DTCF DERGİSİ JOURNAL

DTCF Dergisi 59.1 (2019): 646-661

RAW MATERIAL ANALYSES OF THE LOWER PALEOLITHIC CHIPPED STONE INDUSTRY OF KARAIN CAVE: PRELIMINARY RESULTS

KARAİN MAĞARASI ALT PALEOLİTİK DÖNEM YONTMATAŞ ENDÜSTRİSİNİN HAMMADDE ANALİZLERİ: PRELİMİNER SONUÇLAR

Yavuz AYDIN
Arş. Gör. Dr., Ankara Üniversitesi, Dil ve Tarih-Coğrafya Fakültesi, Arkeoloji Bölümü, Tarih Öncesi Arkeolojisi Anabilim Dalı, yavuzaydin.dtcf@gmail.com

Michael BRANDL
Dr., Institute for Oriental and European Archaeology (OREA), Austrian Academy of Sciences, michael.brandl@oeaw.ac.at

Makale Bilgisi
Gönderildiği tarih: 20 Şubat 2019
Kabul edildiği tarih: 31 Mayıs 2019
Yayınlanma tarihi: 25 Haziran 2019

Article Info
Date submitted: 20 February 2019
Date accepted: 31 May 2019
Date published: 25 June 2019

Anahtar sözcükler
Karain Mağarası; Alt Paleolitik; Yontmataş; Hammadde Analizi; Petrografi

Keywords
Karain Cave; Lower Paleolithic; Chipped Stone; Raw Material Analysis; Petrography

DOI: 10.33171/dtcfjournal.2019.59.1.32

Abstract

The current study represents the first raw material analysis ever conducted on a Lower Paleolithic assemblage in Turkey. A representative sample of 53 archaeological artifacts obtained from the Lower Paleolithic layers of Karain Cave, one of the most important Paleolithic sites in Anatolia, and 26 radiolarite blocks collected from raw material deposits around Karain were used for this undertaking. The goal of the study was to determine the type of raw materials used by the Lower Paleolithic hunter-gatherer groups that settled in the Karain Cave for the production of their chipped stone industry, and obtain initial ideas concerning the potential sources of the raw materials. For raw material characterization and provenance studies, petrographic methods including stereomicroscopy were employed. First results indicate that the Lower Paleolithic inhabitants of Karain Cave used a variety of sources for lithic raw material procurement. As an unexpected result, we found that the Burhan River, which is located approximately 10 km away from the site, might have served as the main source. This preference, which seems irrational at first could be explained by more favorable conditions than those found at closer sources, such as accessibility and abundance of raw materials.

Öz

Bu çalışma, Türkiye'de bir Alt Paleolitik buluntu topluluğu üzerinde yapılan ilk hammadde analizlerinin sonuçlarını sunmaktadır. Bu çalışma için, Anadolu'nun en önemli Paleolitik yerleşimlerinden bir tanesi olan Karain Mağarası'nın Alt Paleolitik seviyelerinden elde edilen 53 adet arkeolojik buluntuya ait karakteristik örnek ile Karain çevresindeki hammadde kaynaklarından toplanmış olan 26 adet radyolarit blok kullanılmıştır. Çalışmanın amacı, Karain Mağarası'nda iskan etmiş olan Alt Paleolitik avcı-toplayıcı grupların yontmataş endüstrinin üretimi için kullanmış oldukları hammadde türlerini belirlemek ve potansiyel hammadde kaynakları ile ilgili ilk fikirleri elde etmekti. Hammadde karakterizasyonu ve köken çalışmaları için stereo-mikroskop analizlerini içeren petrografik yöntemler kullanılmıştır. İlk sonuçlar, Karain Mağarası Alt Paleolitik sakinlerinin yontmataş hammadde temini için çeşitli kaynaklardan faydalandığını göstermektedir. Beklenmeyen bir sonuç olarak, yerleşime yaklaşık 10 km uzaklıkta yer alan Burhan Nehri'nin ana hammadde kaynağı olarak kullanılmış olabileceği görülmüştür. Başlangıçta mantıksız gibi görünen bu tercih, erişilebilirlik ve hammadde bolluğu gibi diğer kaynaklara nazaran daha uygun olan şartların varlığıyla açıklanabilir.

Introduction

The Karain Cave is located in the region of Antalya in southwestern Turkey and represents one of the few excavated sites containing both, Holocene and Pleistocene deposits in stratigraphic positions. Therefore, this site provides a significant database regarding long prehistoric sequences in Turkey.

Excavations at Karain commenced in 1946, were conducted by various researchers and are still ongoing (Kökten 223-239; Yalçınkaya 21-37; Taşkıran et al. 521-538). Especially the most recent work concentrated on systematic excavations documenting the complex stratigraphy and related finds. Specifically the chipped stone industry recovered from layers of different settlement periods of the cave were analyzed techno-typologically and the results were published in various journals (Aydın, "Pleyistosen Dönem'den…" 529-556; Ceylan 173-186; Kartal, "Karain B Gözü Orta Paleolitik…" 89-108; Kartal, "Karain B Gözü Kalkolitik Çağ…" 25-49; Otte et al., "The Anatolian Middle Paleolithic…" 287-299; Otte et al., "Évolution Technique…" 529-561; Otte et al., "Paléolithique Ancien…; 149-156" Otte et al., "Long-term Technical…" 413-431; Özçelik, "Karain Mağarası B Gözü'nde…" 83-95; Özçelik, "Le Paléolithique supérieur…" 600-609; Özçelik, "Karain Mağarası B Gözü Epi-paleolitik…" 213-225; Taşkıran, *Karain Mağarası Kenar Kazıyıcılarının…*). Additional to techno-typological investigations, archaeometric methods have increasingly been employed in order to understand the routines, preferences and choices of the prehistoric people producing specific lithic industries.

