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Middle Paleolithic Lithic Industry from Qaleh Kurd Cave, Qazvin Province, Iran

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Abstract

This paper focuses on the lithic finds from two seasons of excavations at Qaleh Kurd (QK), a cave site in western Central Plateau. Through sedimentological studies, Holocene and Pleistocene deposits were identified during the excavations. Analysis of sedimentary context and the spatial distribution of the faunal remains and lithics suggested that the Pleistocene deposits at QK split into three sub-periods. Statistical analysis based on the lithic techno-typology confirmed such suggestion with the lithics featuring Middle Paleolithic (MP) affinities in all phases. The cross-sequence comparisons of QK's lithics with the Zagros and Central Plateau MP assemblages suggested stronger affinities of QK with the former. The overall characteristics of the QK tool kit consist of a scraper-rich, flake-base typology, low frequency of denticulate and notch, the abundance of points, application of Levallois technique, frequent signs of direct percussion, minimal preparation of platform, and the presence of intense retouching and rejuvenating the edges.

Keywords: Qaleh Kurd Cave, Middle Paleolithic, Lithics, the Zagros, Iranian Central Plateau.

Article Type: Research Article

Introduction

The Middle Paleolithic (MP) in Iran is known from some key sites that primarily lie in the Zagros region and Iranian Central Plateau (Coon 1951; Braidwood *et al*. 1961; Young and Smith 1966; Hole and Flannery 1967; McBurney 1970; Bewley *et al*. 1984; Biglari and Heydari 2001; Jaubert *et al*. 2009; Biglari *et al*. 2009; Bazgir *et al*. 2014; Bazgir *et al*. 2017; Conard and Zeidi 2019; Vahdati Nasab *et al*. 2019b; Vahdati Nasab *et al*. 2021; Heydari-Guran *et al*. 2021). Most MP sites in Iran have been relatively dated by a range of characteristic technologies and tool types, and few absolute dating has been published so far (Bewley *et al*. 1984; Vahdati Nasab *et al*. 2019b; Heydari *et al*. 2021).

Qaleh Kurd Cave (QK) lies in a namesake village in western Qazvin Province, southwest of the Alborz Mountains in Iran (Figures. 1a & 1b). The cave is at an intermediate location between the two regions of the Zagros and the Iranian Central Plateau, along one of the proposed dispersal corridors across the

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Iranian Plateau (Vahdati Nasab *et al*. 2013; Dennell 2020; Shoaee *et al*. 2021). With an elevation above sea level of about 2137 m, the site is situated at latitude 35°47'49" N, longitude 48°51'23" E. The cave's entrance measures 8 x 6 m, and it consists of two main corridors. The first a long corridor in the northwest that ends to a vast hall, and the second shorter dead-end corridor occupies the west side of the cave (Figures. 1c & 1d). This archaeological cave is an attraction for cave explorers, and was the subject of a paleoclimatology study using speleothems (Mehterian *et al*. 2017). The first archaeological study in QK was conducted in 2012, as part of which a small surface collection of 35 lithic artifacts were studied and attributed to the MP (Soleymani and Alibaigi 2012). The presence of old-looking faunal remains and lithics in the reworked deposits related to the clandestine holes inside the cave led to the systematic excavations of 2018, 2019, and 2022 by a joint Iranian-French expedition (Vahdati Nasab 2018; Vahdati Nasab *et al*. 2019a; Vahdati Nasab 2022). QK was excavated by a square meter grid and artificial vertical cuts of 5 cm depth. This cave has two sedimentological sequences of Holocene and Pleistocene dates, and contains some 25 stratigraphic units in Trench 1. Units 1–9 are of a Holocene date, while units 10–25 represent the Pleistocene period. Preliminary absolute dating places the Pleistocene deposit in the Middle Pleistocene period. Therefore, QK offers one of the earliest Paleolithic occupations across Iran (Vahdati Nasab *et al*. 2021). The present paper aims to describe the assemblage and variation of the MP lithics in QK and put it into regional-scale comparisons with the Zagros Mousterian and the MP lithic industries of the Iranian Central Plateau. This study provides quantitative insights and indispensable information about the MP lithic variation in Iran during the Pleistocene.

Materials and Methods

The lithics that compose the sample considered here were recovered in the 2018 and 2019 excavation seasons in QK. In total, 1257 chipped stone pieces were recovered in Trenches 1 and 3 (Figures. 1e & 1f). This study presents the preliminary results of the lithic assemblage of Trench 1 where the more considerable excavation was conducted on 1.2966 m2 in the first season and 6.195 m2 in the second. The study sample comprises 902 lithics that include retouched tools, débitage, cores, and debris. Dimensions, typology, and technological features of every piece were registered. Typological aspects of the lithics were classified and described (using the criteria outlined in Bordes 1961), and artifacts were studied with the chaîne opératoire approach (see Pélégrin *et al*. 1988).

