Reconstructing the Subsistence Patterns of Kaldar Cave through Functional Analysis, Khorramabad Valley, Western Iran

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Introduction

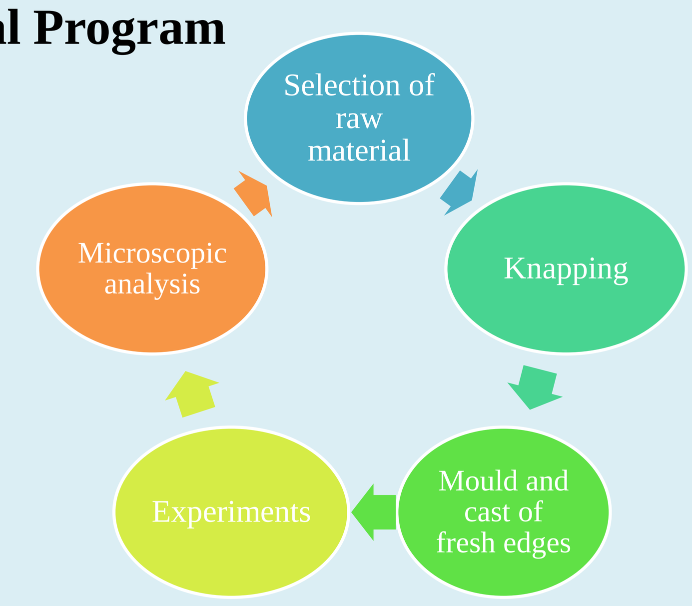
Kaldar Cave is a key archaeological site, containing a long Upper Palaeolithic occupation starting from 23,100 ± 3300 / 29,400 ± 2300 BP (TL dating) to 38650-36750 / 54400-46050 cal BP (C14 dating). The lower most sequence of the Upper Palaeolithic in this cave is now considered as one of the oldest cultural remains attributed to early Anatomically Modern Humans in western Asia, along with an underlying Middle Palaeolithic layer with clear presence of Mousterian industry (Bazgir et al. 2014, 2017; Becerra-Valdivia et.al. 2017). The current research is an attempt to apply functional studies on the recovered lithic assemblages from Kaldar Cave (2011-12 and 2014-15 excavation seasons). With the analysed use-wear and residues left on the archaeological stone tools, we compared them with a set of experimental stone tools to reconstruct some behavioural dimensions and subsistent pattern of the early modern humans as well as the last Neanderthals in the region.

Statement of Problem

So far, in Iranian Palaeolithic research, only two works have applied functional studies to the lithic assemblages (Claud et.al 2012; Bazgir and Tumung, 2013). Claud performed a limited preliminary study on three points belonging to the Middle Palaeolithic level of the Qaleh Bozi 3 Rockshelter, central Iran. She used a binocular and metallographic microscope (low and high magnifications) to analyse the points (1 Mousterian and 2 bifacial Points). She interpreted two points were used for the butchery activities (especially cutting meat). Whereas in our study, under Zeiss Axio Scope A1 microscope, we analyzed 105 Levallois-Mousterian and Aurignacian points belonging to Middle and Upper Palaeolithic level of Gilvaran, Ghamari and Kaldar cave. 20 pieces showed the results of usewear and residues indicated of possible hunting activities in the valley. Current research is the first time attempt in Iranian history to apply functional study to a complete lithic assemblage of a site.

Fig 1: Location and general view of the Kaldar Cave

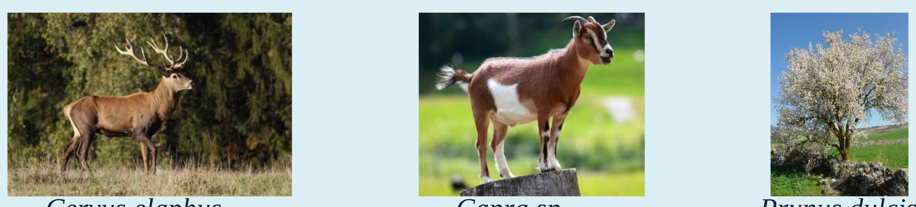
Experimental Program



Raw material

Fig 2: Experimental lithics were knapped from Khorramabad flint to replicate the usewear