The current study represents the first in-depth raw material study ever conducted for a Lower Paleolithic assemblage in Turkey. The goal of this undertaking was 1) the characterization of the lithic materials in the assemblage, 2) to identify the potential origin of the raw materials used for chipped stone tool production. Material characterization and provenance analyses of the archaeological material were performed through stereomicroscopic investigations. In order to understand which raw materials were used for the Lower Paleolithic chipped stone industry at Karain and to identify the sources from which they could have been procured, results of petrographic and micropaleontological examinations of the archaeological artifacts were compared with data of geological samples.

Material and Method

The material investigated for the current study consists of archaeological artifacts from the Lower Paleolithic levels in the Karain Cave, and raw material collected from two river sources in the vicinity of the site as geological comparative samples.

The archaeological samples comprise 53 typologically uncharacteristic specimens representing debris (chipping wastes) from various levels in the Karain Lower Paleolithic deposit (Table 1).

Table 1: List of Archaeological Samples from Karain Cave

Örnek Numarası	Plankare	Arkeolojik Seviye	Jeolojik Seviye	Örnek Numarası	Plankare	Arkeolojik Seviye	Jeolojik Seviye
1	I 15	79	V.1.2	28	I 18	70	V.2
2	I 15	79	V.1.2	29	I 18	66	V.1.2
3	I 15	79	V.1.2	30	I 18	71	V.2
4	I 15	79	V.1.2	31	I 18	71	V.2
5	I 15	79	V.1.2	32	I 18	67	V.1.2
6	I 15	80	V.1.2/V.3	33	I 18	67	V.1.2
7	I 15	80	V.1.2/V.3	34	J 17	90	VI
8	I 15	77	V.2	35	I 18	71	V.2
9	I 15	77	V.2	36	I 19	83	V.3
10	I 15	77	V.1.2/V.2	37	I 19	76	V.3
11	I 15	77	V.1.2/V.2	38	I 19	76	V.3
12	I 15	75	V.1.2	39	I 19	76	V.3
13	I 15	74	V.1.2	40	I 19	76	V.3
14	I 15	74	V.1.2	41	I 19	80	V.3
15	I 15	78	V.1.2/V.2-V.2	42	I 19	82	V.3
16	I 15	78	V.1.2/V.2-V.2	43	I 19	78	V.3
17	I 15	76	V.1.2	44	I 19	87	VI
18	I 15	76	V.1.2	45	I 19	74	V.2
19	I 15	78	V.1.2/V.2-V.1.2	46	I 19	74	V.2
20	I 19	66	V.1.2	47	I 19	73	V.1.2
21	I 19	70	V.1.2	48	I 19	72	V.1.2
22	I 19	70	V.1.2	49	I 19	74	V.3
23	I 19	70	V.1.2	50	I 19	74	V.3
24	I 19	69	V.1.2	51	I 19	74	V.3
25	I 19	69	V.1.2	52	I 19	74	V.3
26	I 19	69	V.1.2	53	I 19	74	V.3
27	I 19	68	V.1.2	54	I 19	73	V.1.2

Geological samples were collected from potential raw material sources in the surroundings of Karain. Based on previous research, three potential source locations have been identified: The Kızılin River and Çakmak Hill, which are approximately 3 km away from Karain Cave, and the Burhan River, located approximately 10 km from the site. At these locals, surveys targeting potential raw material deposits in the vicinity of Karain have produced evidence of materials suitable for chipped stone tool production in previous years (Kayan 10-31; Pawlikowski 351-369; Taşkıran, "The Supply Areas…" 207-211). The sampling strategy for the current study was based upon these previous undertakings, defining the Kızılin-Burhan Rivers and Çakmak Hill as the most likely sources of the raw material of the chipped stone industry in the Lower Paleolithic sequences of Karain Cave. Although all three sources were surveyed in order to obtain geological material in the course of this undertaking, it was only possible to collect representative samples from two of them, Kızılin and Burhan.

Unfortunately, the Çakmak Hill (Tepesi) source was entirely destroyed in the course of construction work, therefore it was not possible to acquire suitable sample material.

For raw material characterization and provenance studies, a two-step petrographic analytical process was employed. In the first stage, archaeological artifacts were macroscopically sorted into groups, based on color characteristics, texture, granularity, and inclusions visible by naked eye. Subsequently, geological samples (i.e. raw material nodules or blocks) from both, the Kızılin and Burhan Rivers, were collected according to the macroscopic groups defined for the archaeological specimens. Following this strategy, 16 raw material samples from the Kızılin River and 10 raw material samples from the Burhan River were selected (Figure 1). Considering the significant visual similarity of many silicites, macroscopic grouping only provides a rough estimation and is not suitable for any secure assessments (Brandl, "The Multi Layered Chert ..." 150).