As already indicated, the Pleistocene strata in Trench 1 are divided into fifteen sedimentological units and five successive archaeological assemblages or phases. The phasing is based on the stratigraphic observations, changes in the lithic-fauna densities, and data distributions through the depth (Z) of Trench 1. The three phases presented and described below, which represent the three upper strata of the Pleistocene deposit, contain the densest lithic artifacts compared to the other pertaining phases. The uppermost phase or QK1 starts from about -50 to -80 cm (Z) of Trench 1 and includes the Pleistocene sedimentary units 11–12. Units 11 and 12 contain intercalations of sandy silt/clayey silt, very damp soil with remains of charcoal. QK2 is the middle phase spanning the depths -80 to -105 cm, and is somehow confined to Unit 13. This unit shows visible lamination, and contains light brown to light yellow silt with many pebbles and flat calcite debris. The lower phase is QK3, which beings at the approximate depth of -106 cm and continues down to about -130 cm and is defined within the sedimentary units 14–16. Units 14, 15, and 16 consist of clayey silt with gravel and organic silt in brown color (Figure. 2).

Results

Raw Material

The lithic raw materials were diverse in QK, including silica-rich limestone, jasper, chert group, volcanic rocks such as basalt. Artifacts of marble, radiolarite, claystone, and quartzite are also present in small quantities (Table. 1). The most common raw material in all phases of QK was silica-rich limestone, which accounts for about 22% of the lithic artifacts in the upper, 20% in the middle, and 32% in the lower phase. Limestone use at the site is attested in different textures, colors, and degrees of silicification, with the relatively coarse grained being the most common variety. The other common types of raw material in the entire assemblage are jasper and chert, and some 16% of the pieces in QK2 were made on basalt. According to the geological map of the Avaj region, QK appears to be surrounded

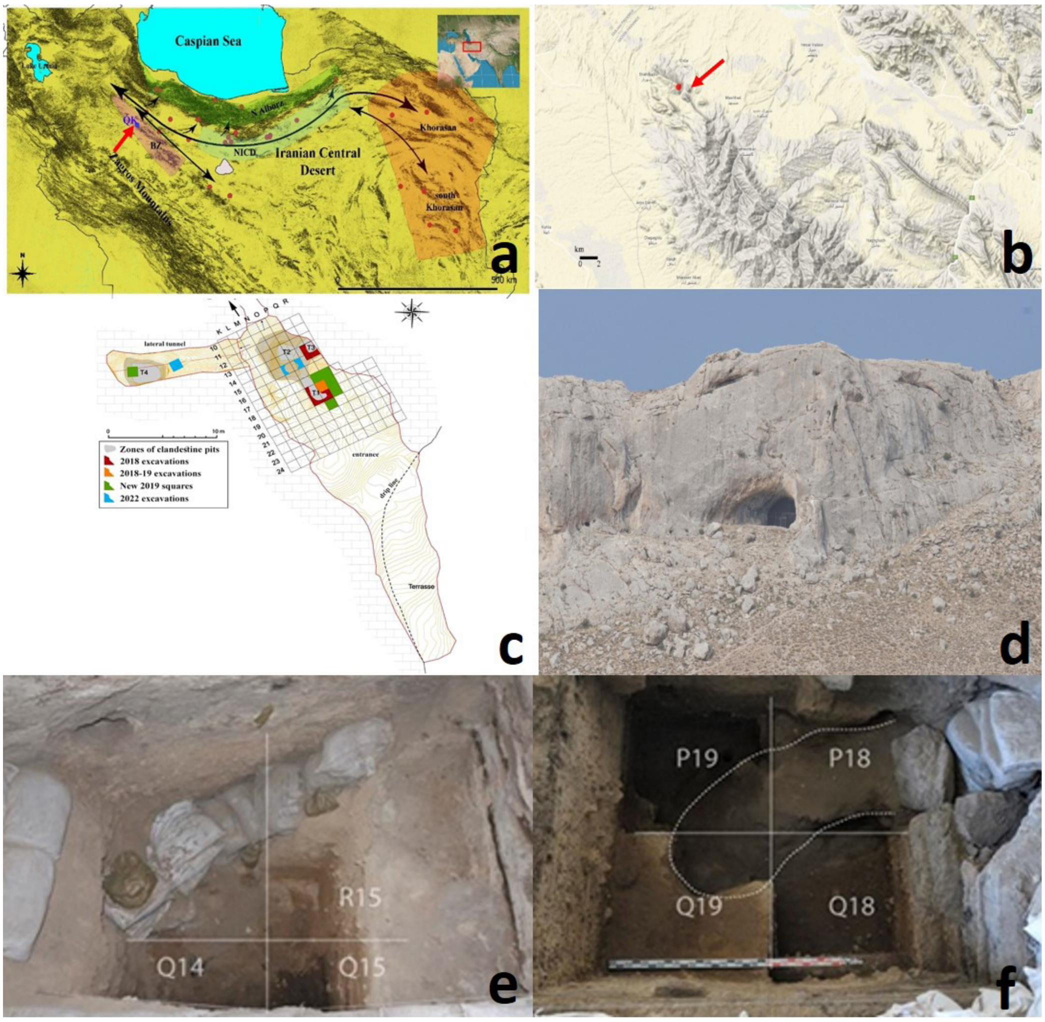

Figure. 1:*(a) Location of Qaleh Kurd cave (QK) in Iran, (b) Location of QK in Qazvin Province, (c) Topographic map of QK with the corridors and Trenches 1–4, (d) QK, (e) Trench 3, (f) Trench 1.*

by limestone, formations with veins of green tuff, andesite, basalt, sandstone, conglomerate, dolomite, and gypsum. At least some of the raw materials may be found close to the site, while more precise knowledge of local raw materials is expected from ongoing surveys.