Contact material



Cervus elaphus *Capra sp.* *Prunus dulcis*

Experiments

Lithic number	Worked material	Species	Working angle	Motion	Action	Hand	Time (in minutes)
AKF1-H1	Fresh hide	*Cervus elaphus*	90º	Transverse-unidirectional	Scraping	Right	45
AKF1-B1	Bone	*Cervus elaphus*	45º	Transverse-unidirectional	Scraping	Right	35
AFK1-Bu1	Meat-Bone	*Cervus elaphus*	45º-90º	Longitudinal- unidirectional	Cutting/defleshing	Right	30
AKF1-W1	Stem of fresh wood	*Prunus dulcis*	45º	Transverse-unidirectional	Wilting	Right	40
KF1-No.5	Meat-Bone	*Capra sp.*	75º-90º	longitudinal-bidirectional	Cutting/defleshing	Right	30
KF1-No.6	Meat-Bone	*Capra sp.*	45º	Transverse-unidirectional	Scraping	Right	30
KF1-No.7	Bone	*Capra sp.*	90º	Longitudinal-bidirectional	Cutting	Right	30
KF4-No.1	Meat-Bone	*Capra sp.*	75º	Longitudinal-unidirectional	Cutting/defleshing	Right	30
KF4-No.2	Bone	*Capra sp.*	45º	Transverse-unidirectional	Cutting/defleshing	Right	30
KF4-No.3	Bone	*Capra sp.*	45º	Transverse-unidirectional	Scraping	Right	30
KF6-No.1	Meat-Bone	*Capra sp.*	75º	Longitudinal-unidirectional	Cutting/defleshing	Right	30
KF6-No.2	Bone	*Capra sp.*	45º	Transverse-unidirectional	Scraping	Right	30

