39.39	9.09	9.09	18.18	100

Shahrake Firouzeh Site, it can be observed that although the pressure technique of bladelet production is visible and the only core in the collection is of bladelet pressure core (No. 3038), the debitage production and consumption has been prevalent both in finds and tools. Therefore, direct and indirect impact to produce debitage and blades followed by pressure removal of bladelets seems to be the production technique in this site and both types of lifts have been used for production of tools.

Tappeh Hesar in Damghan is an archaeological site in Northeast of Iran. The tools in this site show little homogeneity compared with tools in Shahrake Firouzeh site. A

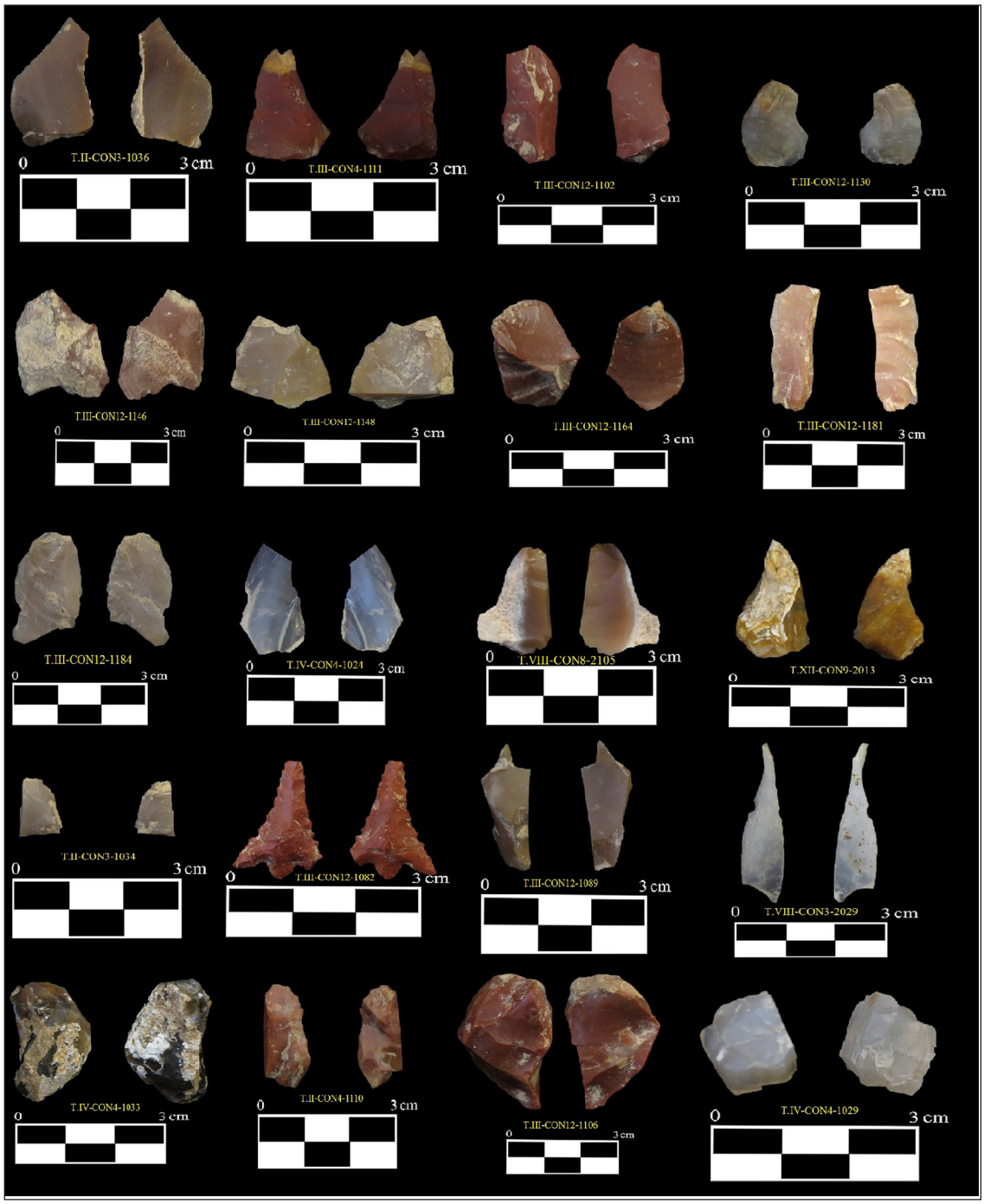

Figure 7: Lithics of Shahrake Firouzeh Site.

feature of Tappeh Hesar is the attention paid to production of lithics despite industrial application of the majority of tools. Maximum use of the blades and bladelets for making tools and less attention to tools made from debitage is another indicator of Tappeh Hesar site (Rosenberg, 1989: 115). while most tools in Shahrake Firouzeh Site are of debitage type.

Conclusion

During the Bronze Age, a fundamental change took place in the structure of human societies and communities that proceeded towards urbanization with its Their own parameters. Keeping this matter in mind, Bronze Age settlers of Neyshabur Plain left the foothills and chose lowlands for access to more spacious and fertile lands. Due to presence of alluvial beds, there were more agricultural lands in lowlands. Shahrake Firouzeh was located in the path of important East-West roads in the latter half of second millennium BC and was rich in terms of ores and precious metals. Turquoise is the most important mine in Shahrake Firouzeh Site, which was of international quality and its use as a valuable commodity has been reported through archaeological excavations in many prehistoric settlements in neighboring regions of Neyshabur Plain as well as remote areas.

The lack of blade core against the presence of blade/blade tools in collections, while their material is different from the gray-green chert, also suggests that

these blades were imported as industrial products and their production Has taken place in another place. Tools manufacturers in the Shahrake Firouzeh site encountered a greater tendency to make blades and bladelets, while other stone products were of secondary importance. Almost half of the lithics in this site has been damaged by factors, and it is likely after some time that these lithics have been broken and manufacturers have had to make other tools. In comparison to other contemporary sites in the region or elsewhere in the country, tool industry and stone cutting in Shahrake Firouzeh show a lower density and diversity in terms of technology and raw materials. All the lithics of Shahrake Firouzeh are made of chert stone and most tool fragments collected in this site lack a cortex. It is likely that the producers had the opportunity of production and immediate use of lithics since the majority of lithics are unadorned or show scattered retouching with occasional use of special retouching techniques such as denticulate and chisel. The few specific retouching cases as well as sickle gloss in lithics collection of Shahrake Firouzeh indicate that these tools were sporadically used in agricultural work.

Competing Interests

The authors have no competing interests to declare.

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