Lithic Typo-Technology

The overall characteristics of the QK toolkit consist of high frequency of scrapers, flake-base typology, low frequency of denticulate and notch, the abundance of points, especially Mousterian points, and absence of bifacial and truncated-faceted pieces. Also notable are the relatively low quantities of the other types of tools such as burin, borer, naturally backed, crested blade, and cleaver, the use of the Levallois technique, frequent signs of direct percussion, minimal preparation of platform, and the presence of intense retouching and rejuvenated edges. The process of lithic production

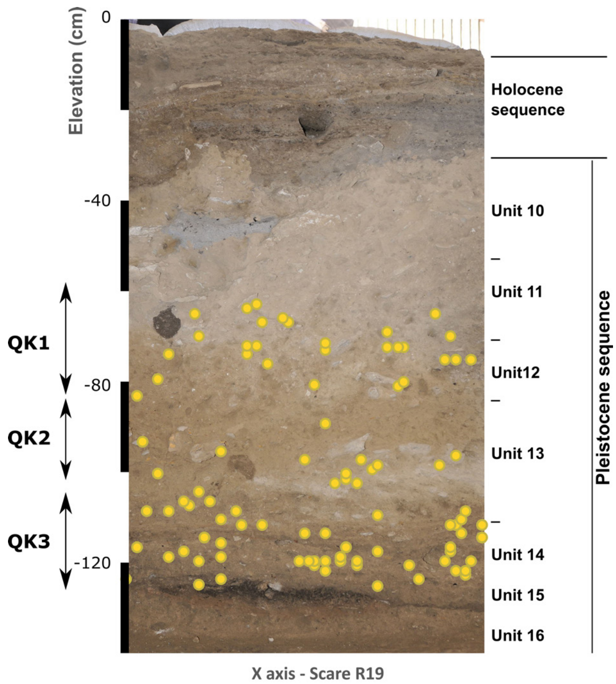

Figure. 2: *Lithic spatial distribution.*

Table. 1: Raw Material Variability

		chert	jasper	limestone	Igneous rock	basalt	Quartzite	filint	Radiolarite	clay stone	marble	indet
QK1	N	26	77	54	7	21	0	0	2	0	1	51
	%	10.80%	32%	22.50%	2.95%	8.75%	0%	0%	0.85%	0%	0.45%	21.70%
QK2	N	27	45	53	10	41	1	1	4	1	0	73
	%	10.46%	17.44%	20.54%	3.87%	15.90%	0.38%	0.38%	1.50%	0.38%	0%	29%
QK3	N	53	52	131	18	30	3	1	4	0	0	115
	%	13%	12.75%	32.10%	4.41%	7.35%	0.73%	0.24%	0.98%	0%	0%	28.44%

at QK represents a technology focused on débitage, flake tools, resharpening of tools, and exhausted and limited cores (about 0.3% in assemblage). Typo-technological variations of artifacts by phase are outlined below:

QK1: In this phase, débitage comprises about 88% and debris and unspecified pieces make up 2% of the lithic assemblage. Among the débitage, flakes (73¬%) are the most common removals (Table. 2), and 17% of the flakes are elongated. Flake tools, comprising 78% of the retouched pieces, are the most common. Some 14.3% of the lithic collection from the latest phase consists of blades, 40% of which were used as tools (Figure. 3). In QK1 more blades were seemingly turned into tools than flakes (30%) and bladelets (0%). Moreover, in QK1 the frequency of blades was higher than the two remaining phases (Table. 2). Bladelet accounts for about 1% of the sub-assemblages in all phases, and no tools were made on the bladelets (Table. 2). Among QK1 tools, scrapers are the most abundant at 65.5%, attested in the side-, end-, double side, and dejete varieties. Points are also abundant, and among the various present forms (Figure. 3) the Mousterian Points are more frequent at 10.80% (Table. 3). In QK1, blades were removed after a higher degree of platform preparation. About 54% of QK1's blades exhibit faceted platforms, whereas this platform type occurs on only 34% and 38% of the blades of QK2 and QK3, respectively. Yet, in all phases plain and faceted platforms are dominant regardless of blank type (Table. 4). Tools like burins, borers, and crested blades are found only in the latest phase (Figure. 3). The majority of the retouched tools contain scalar (62%) and stepped (31%) retouches. In some cases, rejuvenating the edges of the tools is also visible (Table. 5). About 40% of the flakes and 50% of the blades show fissure or errailure on the bulb. Also, 4% of the lithics have double bulb, and 6% of them show prominent bulb, which indicates direct percussion by hard or soft hammer (Pélégrin 2000) (Table. 6).

Table. 2: Lithic summary of Qaleh Kurd cave (QK).

	Flake	Blade	Bladelet	Fragment	Debris	Indet
QK1	168	33	3	19	1	6
	73%	14.50%	1.30%	8.20%	0.40%	2.60%
QK2	176	28	4	31	2	14
	69%	10.98%	1.60%	12.15%	0.77%	5.50%
QK3	282	39	6	44	8	19
	71.20%	9.80%	1.50%	11%	2%	4.50%

According to the cortex percentage of debitage, the evidence of primary knapping is confined in all phases (Table. 7).