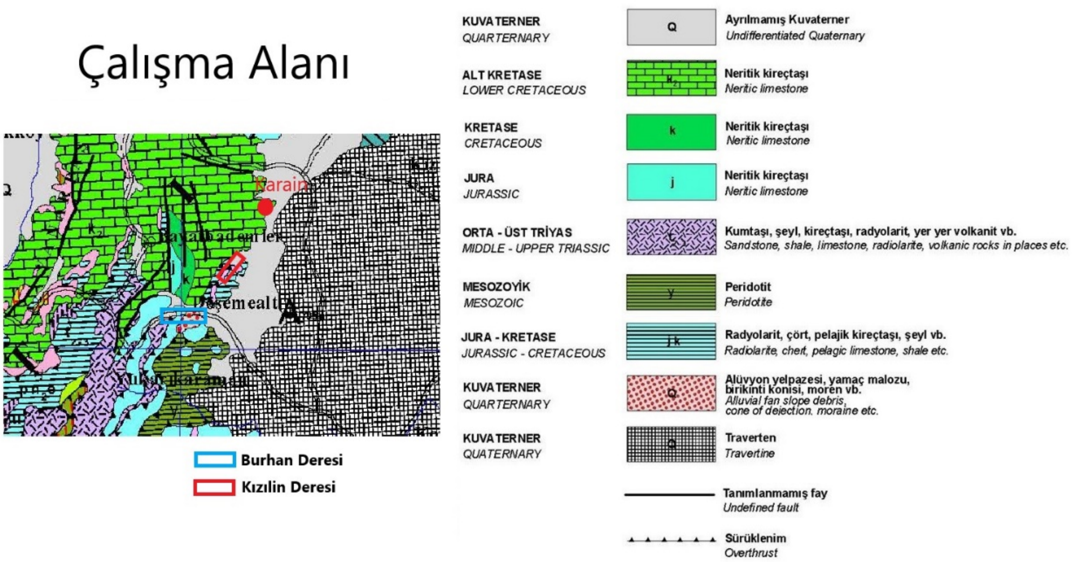

Figure 1: Study Area in Relation to the Geology of the Region

Therefore, stereomicroscopic investigations were performed as step two of the analytical process on each archaeological and geological macroscopic group in order to test them for their internal consistency.

Stereomicroscopic Microfacies Analysis

Microscopic investigation is a well-established petrographic method typically performed on thin sections. Archaeological materials however require non-destructive techniques. In this regard, a method known as stereomicroscopic individual artifact analysis on unpolished specimens has been developed by various researchers active in archaeometric studies (Affolter; Brooks 53-71; Přichystal 146-152). This analysis requires substantial experience, however if applied in a systematic and suitable manner, the results form a solid base for further investigations.

Stereomicroscopy can be applied to all kinds of lithic materials and aims at the identification of characteristics such as the microstructure, i.e. size, shape and spatial arrangement of the rock-building components, and particular inclusions. In the case of silicites, i.e. organically formed SiO_2 modifications (Brandl, "Genesis, Provenance and…" 33-58), this investigation primarily focusses on the detection of microfossil remains, however, non-fossil inclusions are also recorded and may be representative of specific source environments. In marine contexts, one of the most important source environments for silicites, microfacies analysis is able to differentiate between deep sea facies (pelagic) and shallow water facies (neritic). The neritic zone can again be subdivided into a reef- and a laguna-facies. Each facies displays specific features preserved in solidified sediments, most importantly microfossils, which are indicative of particular habitats. Therefore, micropaleontological analysis allows to identify a raw material cluster by reconstructing the microfacies of siliceous rocks. For the current study, analyses were performed with a Zeiss SteREO Discovery.V20 varyingly applying 40–150 times magnification. Microphotos were produced under standardized 40 times magnification under water immersion at unpolished rock surfaces.

Parameters for Stereomicroscopic Analyses

For microfacies analyses, both microfossil and non-fossil inclusions were recorded. The individual parameters, i.e. microfossils and other recorded inclusions, are detailed in Table 2.

Table 2: Parameters for the Stereomicroscopic Analyses

Inclusions			
fossil	radiolarians	non-fossil	quartz or clacite monocrystal
	blue radiolarians		chalcedony veins
	radiolarian phantoms		foreign mineral particals
	marine detritus (POM)		chalcedony inclusions
	opaque organic phases		Fe-oxides
	calcispheres		Fe-sulfides
	carbonatic bioclasts		poorly sil. host rock remains
	bryozoa		phosphates
	shell		limonite as cleft fillings
	brachiopods		
	echinoderms		
	benthic and planktic foaraminifera		
	sponge spicules		
	peloids		
	intraclasts		
	larger indet. organic detritus		

The coloration of certain microfossil remains can be explained by diagenetic processes, during which tests of e.g. radiolarians were recrystallized and subsequently filled with either different SiO_2 phases (e.g. chalcedony or moganite), which results in blue or gray color tones, or alternatively with calcite monocrystals producing characteristic cleavage surfaces or leaving behind cavities in case of weathering. Phantoms are the result of fossil dissolution in the course of the solidification and silicification of sediments.