Table 1: Showing the details of the experiments

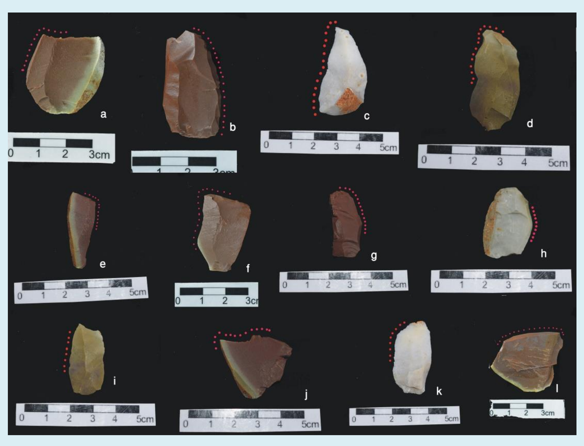


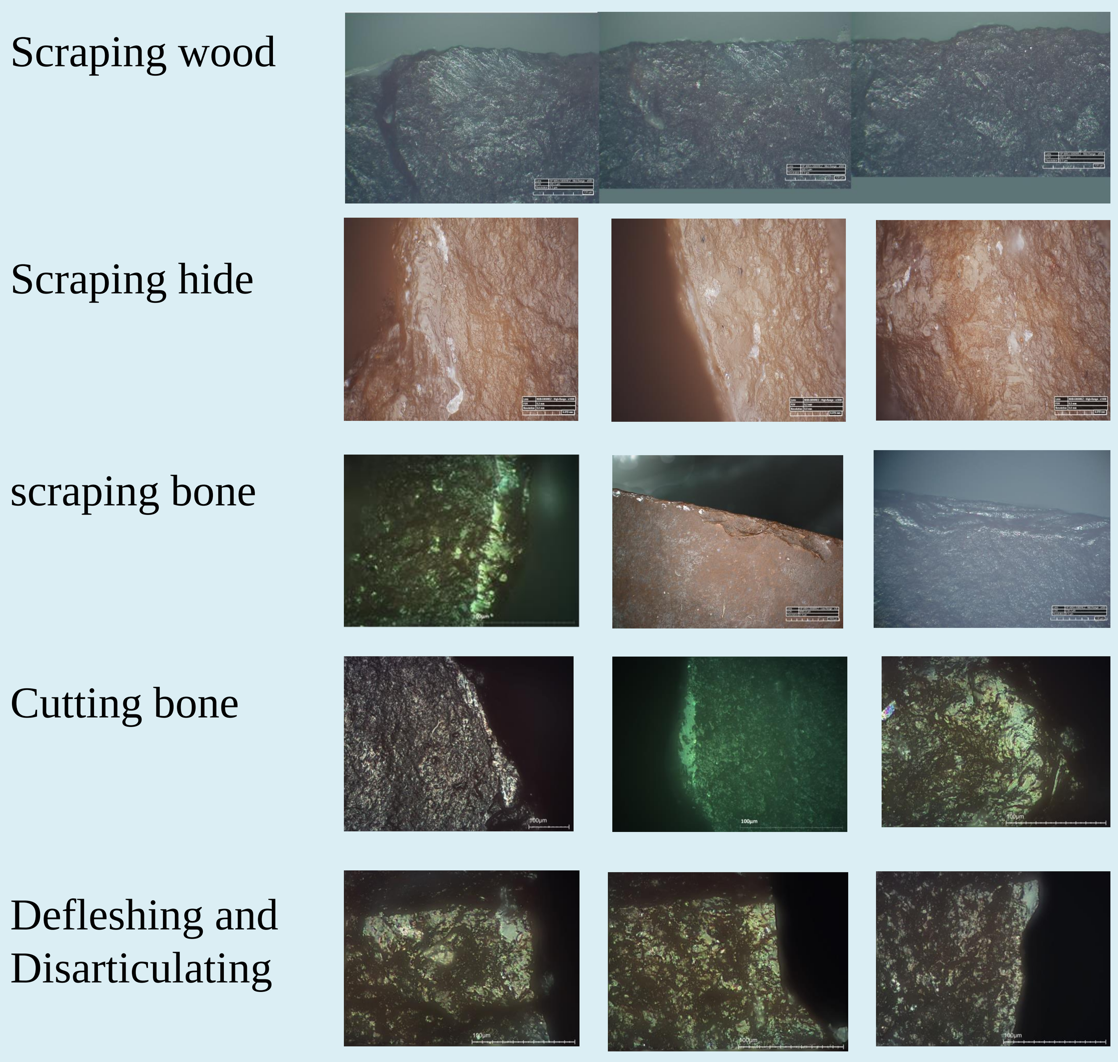
Fig 3: Experimental lithics a) wilting fresh wood, b) scraping fresh hide, c-f) defleshing and disarticulating, g-h) cutting fresh bone, i-l) scraping fresh bone

Fig 4: Experiments performed were scraping fresh wood and butchery activities (defleshing and disarticulating, scraping fresh hide and bone, cutting fresh bone)

Microscopics analysis

Fig 5: For the preliminary examination of the lithics we used Zeiss and Digital 3D Hirox. ESEM was used for the detailed images of the usewear traces and to extract the chemical composition of the residue. Other techniques like Micro X-ray diffraction, Raman and FTIR were considered to confirm composition of the residue.