Table. 3: *Tool typology of Qaleh Kurd cave (QK).*

		QK1		QK2		QK3	
Crested blade		1	1%	0	0%	0	0%
Borer		2	2.20%	0	0%	0	0%
Cleaver		0	0%	1	1.70%	0	0%
Notch		1	1%	2	3.30%	2	3%
Point		1	1%	3	5%	3	4.80%
Dejete point		3	3.40%	3	5%	2	3%
Retouched		7	7.60%	7	11.70%	2	3%
Naturally backed/Knife?		1	1%	0	0%	2	3%
Levallois point		3	3.40%	1	1.70%	4	6.30%
Elongated Mousterian point		1	1%	1	1.70%	1	1.50%
Mousterian point		10	10.80%	8	13.30%	11	17.20%
Burin		1	1%	0	0%	0	0%
Scraper	Dejete scraper	1	1%	1	1.70%	0	0%
	Side and end scraper	3	3.40%	1	1.70%	1	1.50%
	Double side scraper	13	14.10%	9	15%	6	9.50%
	Convergent scraper	11	12%	7	11.70%	9	14%
	End scraper	3	3.40%	2	3.30%	0	0%
	Side scraper	30	32.70%	14	23.20%	21	32.80%

Table. 4: *Platform type of Qaleh Kurd cave (QK).*

	Faceted	Plain	Cortical	Linear	Dihedral	Punctiform	Chapeau de jendarm
QK1	52	75	9	10	0	9	1
	33.30%	48%	5.80%	6.50%	0.00%	5.80%	0.60%
QK2	47	88	13	14	2	7	4
	26.85%	50.28%	7.42%	8%	1.15%	4%	2.30%
QK3	66	141	16	16	4	13	5
	25.20%	54%	6.20%	6.20%	1.52%	4.98%	1.90%

Table. 5: *Retouch type of Qaleh Kurd cave (QK).*

	Stepped	Scalar	Irregular	Scalar/Stepped
QK1	29	58	3	3
	31.2%	62.4%	3.2%	3.2%
QK2	14	39	3	4
	23%	65%	5%	6.7%
QK3	19	39	0	7
	29.2%	60%	0%	10.8%

Table. 6: *The bulb of percussion*

	Fissures on the bulb	Errailure-fissures on the bulb	Errailure on the bulb	Double bulb	Prominent bulb
QK1	33%	23%	34%	4%	6%
QK2	36%	18%	25%	2%	7%
QK3	35%	13%	8%	4%	8%

Table. 7: *Cortex of Qaleh Kurd cave (QK).*

	0-25%	25-50%	50-75%	75-100%
QK1	7%	5%	1.70%	1.70%
QK 2	12.50%	4.60%	2%	4.10%
QK 3	10.50%	5.70%	0.20%	2.10%

Figure. 3: *Selected tools of QK1*

QK2: In this phase, about 78% of the assemblage is formed by débitage. Flakes are the most abundant blank form at 69%, and blades make up about 11% of the collection (Table. 2). In QK2, tools include 24% of the lithic assemblage. Various forms of scrapers (57%) and points (26.7%) are the most common tools in this phase (Table. 3, Figure. 4). There are indications of direct percussion on the bulb, including fissures and errailure on 34% of the flakes and 22% of the blades (Table. 6). QK2 is similar to QK1 in the frequency of the flakes, blades, and bladelets, while in terms of typology of the tools, the QK2 assemblage is more similar to QK3.

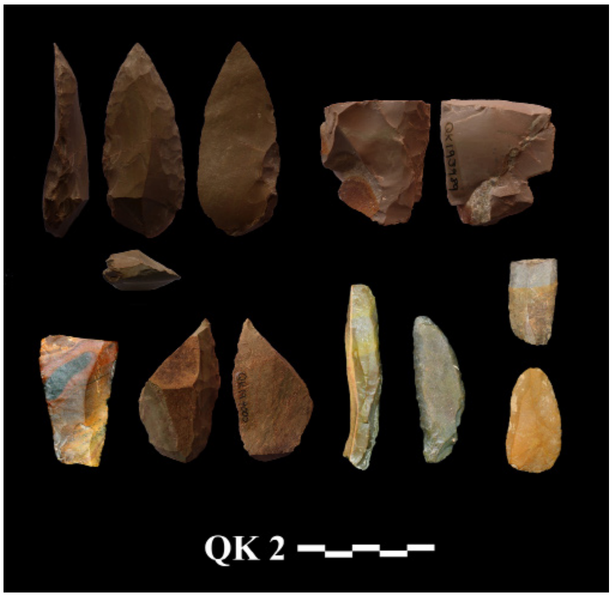

Figure. 4: *Selected tools of QK2*

QK3: This is the lowest phase to be presented here. In this phase, the most abundant tools are various forms of scrapers, and points (Figure. 5). The absence of denticulate and low percentage of notched pieces (about 1% in QK1 and 3% in QK2 & QK3) in all phases is remarkable (Table. 3). QK3 appears to be the most prosperous compared to the former two phases, being significantly different from them in the high concentration of the lithics. Over 45% of the lithic assemblage derive from QK3 (Table. 2; Figure. 6a). Like other phases, a large portion of the blanks are made on flake (71.20%). Also, 51% of the entire chips (flake with maximum lengths of less than 2 cm) from the site were obtained from this phase (Figure. 6b). Another distinguishing feature of QK3 is the higher frequency of the Levallois technique (Figure. 6c). While the technique is in evidence in all phases, it is attested on only about 8.2% of the pieces in QK1, and about 7% of the pieces in KQ2.