Preliminary Results

Raw Material Characterization

Based on microscopic investigations, the principal raw material used by the Lower Paleolithic inhabitants of Karain Cave was identified as radiolarite. This siliceous rock type is typically formed in Mesozoic limestone formations and primarily composed of the tests of radiolarians. Those are marine planktonic microorganisms with an average size range between 10 and 100 mm and coated by an amorphous silica skeleton. They are in most cases found in deep sea sediments.

Indications for Raw Material Provenance

According to macroscopic observations on the 53 archaeological chipped stone wastes, 13 visual groups were determined within the assemblage. Following the same classification criteria, 16 different geological sample groups were determined (Figure 2).

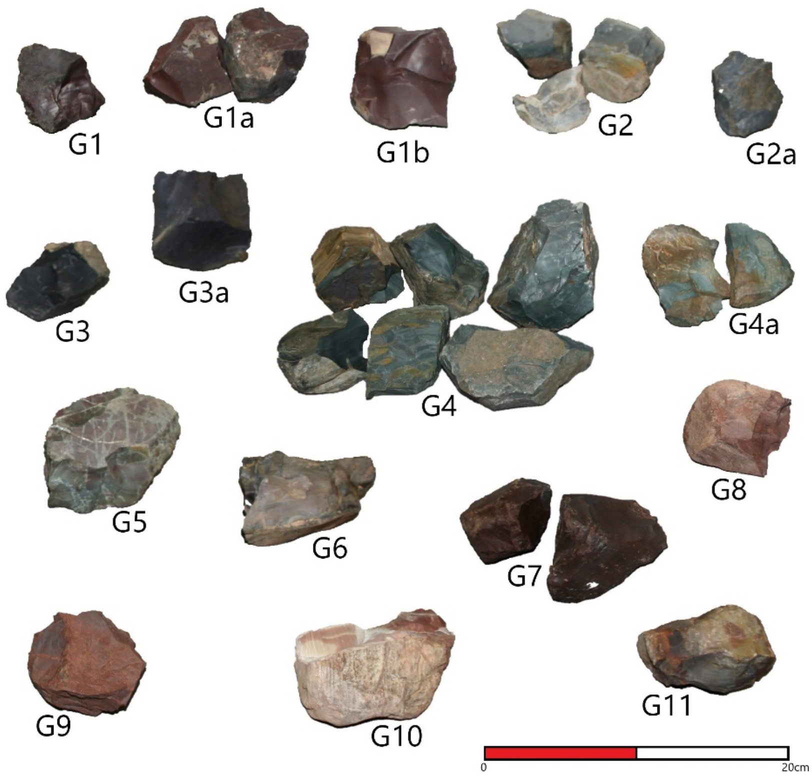

Figure 2: Macroscopic Groups Defined for the Geological Samples from the Kızılin and Burhan Rivers

Stereomicroscopic analysis resulted in the identification of 13 microscopic groups for the archaeological specimens, which slightly deviated from the macroscopic grouping (Figure 3). Amongst the 26 geological samples from both potential sources, the Kızılin and Burhan Rivers, 16 microscopic groups were identified (Figure 4). In order to explore similarities and differences between the archaeological and geological samples, which allows for preliminary assessments of the provenance of the investigated chipped stone wastes from Karain, the results for the geological samples will be discussed first.

Material	MAC. Group	MIC. Group	Colour	Material	Defining Charecteristics	Quality	Corresponds to geo. group	Samples
KARAİN CAVE Archaeological	6, 13	1	Dark red – reddish brown, can have greenish parts	Radiolarite	Frequently chalcedony veins, radiolarians mostly well preserved	hq	G1	1, 2, 3, 4, 5, 6, 7, 8, 41
	6, 7, 8	2	Dark red – reddish brown, can have greenish parts	Radiolarite	As group 1, main difference: clearly visible calcisphere inclusions	hq	No corresponding geological sample	9, 10, 11, 12, 13, 14, 15, 16
	3	3	Dark red – reddish brown, can have greenish parts	Radiolarite	As group 1, main difference: frequent inclusion of reflectice particles; some radiolarians filled with chalcedony/moganite, some with a monocrystal	hq	G1a and 1b	17, 18, 19, 20
	10	4	Dark reddish Brown with gray patches	Radiolarite	Gray patches are radiolarite clasts, radiolarians are concentrated in those patches; has reflective particle inclusions	hq	G6 (?)	21
	10, 12	4a	Grayish green – dark reddish Brown (patchy texture)	Radiolarite	As group 4, radiolarians are less well preserved due to diagenesis	hq	G6 (?)	22, 23, 27
	11	5	Brick red	Radiolarite	Abundant blue radiolarians, reflective particles	hq	G1a	24
	2	5a	Dark greenish – grayish	Radiolarite	As group 5, different colour	hq	G3 and 3a	51
	1, 12	6	(Dark) green – grayish	Radiolarite	Frequent inclusions of calcispheres and carbonatic bioclasts, reflective particles, often banded or striped	hq	G4a	25, 26, 28, 29, 30, 31, 32, 53
	3, 13	7	Greenish – grayish, partly patchy	Radiolarite	Frequent radiolarians are only preserved as phantoms, reflective particles	hq	G2, (G3 less likely)	33, 34, 35, 36, 37, 38, 39, 40, 42, 50
	14	8	Light gray	Radiolarite	Radiolarians mostly only preserved as phantoms	hq	G2 (light gray parts)	43, 44, 45
	4	8a	Multi-coloured banded	Radiolarite	As group 8, material heavily banded/striped, bands of various colours	mq	G4 banded and G6	48
	4, 5	9	Brown, partly banded	Radiolarite	Radiolarians often only present as phantoms, reflective particles	mq-hq	No corresponding geological sample	46, 47, 49
	1	10	Dark gray patchy	Chert	Few radiolarians, calcispheres/carbonatic bioclasts in layers, main charecteristics: Inclusion of large mineral (unidentified, silver-gray, can be stratched with a nail, not magnetic	lq	No corresponding geological sample	52