Experimental Results



Archaeological Materials

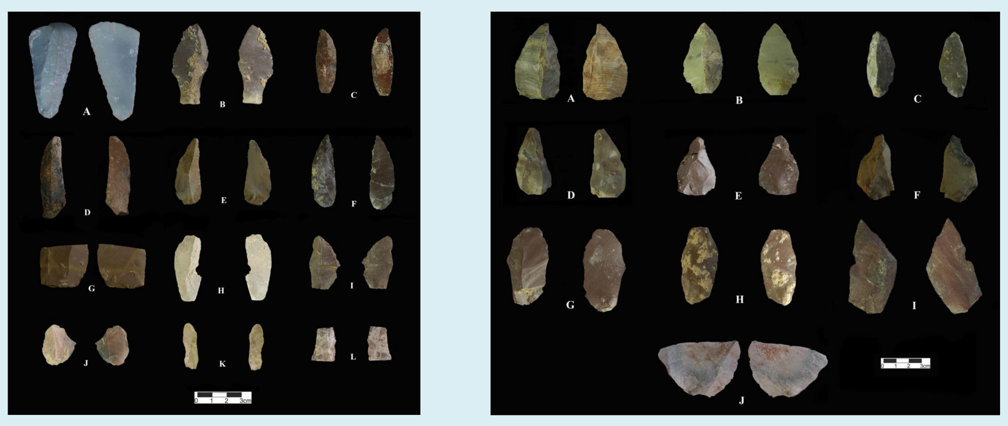


Fig 6: Archaeological lithics on the left side belong to the Upper Palaeolithic level and on the right Middle Palaeolithic level

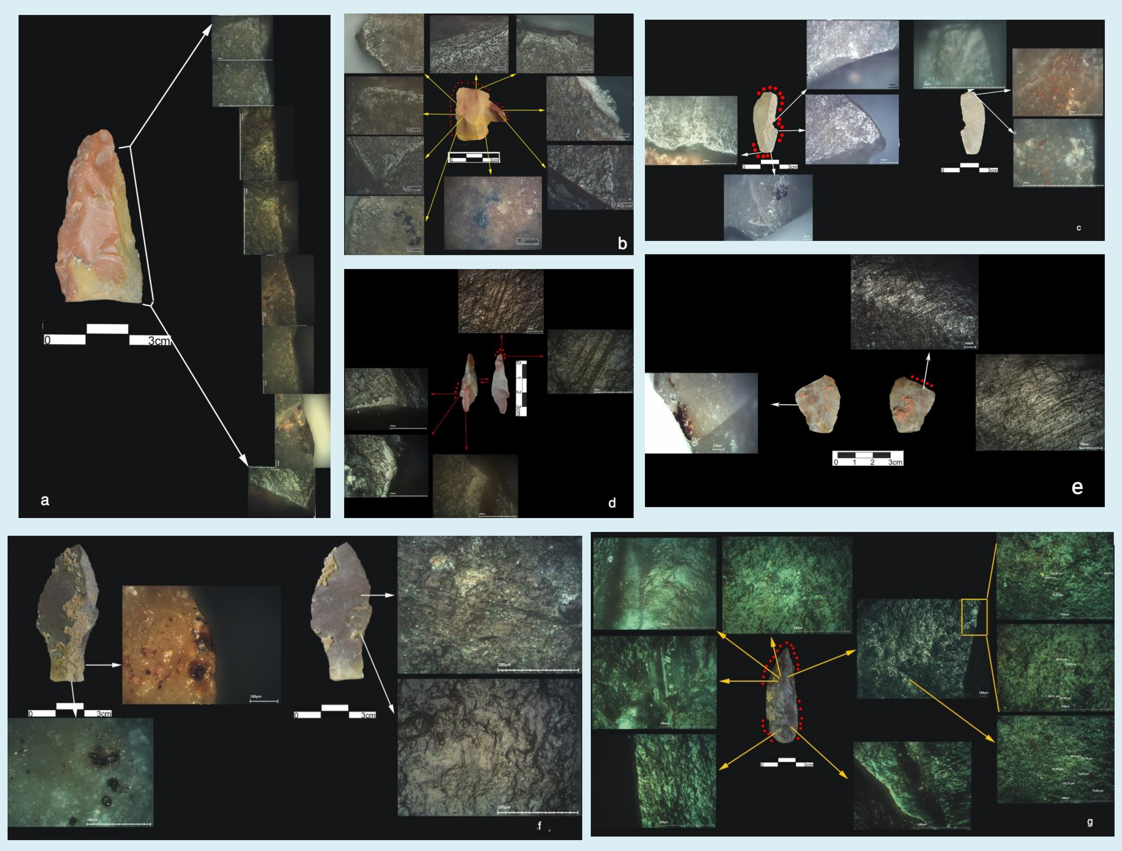


Fig 7: Few examples of the archaeological usewear and residues: a) side scraper, b) retouched flake, c) retouched blade d) pointed flake, e) flake, f) tanged point and g) Arjeneh point.