Figure. 5: *Selected tools of QK3*

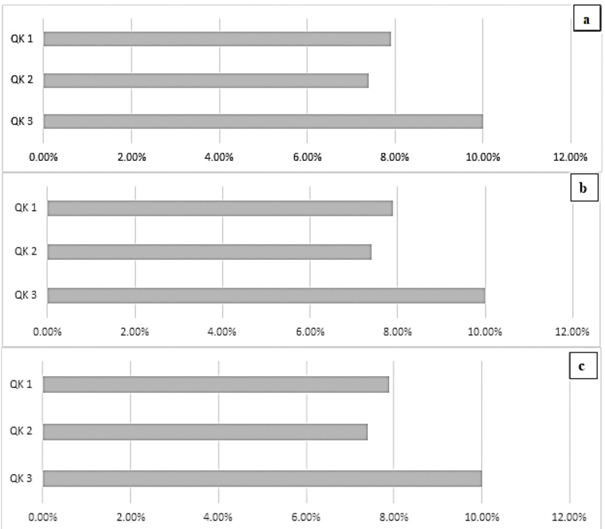

Figure. 6: *(a) Lithic accumulation in the phases, (b) Chips distribution in the phases, (c) Levallois production distribution in the phases*

Lithic Dimensions

The analysis and review of the QKs phases continued with examining the differences between phases in terms of artifacts dimensions through statistical analyses. Therefore, Linear Regression Analysis (LRA) with R programming was performed on the dimensions of the lithic artifacts from all three phases. LRA estimates a combination of archaeological collections and bears some resemblance to standard seriation. Actually, LRA models a relationship between explanatory variables. In the regression analysis, complete removals with no signs of breakage were separated and classified into two categories of flakes and blades. Due to the small number of bladelets, they were ignored during the calculations. The LRA results indicate that blades are somewhat different but there is no significant difference in the flake dimensions across the three phases (Table. 8; Figure. 7 (A & B)).

Table. 8: *The average dimension (mm) of complete flakes and blades.*

Blade	Average length	Average Width
QK1	54.37	20.15
QK2	56.18	19.87
QK3	56.67	21.19
Flake		
QK1	38	27.73
QK2	39.86	27.76
QK3	36.8	27

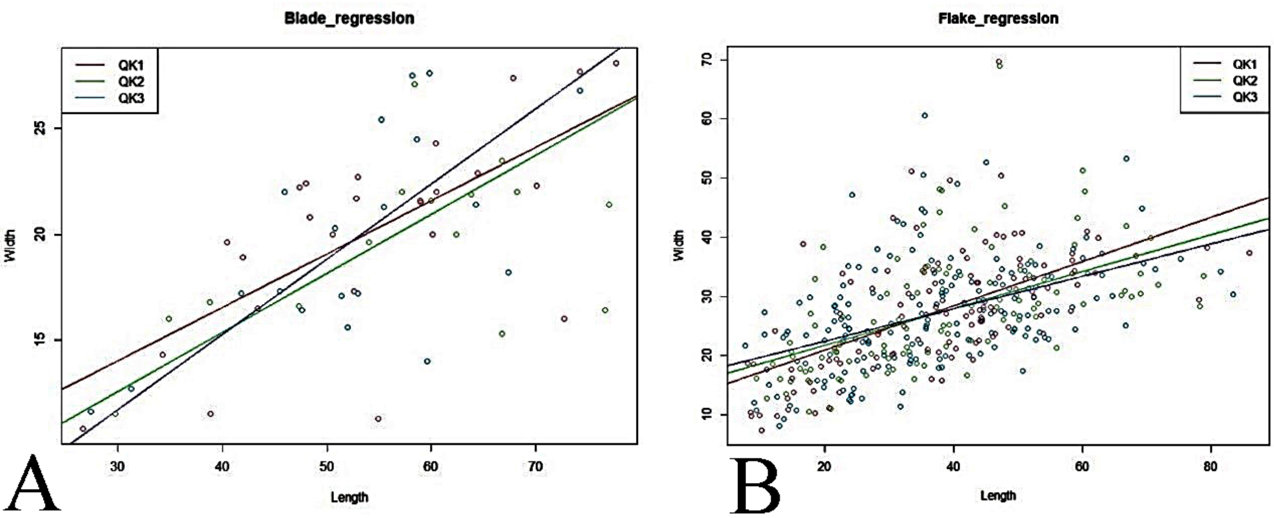

Figure. 7: *The diagram of Linear Regression Analysis.*

Comparison with Mousterian of Zagros and Central Plateau

The three phases (QK1, QK2, and QK3) were compared with the MP sites of Zagros, and the Iranian Central Plateau, including Bisitun (Coon 1951; Lindly 2005), Warwasi and Qobeh (Braidwood *et al.* 1961; Dibble and Holdaway 1993; Lindly 2005), Kunji (Hole and Flannery 1967; Baumler and Speth 1993), Gar Arjeneh Rockshelter (Hole and Flannery 1967; Lindly 2005) Gilvaran, Ghamari and Kaldar caves (Bazgir *et al*. 2014), Mar-Tarik (Jaubert *et al.* 2009), Bawa-Yawan (Heydari-Guran 2021), Chahe-Jam (Vahdati Nasab and Hashemi 2016), and Mirak (Vahdati Nasab *et al*. 2019b).