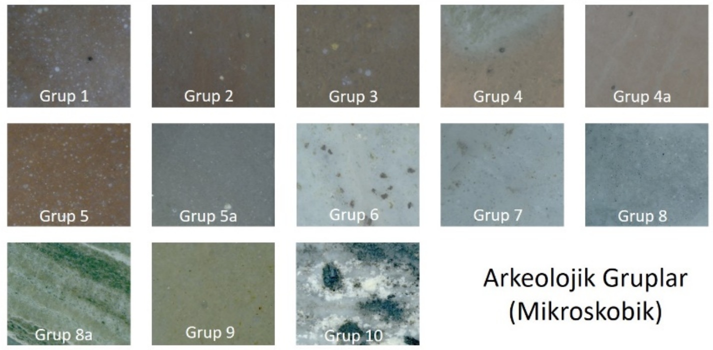

Figure 3: Microscopic Groups Defined for the Archaeological Samples

Material	MAC. Group	MIC. Group	Colour	Material	Defining Charecteristics	Quality	Source
Geological	K1	G1	Dark red – reddish brown	Radiolarite	Blue radiolarians – 15%	hq	Kizilin River (16 samples)
	K1	G1a	Dark red – reddish brown	Radiolarite	Blue radiolarians – 15%, reflective particles	hq	
	K1	G1b	Dark red – reddish brown, green-gray rock parts	Radiolarite	No blue radiolarians, reflective particles – 15%	hq	
	K2, B3, B5	G2	Light gray – gray – greenish	Radiolarite	Mainly radiolarian phantoms, slightly banded	hq	
	K2	G2a	Gray	Radiolarite	Blue radiolarians – 15%	hq	
	K3	G3	Dark gray	Radiolarite	Blue radiolarians – 10%	hq	
	K3	G3a	Dark gray	Radiolarite	Mainly radiolarian phantoms, abundant reflective particles	hq	
	K4, B3	G4	Dark green	Radiolarite	Can be slightly banded, clearly visible radiolarians -20%, reflective particles (amount varies)	hq	
	K4	G4a	Dark green	Radiolarite	As group G4, plus calcispheres /carbonatic bioclasts in varying amounts	hq	
	K5	G5	Green with red patches	Radiolarite	Mainly radiolarian phantoms	hq	
	K6	G6	Violet – green – gray vividly banded	Radiolarite	Blue radiolarians and phantoms 15-20%	hq	
	B1	G7	Dark reddish Brown	Radiolarite	Heavily dissolved radiolarian phantoms	hq	Burhan River (10 samples)
	B2	G8	Red - brown	Radiolarite	Radiolarians 15-20%, cleft material	mq-lq	
	B2	G9	Red – Brown	Radiolarite	Radiolarians -20%, some appear black, «ophiolithic» texture	mq-lq	
	B4	G10	Light red patchy	Radiolarite	Blue/White radiolarians -20%	hq-mq	
	B6	G11	Gray – pale reddish brecciated	Radiolarite	Mainly phantoms, «breccia» texture (red clasts in gray matrix)	hq	

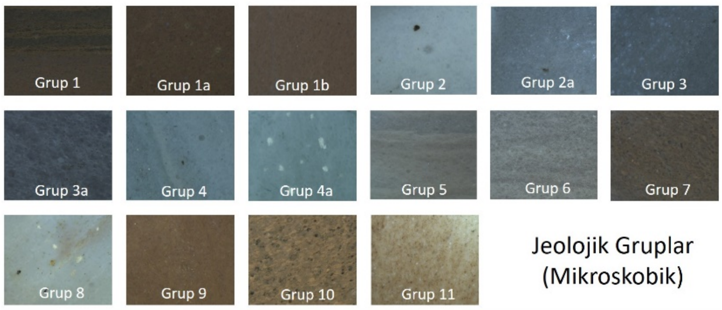

Figure 4: Microscopic Groups Defined for the Geological Samples

As seen from Table 3, radiolarites from the Kızılin River by tendency display more bluish colored radiolarians and radiolarian phantoms than the samples from Burhan, and monocrystals of clear quartz or calcite filling radiolarian skeletons. In contrast, colorless radiolarian skeletons and remains of unidentifiable particulate organic matter (POM) are less frequent in all microscopic groups recorded from the Kızılin River. This indicates slight differences in the formation processes of the radiolarite nodules and –banks entering the different river systems and provides some potential for a differentiation.