Archaeological residue analysis results

Lithic no.	Tool type	Residue			Use-wears			Location
		ESEM	X- Ray	FTIR	Straition	Polish	Edge fracture	
KLD-59	Point	Bone	-	-	X	-	-	Tip
KLD-F6-5-741	Pointed Flake	Bone	-	-	X	-	-	Tip
KLD-E5-5-238	Bladelet Flake	Bone	-	-	-	-	X	Tip
KLD-E6-5II-912	Flake	Bone	Bone	-	X	-	-	Proximal
KLD-E6-7II-1101	Point	Bone	-	-	-	-	-	Medial
KLD- E7-5-276	Flake	Organic residue	-	-	-	-	-	Tip

Table 2 : Showing the details of the lithics with the presence of bone residue under ESEM and were cross-checked with other techniques.

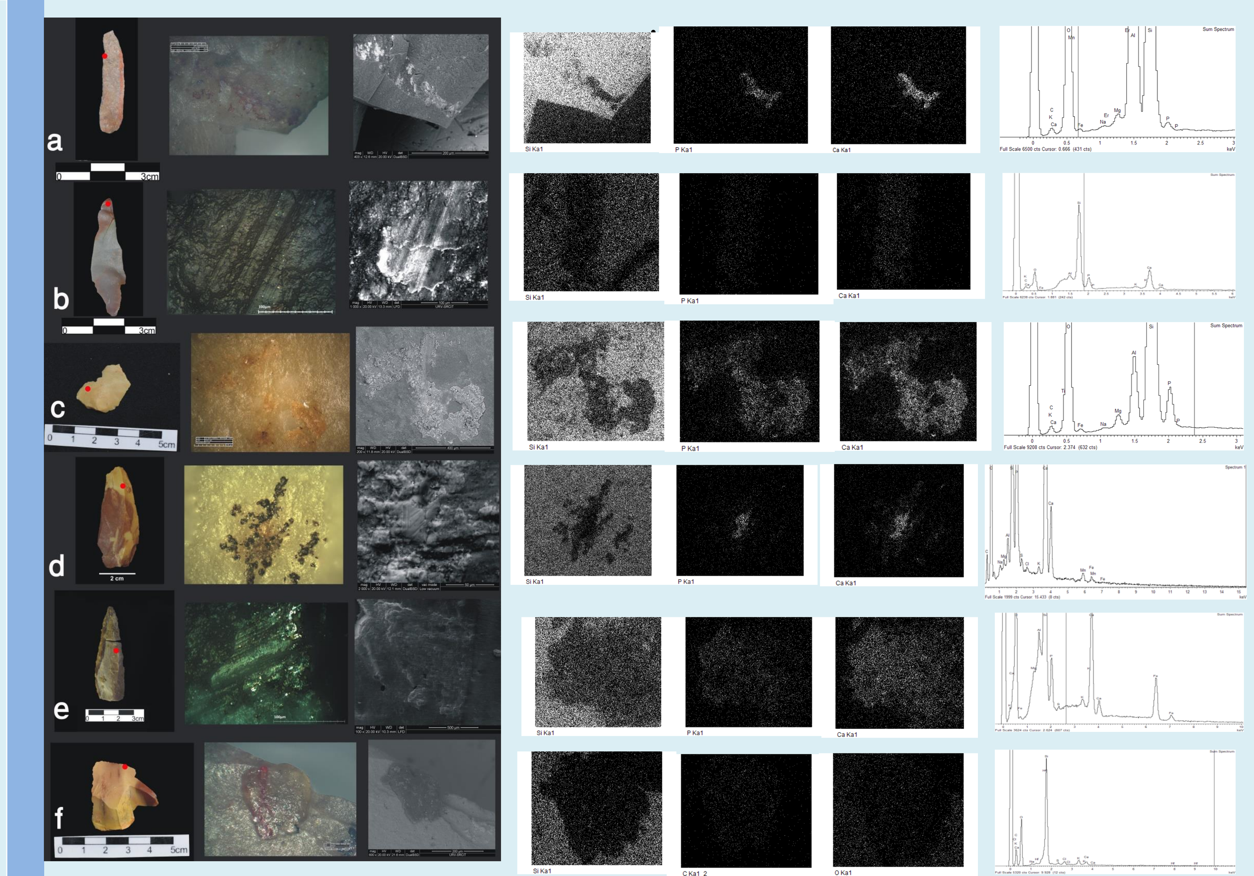


Fig 8: Lithics (a-c and f) belong to the Upper Palaeolithic layer and (d-e) belong to the Middle Palaeolithic layer. Red dot showing the location of the residue. Element maps and graphs show the distribution and composition of the residues.

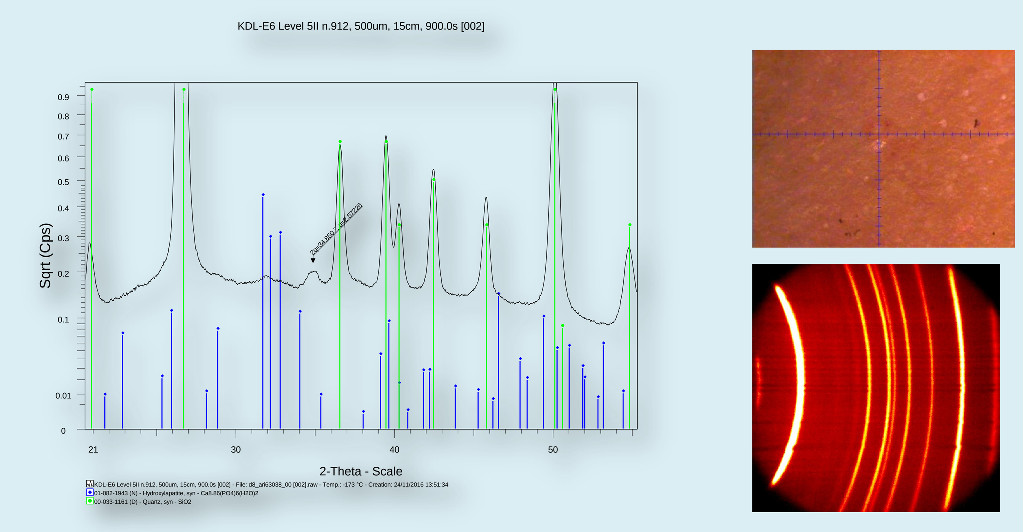


Fig 9: Micro X-ray diffraction showing the presence of hydroxylapatile on the lithic c.

Conclusion

Although our experimental program was small, however it provided valuable information about knapping techniques as well as distribution of the residue and usewear development on the lithics. In our experimental study, we observed that selection of raw material plays an important role for knapping activities. The cobbles selected from Khorramabad Valley had lots of fissures and were small in size; therefore, it was slightly difficult to knap the desired tool shape.

Our usewear analysis showed that the archaeological lithics have been used for a longer duration of time as the usewear recorded on the experimental pieces is not as developed as the archaeological one. More experiments with longer duration are needed for a better interpretation.

In defleshing and disarticulating actions the lithics worked efficiently but after long duration they lose the sharpness and cannot cut through tendons.

Bone scraping gives much developed polish compared to the other scraping actions (fresh hide and wood). In cutting bone action, we lose the usewear traces as micro-chipping of the edge happens during the experiment which could mislead us in interpretation of some archaeological samples (mainly in case of bladelets cutting edges) resembling retouch appearance.

In our experimental program we realised that, the choice of the flint colour also effects on the efficiency of the function and use-wear development. Red flints worked much better than the green and white ones. This is in agreement with the dominancy of the red flints within the recovered archaeological assemblage.

For residue analysis, different microscopes and techniques complement each other as well as enhance the quality of interpretation of the residues. The colour and texture of the residue cannot be the sole indicator of the residue type. For the detection of the residue composition, size and amount of the residue also plays an important role.

Acknowlegdements

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