To compare the tool typology of QK with the Zagros and Iranian Central Plateau sites, 24 types of tools were selected based on the inter-site most shared items (Table. 9). The QK assemblage shared many typological traits with the Mousterian of Zagros¬, such as high frequency of scrapers (especially side-scraper) and points, few notch and denticulate and the same extent of the application of the Levallois technique. Scrapers are the major typological category and various forms of scraper, including side-scraper, double side scraper, convergent scraper, dejete scraper, and Mousterian points, display a higher frequency at the Zagros sites than in the Central Plateau. Regarding the frequency of tools, QK1, QK2 and QK3 were the same as Kaldar, Mirak, and Gilvaran, respectively. Hierarchical clustering of the tools implied that the tool characteristics of these sites could be placed in two general groups: one group consisting of QK, Gar Arjeneh, Bisitun, Qobeh, Kunji, and Warwasi, and the other consisting of Kalder, Mar-Tarik, Chahe Jam, and Mirak (Figure. 8). Levallois index (IL) was also analyzed for Bawa-Yawan, Ghamari, Gilvaran, Kaldar, Mirak, and QK (Table. 10). There was the highest frequency of Levallois production at the Mirak (IL: 0.19) and the lowest at Bawa-Yawan (IL: 0.01). Among the QK phases, QK3 showed the highest Levallois frequency (IL: 0.10), an observation that links this phase to Kaldar L5 (IL: 0.13).

Discussion

As mentioned before, the archaeological and sedimentary sequence of QK indicates five distinct levels, of which the three upper levels will be discussed here. Artifact and tools density could furnish an imprecise but consistent estimator of residence period at a site and mobility strategy (Riel-Salvatore and Barton 2004; Kuhn and Clark 2015; Clark and Barton 2017), or might reflect sedimentation rate and group size (Centi and Zaidner 2020). Lithics are the result of past human choices, which could have been influenced by the combined effects of social implications and extended learning (Hiscock 2014), length of stay at sites, raw material distribution, the difference in tasks, and mobility patterns (Barton and Riel-Salvatore 2014). Bordes (1969) believed that lithic variability resulted from different cultural traditions; however, Binford (1973–1980) later proved that site function could be a determining factor. The processes of cultural adaptation in past populations (de Azevedo *et al*. 2014), and socioeconomic and environmental reasons (Rolland and Dibble 1990; Andrefsky 1994; Kuhn 1994; Prentiss and Clark 2008; Clark and Barton 2017) are among the other interpretations proposed for lithics variability. Binford (1980) suggested that the variety in the lithic typological composition was due to different mobility strategies, and relied on models of residential and logistical mobility patterns. Based on Binford's model, Chatters (1987) introduced three types of camps, including winter base camp, winter hunt camp, and spring residence camp, and used the evenness index. Chatters' evenness index ranges between 0 (least diversity) and 1 (most diversity). Higher values indicate residential base camps where occupations were of longer duration and a more comprehensive range of activities took place; low values indicate transient campsites with a limited range of activities. The evenness index (E) was calculated by Eq (1): (Andrefsky 2005)

$$E = -\frac{\sum[(\frac{ni}{N})\log(\frac{ni}{N})]}{\log s} \quad (1)$$

Where ni is the number of tools, N is the total number of tools and S is the number of types (Odum 1971). The E values for QK1, QK2, and QK3 are 0.91, 0.85, and 0.81, respectively. These E values demonstrate a high variety for the tools in all phases of QK. Therefore, due to the existence of a wide range of activities, more diversity of tools was observed and it seems that QK was used as the base camp during all the phases considered here.

By comparing the phases of QK with the MP sites of the Zagros and the Central Plateau, we realized that the QK assemblage shared many typological traits with the Mousterian horizon of the Zagros¬,