Table 3: Detailed Stereomicroscopic Results. Geological Samples: K – Kızılin River, B – Burhan River

sample No.	fossil inclusions in percentages							non-fossil inclusions (x=present)				MIC group
	radio-larians	blue rad.	rad. phantoms	POM	opaque organic phases	calci-spheres	carbonatic bioclasts	quartz or clacite mono-crystal	chlace-dony veins	foreign mineral particles	chalce-dony inclusons	
KC1	30			15	5				x	x		1
KC2	25		25	15					x	x		1
KC3	20			20	5				x	x		1
KC4	30			15	5				x	x		1
KC5	25		25	15					x	x		1
KC6	20			5						x		1
KC7	20		20	15	3				x	x		1
KC8	20		20	3	3					x		1
KC9	20		20	3	3		5		x	x		2
KC10	25			15					x	x		2
KC11	25		25	15						x	x	2
KC12	30		30	15	3		5		x	x		2
KC13	15		15	15			5			x	x	2
KC14	20		20	15			5			x	x	2
KC15	25		25	15			5		x	x		2
KC16	25		25	15	3		5			x	x	2
KC17	30			15	5					x		3
KC18	30	5	30	15					x	x		3
KC19	20	10	25	10					x	x		3
KC20	20	10	20	15					x	x		3
KC21	10		10	20	5					x	x	4
KC22	5		20	0				x		x	x	4a
KC23		25		10	3			x		x	x	4a
KC24	25	20		20	3					x		5
KC25	5			5	5	5	5	x	x	x		6
KC26	5			5	5	5	5	x	x	x		6
KC27	20			0	5		1	x	x	x		4a
KC28	5			5	5	1	1	x	x	x		6

Table 3 Continued: Archaeological Samples: KC – Karain Cave, Samples 1-28

sample No.	fossil inclusions in percentages							non-fossil inclusions (x=present)				MIC group
	radio-larians	blue rad.	rad. phanto ms	POM	opaque organic phases	calci-spheres	carbonatic bioclasts	quartz or clacite mono-crystal	chlace-dony veins	foreign mineral particle s	chalce-dony inclusons	
KC1	30			15	5				x	x		1
KC2	25		25	15					x	x		1
KC3	20			20	5				x	x		1
KC4	30			15	5				x	x		1
KC5	25		25	15					x	x		1
KC6	20			5						x		1
KC7	20		20	15	3				x	x		1
KC8	20		20	3	3					x		1
KC9	20		20	3	3		5		x	x		2
KC10	25			15					x	x		2
KC11	25		25	15						x	x	2
KC12	30		30	15	3		5		x	x		2
KC13	15		15	15			5			x	x	2
KC14	20		20	15			5			x	x	2
KC15	25		25	15			5		x	x		2
KC16	25		25	15	3		5			x	x	2
KC17	30			15	5					x		3
KC18	30	5	30	15					x	x		3
KC19	20	10	25	10					x	x		3
KC20	20	10	20	15					x	x		3
KC21	10		10	20	5					x	x	4
KC22	5		20	0				x		x	x	4a
KC23		25		10	3			x		x	x	4a
KC24	25	20		20	3					x		5
KC25	5			5	5	5	5	x	x	x		6
KC26	5			5	5	5	5	x	x	x		6
KC27	20			0	5		1	x	x	x		4a
KC28	5			5	5	1	1	x	x	x		6

In a general comparison between the microscopic groups defined for the archaeological material and those determined for the geological samples, it appears that the archaeological specimens display more similarities with samples from the Kızılin River (see Figure 3 and 4). Considering the fact that groups G2 and G4 also occur in the Burhan River, the possibility that some chipped artifacts derived from the latter could also not be excluded.

A detailed comparative analysis including the percentages of individual microscopic components however reveals a more complex scenario. This analysis is based on the most abundant and therefore best comparable recorded parameters, which are translucent and blue infilled radiolarians, radiolarian phantoms and particulate organic matter (POM) (Table 3). Results from this evaluation indicate that the majority of the archaeological specimens could in fact have derived from the Burhan River source rather than from Kızılin. This is a very preliminary observation, which needs to be substantiated in the future also including geochemical techniques and a multi-scalar investigation such as the Multi Layered Chert Sourcing Approach (MLA), which allowed for secure provenance studies of lithic artifacts produced from silicites such as radiolarite (Brandl, "The Multi Layered Chert ..." 145-156; Brandl et al. 1-34).

Discussion and Conclusion

The findings of this pilot study provided useful and previously unavailable information concerning the characterization and the potential origin of raw materials used by Lower Paleolithic inhabitants of Karain. These preliminary assessments however need to be substantiated through more sophisticated analytical techniques, including geochemistry and statistical evaluation of the datasets. Nonetheless, it is possible to discuss the implication of the results gathered in the course of the current investigations.

During the first stage of the project, the most commonly used raw material varieties from the Lower Paleolithic sequences in the Karain Cave were determined applying stereomicroscopic petrographic analyses. Subsequently, geological comparative samples from previously detected potential raw material sources in the surrounding of the cave were included into the investigations. Through in-depth petrographic examinations, similarities and differences between the archaeological material and the geological samples have been worked out. Through this it was possible to build hypotheses concerning the most likely sources used by the people who lived in the cave during Lower Paleolithic times. These results also provide hints towards raw material procurement strategies of Lower Paleolithic people in the region in general.