Table. 9: *Tool typology of the Middle Paleolithic sites.*

Site	Number/Percent	Side scraper	End scraper	Convergent scraper	Double side scraper	Side and endscraper	Dejete scraper	Dejete point	Carinated Scraper	Transverse Scraper	Piercer	Burin	Denticulate	Notch	Mousterian point	Levallois point[1]	Naturally backed/Knife?	Retouched	Tayac point	Borer	Crested blade	Limac	Truncated-faceted piece	Foliated bifacial point	Bifacial retouched	Others[2]	Reference
Bisitun E+-G	N	83	-	95[3]	48	-	9	-	-	2	-	-	3[4]	-	-	-	5	-	-	-	-	-	-	-	-	-	Lindly 2005
	%	33.9	-	38.8	19.6	-	3.7	-	-	0.8	-	-	1.2	-	-	-	2	-	-	-	-	-	-	-	-	-	
Chahe Jam	N	20	8	73	9	-	-	-	5	8	-	-	20	-	-	-	1	60	-	-	-	3	-	-	2	12	Vahdati Nasab and Hashemi 2016
	%	9	3.6	33	4	-	-	-	2.3	3.6	-	-	9	-	-	-	0.5	27.2	-	-	-	1.4	-	-	0.9	5.5	
Kaldar L5	N	13[5]	-	-	-	-	-	-	-	-	-	-	-	-	14	12	-	22	1	-	-	1	-	-	-	3	Bazgir et al., 2017
	%	19.7	-	-	-	-	-	-	-	-	-	-	-	-	21.2	18.2	-	33.4	1.5	-	-	1.5	-	-	-	4.5	
Kunji	N	294[6]	8	85[7]	83[8]	-	14	-	-	32[9]	17	5	19	11	61	10	56	94	-	-	-	1	25	-	-	96	Baumler and Speth, 1993
	%	32.3	0.8	9.3	9.1	-	1.5	-	-	3.5	1.8	0.5	2	1.2	6.6	1	6.1	10.3	-	-	-	0.1	2.7	-	-	10.5	
MarTarik	N	20[10]	5	14[11]	5[12]	-	4	-	-	2	-	4	-	1	6	-	-	92	-	-	-	1	1	1	-	2	Jaubert et al., 2009
	%	12.7	3.2	8.8	3.2	-	2.6	-	-	1.2	-	2.6	-	0.6	3.8	-	-	58.3	-	-	-	0.6	0.6	0.6	-	1.2	
Warwasi jj-CCC	N	298	10	57	191	-	8	-	-	10	5	31	57	31	45	8	22	-	3	-	-	-	23	-	-	-	Dibble and Holdaway, 1993
	%	37.3	1.2	7.3	23.9	-	1	-	-	1.2	0.6	3.8	7.3	3.8	5.6	1	2.7	-	0.4	-	-	-	2.9	-	-	-	
Qobeh P-EE	N	147	-	103[13]	69	-	19	-	-	15	-	-	29[14]	-	-	-	4	-	-	-	-	-	-	-	-	-	Lindly, 2005
	%	38	-	26.7	17.8	-	5	-	-	3.9	-	-	7.5	-	-	-	1.1	-	-	-	-	-	-	-	-	-	
Gar Arjaneh	N	68	-	32[15]	13	-	16	-	-	9	-	-	2[16]	-	-	-	2	-	-	-	-	-	-	-	-	-	Lindly, 2005
	%	48	-	22	9	-	11	-	-	7	-	-	1	-	-	-	1	-	-	-	-	-	-	-	-	-	
Mirak L3	N	44	9	18	16	4	1	1	1	1	-	4	18	41	5	2	2	66	-	2	-	-	-	-	2	-	
	%	18.6	3.8	7.7	6.7	1.7	0.4	0.4	0.4	0.4	-	1.7	7.7	17.4	2.1	0.8	0.8	27.8	-	0.8	-	-	-	-	0.8	-	
Qaleh Kurd 1	N	30	3	11	13	3	1	3	-	-	-	1	-	1	11	4	1	7	-	2	1	-	-	-	-	1	
	%	32.4	3.3	11.8	13.9	3.3	1	3.3	-	-	-	1	-	1	11.8	4.4	1	7.6	-	2.2	1	-	-	-	-	1	
Qaleh Kurd 2	N	14	2	7	9	1	1	3	-	-	-	-	-	2	9	1	-	7	-	-	-	-	-	-	-	4	
	%	23.4	3.4	11.6	15	1.7	1.7	5	-	-	-	-	-	3.4	15	1.7	-	11.6	-	-	-	-	-	-	-	6.5	
Qaleh Kurd 3	N	21	-	9	6	1	-	2	-	-	-	-	-	2	12	4	2	2	-	-	-	-	-	-	-	3	
	%	32.3	-	13.9	9.4	1.5	-	3	-	-	-	-	-	3.5	18.5	6.2	3.5	3.5	-	-	-	-	-	-	-	4.7	

[1]Including Pseudo-Levallois point & retouched levallois point.

[2]Special and non-repetitive tools of the sites are included in the other section.

[3]Including Convergent Scraper & Mousterian Point (Lindly, 2005: 67).

[4]Including Denticulate & Notch (Lindly, 2005: 67).

[5]Including cortical scraper, Side scraper, Nosed scraper, and Scraper (Bazgir *et al*, 2017: 8).

[6]Including Single Straight SS, Convex SS Single, and Concave SS Single (Baumler and Speth, 1993: 29-30-45).

[7]Including Convergent Straight SS, Convergent Convex SS, and Convergent Concave SS (Baumler and Speth, 1993: 29-30-45).

[8]Including Double Convex/Concave SS, Concave SS Double, Convex SS Double, Straight/Concave SS Double, Straight/Convex SS Double, Straight SS Double (Baumler and Speth, 1993: 29-30-45).

[9]Including Transverse Concave SS, Transverse Convex SS, and Straight SS Transverse (Baumler and Speth, 1993: 29-30-45).

[10]Including Simple straight scraper, Simple convex scraper, Simple convex scraper 1/2 Quina, Simple concave scraper, Simple concave scraper 1/2 Quina, and Simple concave-convex scraper (Jaubert *et al* 2009).

[11]Including Convergent scraper, Concave convex convergent scraper, convex convergent scraper, straight convex convergent scraper, and Irregular convex convergent scraper (Jaubert *et al* 2009).

[12]Including Double straight convex scraper, double biconvex scraper, and Double irregular scraper (Jaubert *et al* 2009).

[13]Including Convergent Scraper & Mousterian Point (Lindly, 2005: 67).

[14]Including Denticulate & Notch (Lindly, 2005: 67).