According to parameters used to define raw material quality, i.e. cleft frequency and granularity, the raw materials used by the Lower Paleolithic people at Karain can be characterized as medium to high. The results of more detailed petrographic comparisons between the raw material samples from the two river sources and the archaeological finds suggest that material from both rivers was potentially used by the Lower Paleolithic flintknappers, with a preference tendency towards material derived from the Burhan River which is located further away from the site than

Kızılin. Raw material surveys undertaken in the course of sample collection for this pilot project demonstrated that both river systems carry material suitable for chipped stone tool production and corresponding to the preferred raw material types used in the Lower Paleolithic chipped stone industry of Karain Cave based on visual as well as general microscopic grouping. The supposed preference for Burhan River materials therefore raises questions concerning this seemingly irrational choice.

As mentioned above, raw material quality as documented from geological outcrops in the Kızılin River bed cannot be considered as the principal reason, since high quality radiolarites do occur in this deposit. A more relevant fact concerns the availability of specific raw material types from both river sources. Today, the Kızılin is a rather small and steep river exposing layers of Mesozoic formations, including radiolarite beds. However, to date there exists no secure information regarding the geological condition of this river bed 400.000 years in the past. It is possible that the geological layers producing the radiolarite accessible today was not yet available at that time. Numerous young geological faults in the immediate vicinity of the Kızılin River provide strong indications for this assumption. Only detailed geological fieldwork will be able to reconstruct the geological condition of the Kızılin River bed and allow to answer the question which lithologies were cropping out during Lower Paleolithic times.

While this scenario offers a possible explanation for the preference enigma, other factors also have to be considered. When compared to the relatively small Kızılin River, the bed of the Burhan River represents a significantly larger, old river system, producing well accessible gravel banks and –fans, which provide an ideal potential for lithic raw material gathering. Additionally, the river bed contains pebbles from numerous small tributaries feeding it during rainy periods. Since these pebbles are transported from different sources over sometimes significant distances, this deposit contains a large variety of materials which have already been presorted by the transportation process, i.e. only materials of higher quality survive such a process.

Although further away from the site, these favorable conditions found at the Burhan River provide an additional explanation for the preference of the Paleolithic flintknappers for this source.

The deliberate choice of a more distant raw material source also stimulates ideas concerning the movement, procurement strategies and planning of the Pleistocene hunter-gatherers. Our results suggest that the Burhan River, which is located approximately 10 km away from Karain Cave, was visited frequently by the cave`s inhabitants in order to procure raw materials. Although 10 km are not an unusually far travel distance for hunter-gatherer societies, we can infer a specific degree of planning depth for the Lower Paleolithic inhabitants of the Karain Cave.

This is suggested by the fact that all raw material nodules and blocks have been tested or partially decortified before they were brought into the settlement. Technological analyses revealed that no primary cortical flakes are present amongst the chipping products and tools within the Karain Lower Paleolithic chipped stone industry (Aydın, "Karain Mağarası Tayacian Alet…" 1327-1346). The absence of these elements of the *chaîne opératoire* from the lithic assemblage at the site (Inizan et al.) indicates that the raw material was transported to the settlement after being tested at the source or after being flaked to a certain extent. However, the presence of cores and a large number of chipping debris within the Lower Paleolithic industry indicates that the chipping process took place predominantly in the settlement.

The investigation of a significant number of chipped stone wastes from the Lower Paleolithic levels and the raw materials collected from two sources provided important preliminary results concerning the raw material types and their characteristics used in the Karain Lower Paleolithic industry. These results also compelled us to consider the reasoning behind the behavior of the Paleolithic hunter-gatherers who had settled in Karain, and why they chose a more distant source for raw material procurement over a deposit located in their immediate vicinity. Building upon this pilot study similar and more encompassing projects including geochemical methods will have to follow in the future in order to contribute to our current ideas and to deepen our understanding concerning the subject.

The somewhat unexpected results of this current study represent the first raw material analysis of the Karain Lower Paleolithic chipped stone industry ever conducted, and hopefully will stimulate further research endeavors following a similar path.

Acknowledgements

This study was carried out in Vienna, Austria, between 20.09.2018 and 20.12.2018. The macroscopic and microscopic investigations were undertaken in the Raw Material Lab of the Institute for Oriental and European Archaeology (OREA) in Vienna.

In addition to their contribution and support in the realization of this project, we would like to thank Prof. Dr. Harun Taşkıran, the head of the Karain Cave excavations for providing permission to perform the analyses of the archaeological material, and Prof. Dr. Barbara Horejs for hosting us at the OREA-Institute during the time we stayed in Vienna.

WORKS CITED

Affolter, Jehanne. *Provenance des silex préhistoriques du Jura et des régions limitrophes*, Archéologie Neuchâteloise 28.2, Neuchâtel: Service et Musée cantonal d'archéologie. Switzerland, 2002.

Aydın, Yavuz. "Pleyistosen Dönem'den Bir Alt Paleolitik Kesit: Karain." *Türkiye Jeoloji Bülteni* 60.4 (2017): 529-556.