[15]Including Convergent Scraper & Mousterian Point (Lindly, 2005: 67).

[16]Including Denticulate & Notch (Lindly, 2005: 67).

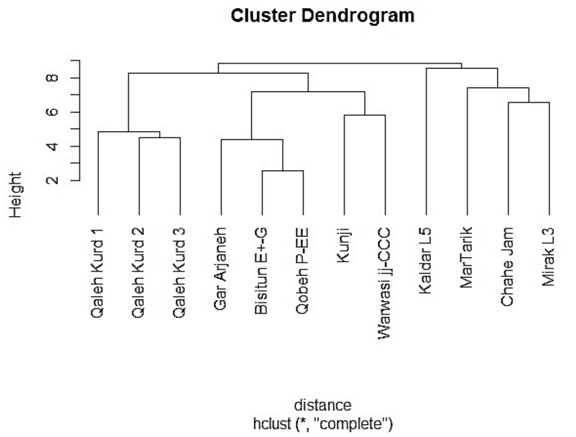

Figure. 8: *Cluster dendrogram of the tools.*

especially in the abundance of points and scrapers. Point represents the most common artifact category in the Mousterian level of Shanidar Cave (Solecki and Solecki 1993). Hole and Flannery (1967) reported that the Zagros Mousterian is known for triangular points and side scrapers. Dibble (1991) believed that the Zagros assemblage in the high abundance of scrapers and retouched tools was very similar to the Charente collections of Europe. Denticulated and notched pieces were abundant among the tools of the MP sites in the Central Plateau. Tools comprise a significant percentage of the artifactual assemblage of Sufi Abad at 45% (Vahdati Nasab and Feiz 2014), as is the case with Mirak (Vahdati Nasab *et al.* 2019b), Qaleh Bozi (Biglari *et al.* 2009), and Chahe

Table. 10: *Levallois technique in the Middle Paleolithic sites*

Site	Flake	%	Blade	%	Core	%	Total blank	Reference
Bawa Yawan Gh3-Gh4-Gh5	39	0.87	10	0.22	-	-	4460	Heydari Guran *et al*., 2021
Ghamari L5	28	12.5	4	1.7	0	-	224	Bazgir *et al.*, 2014
Gilvaran L3-L4-L5	132	4.3	23	0.7	14	0.4	3126	Bazgir *et al.*, 2014
Kaldar L5	42	8.5	20	4	4	0.8	498	Bazgir *et al.*, 2017
Mirak L3	98	14.4	20	3	15	2.1	682	-
Qaleh Kurd 1	11	4.8	8	3.4	1	0.4	230	-
Qaleh Kurd 2	17	6.7	2	0.7	2	0.7	255	-
Qaleh Kurd 3	34	8.5	8	2	0	-	398	-

Jam (Vahdati Nasab and Hashemi 2016). However, in QK denticulated pieces are virtually absent, and only a small amount of notched pieces are attested (Table. 2). The Taglar-Erevan tradition represented in Weasel Cave of northeastern Caucasia also occurs in QK and the Mousterian Zagros sites (Golovanova and Doronichev 2003; Golovanova 2015). A review of the Levallois productions in the MP sites showed that the presence of the Levallois tradition is a significant indicator at most of the MP sites of the Central Plateau. For instance, the MP of Mirak L3 showed the abundance of such technique (Vahdati Nasab *et al*. 2019b). Some 57% of the Chahe Jam lithic assemblage (Vahdati Nasab and Hashemi 2016) and 18% of the Sufi Abad assemblage (Vahdati Nasab & Feiz, 2014) are characterized by this technique. On the other hand, at the Zagros sites, the absence or faint presence of the Levallois technique has been suggested as one of the characteristics of the Zagros Mousterian. In his grouping of the Zagros lithic assemblage, Skinner (1965) defined Group A or the Zagros Mousterian based on the absence of the Levallois method; also Hole and Flannery (1967) reported that the Luristan Mousterian was non-Levallois like other Zagros sites such as Hazarmard, Shanidar, Bisitun, and Warwasi. However, recent investigations by Iranian archaeologists have identified many sites with the Levallois production in the Zagros (Jaubert *et al.* 2009; Bazgir *et al*. 2014; Bazgir *et al.* 2017; Heydari-Guran *et al*. 2021). It seems that the lack of concentration on the features of the preparation technique on the débitage platform and the underestimation of the importance of the dorsal scar patterns on Levallois flake as well as the absence of an accepted concept of the Levallois in the mid-50s have coupled to led to such interpretations (Vahdati Nasab 2010).

Conclusions

Pleistocene sediments of Qaleh Kurd cave shows five main strata, of which three were considered in the present paper. Techno-typologically, these three phases exhibit strong correspondence. In the third phase, MP traits such as the abundance of scrapers, Mousterian points, and Levallois technique are more prominent. Our findings suggest that the site contains an MP lithic assemblage similar to the Mousterian of the Zagros. In conclusion, comparing the shifts of lithic density in the phases enabled us to gain a better understanding of the changes in lithic technology during the occupation of QK. Also comparing the QK assemblages with other sites in Iran led us to an enhanced picture of the MP lithic industries of Iran. Additional comparative work is needed on QK and other sites in the Levant and Caucasia to investigate how cultural interactions and lithic traditions were exchanged during the Middle/Late Pleistocene across the region.

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