---. "Karain Mağarası Tayacian Alet Endüstrisi Tekno-tipolojisi." *Dil ve Tarih-Coğrafya Fakültesi Dergisi* 58.2 (2018): 1327-1346.

Brandl, Michael. "Genesis, Provenance and Classification of Rocks within the Chert Group in Central Europe." *Archaeologia Austriaca* 97-98 (2014): 33-58.

---. "The Multi Layered Chert Sourcing Approach (MLA) Analytical Provenance Studies of Silicite Raw Materials." *Archeometriai Mühely* XIII.3 (2016): 145-156.

Brandl, Michael et al. "A Multi-technique Analytical Approach to Sourcing Scandinavian Flint: Provenance of Ballast Flint from the Shipwreck 'Leirvigen 1', Norway." *PLOS ONE* 13.8 (2018): 1-34.

Brooks, Ian P. "Debugging the System: Characterisation of Flint by Micropalaeontology." *Breaking the Stony Silence: Papers from the Sheffield Lithics Conference 1988.* Ed. Ian P. Brooks and Patricia Phillips. Oxford: BAR British Series 213, 1989. 53-71.

Ceylan, Kadriye. "Karain Mağarası, Levallois Çekirdeklerinin Tekno-tipolojik Analizi." Dil ve Tarih-Coğrafya Fakültesi Dergisi 38.1-2 (1998): 173-186.

Inizan, Marie-Louise, Hélène Roche and Jacques Tixier. *Technology and Terminology of Knapped Stone*, Préhistoire de la Pierre Taillée Tome 3, France, 1992.

Kayan, İlhan. "Tarih Öncesi Yerleşme Yerleri Olarak Antalya Mağaralarının Jeomorfolojik Özellikleri." *Ege Coğrafya Dergisi* 5 (1990): 10-31.

Kartal, Gizem. "Karain B Gözü Orta Paleolitik Yontmataş Alet Tipolojisi." *Anadolu/Anatolia* 38 (2012): 89-108.

---. "Karain B Gözü Kalkolitik Çağ Yontmataş Buluntu Topluluğunun Tekno-Tipolojik Analizi." *Anadolu/Anatolia* 41 (2015): 25-49.

Kökten, İ. Kılıç. "Bazı Prehistorik İstasyonlar Hakkında Yeni Gözlemler." *Dil ve Tarih-Coğrafya Fakültesi Dergisi* 2.5 (1947): 223-239.

Otte, Marcel et al. "The Anatolian Middle Paleolithic: New Research at Karain Cave.",*Journal of Anthropological Research* 51.4 (1995): 287-299.

---. "Évolution Technique au Paléolithique Ancien de Karain (Turquie)." *L'Anthropologie* 99.4 (1995): 529-561.

---. "Paléolithique Ancien de Karain (Turquie)." *Anthropologie et Préhistoire* 107 (1996): 149-156.

---. "Long-term Technical Evolution and Human Remains in the Anatolian Palaeolithic." *Journal of Human Evolution* 34 (1998): 413-431.

Özçelik, Kadriye. "Karain Mağarası B Gözü'nde Üst Paleolitik Sorunu." *Anadolu/Anatolia* 25 (2003): 83-95.

---. "Le Paléolithique supérieur de la Turquie. Essai de synthèse." *L'anthropologie* 115 (2011): 600-609.

---. "Karain Mağarası B Gözü Epi-paleolitik Dönem Yontmataş Endüstrisi." *Işın Yalçınkaya'ya Armağan / Studies in Honour of Işın Yalçınkaya.* Ed. Harun Taşkıran, Metin Kartal, Kadriye Özçelik, Makbule Beray Kösem and Gizem Kartal. Ankara. 213-225.

Pawlikowski, Maciek. "Karain and Öküzini Caves. Turkey. General Geology of Area. Preliminary Report." *Türkiye Coğrafyası Araştırma ve Uygulama Merkezi Dergisi* 3 (1994): 351-369.

Přichystal, Antonin. "Raw Materials of Chipped Stone Artifacts in Moravia (Czechosolvakia) and Methods of their Research." *3rd Seminar on Petroarchaeology Reports*. Ed. Kancho S. Kanchev, Ivan Nachev and N. T. Tcholakov. Plovdiv, 1984. 146-152.

Taşkıran, Harun. *Karain Mağarası Kenar Kazıyıcılarının Teknolojik ve Tipolojik Evrimi.* Diss. Ankara University, 1996.

---. "The Supply Areas of Karain Cave in Southwest Anatolia." *Raw Material Supply Areas and Food Supply Areas. Integrated Approach of the Behaviours, Proceedings of the XV UISPP World Congress (Lisbon, 4-9 September 2006).* Ed.

Marie-Hélène Moncel, Anne-Marie Moigne, Marta Arzarello and Carlo Peretto. Oxford: BAR International Series 1725, 2007. 207-211.

Taşkıran, Harun et al. "2015 Yılı Karain Mağarası Kazıları." *Kazı Sonuçları Toplantısı* 38.1 (2017): 521-538.

Yalçınkaya, Işın. "1985 Yılı Karain Kazıları." *Kazı Sonuçları Toplantısı* 8.1 (1987): 21-37.