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New Chronology for the Middle Palaeolithic Sequence of Kaldar Cave; Insights from the Third Excavation Season

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Abstract: As a key archaeological site, Kaldar Cave provides evidence of the Middle to Upper Palaeolithic transition in Iran. It is also one of the earliest sites with cultural materials attributed to early AMHs in western Asia. Apart from the earlier obtained dates from its Upper Palaeolithic sequence, we provide here the recently obtained Thermoluminescence date from layer 5. In this paper, we elaborate and correlate this dating to a broader discussion within the Zagros Middle and Upper Paleolithic sites. In this study, we also present brief information on the freshly recovered lithic industries, Paleontological data, the obtained T.L dating, and its position in the stratigraphic sequence.

Keywords: *Dating, Thermoluminescence, Middle Palaeolithic, Zagros Chronology, Kaldar Cave.*

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Introduction

Since the 1930's report by Henry Field for an Upper Paleolithic type of lithics at two rock shelters in the Fars province (Field, 1939: 495) and his recognition of the archaeological importance of Kunji cave (Field 1951: 91, footnote 22), to explorations of Hunter and Tamtama Caves in 1949 by Carlton S. Coon (Coon 1951 and 1957), there have been enormous efforts and research on Zagros Paleolithic potential and its importance. Many of these studies have been published in the form of explorations and surface collection reports, some excavation reports, and finally few lithic industry studies and comparative analyses. However, the majority of the research carried out in the region is case studies. The major excavation reports and contextual studies within the Iranian Zagros consist (Hole and Flannery 1967; McBurney 1969, 1970; Bewley 1980, 1984: 35-38; Speth 1971; Baumler and Speth 1993; Jaubert et al. 2009; Trinkaus and Biglari 2006; Biglari et al. 2009; Conard et al. 2009; Otte et al. 2007; Otte et al. 2011; Ghasidian et al. 2009; Ghasidian 2010; Conard and Ghasidian 2011; Mashkour et al. 2012; Tsanova 2013; Bazgir et al. 2014; Allué et al. 2018; Bazgir and Tumung 2014; Bazgir and Davoudi 2014; Ollé et al. 2014; Becerra-Valdivia et al. 2016; Shidrang et al. 2016; Bazgir 2016; Rey Rodríguez et al. 2015; Ghasidian et al. 2017; Bazgir et al. 2017; Becerra-Valdivia et al. 2017; Heydari-Guran et al. 2021; Reynolds et al. 2022).

Although our intention in this article is not to deal with the statement of the problems in the Zagros region Paleolithic research, however, a quick look at the Zagros Paleolithic literature, lack of application of multidisciplinary studies could be easily noted in comparing to Levantine sites and other nearby regions. Additionally, another major problem in the Iranian Paleolithic in general and the Zagros Mountains in specific is the scarcity of obtained dates from the excavated fills of caves and open-air sites. In other words, the Zagros sites are mostly suffering for the absence of dating results, not for lack of localities. There are several reasons for this situation; in the initial stage of the Zagros Paleolithic studies from the beginning of the Twenty century to 1980, only foreign archaeologists carried out works there. Additionally, a twenty years gap in the Paleolithic studies seems to be the most imperative reason. As a result, due to their problems with regular visits to Iran and their study areas, most of the research was interrupted and was limited to few exploration or excavation reports therefore we cannot see any long-term or goal-oriented studies. It is also obvious and worth mentioning that, from the 1930s to the 1990s, advanced and accurate dating techniques were not available, at least for Iranian studies. Times go on, but except for a single attempt by McBurney at Humian 1 Cave (McBurney 1969, 1970; Bewley 1980, 1984: 35-38) and few Iranian-foreign joint teams (Conard et al. 2009; Ghasidian et al. 2009; Ghasidian 2010; Conard and Ghasidian 2011; Otte et al. 2011; Bazgir et al. 2014; Bazgir et al. 2017; Becerra-Valdivia et al. 2017; Heydari-Guran et al. 2021), we again do not see dating results from the Zagros sites systematically to achieve a broad view of the region's chronological framework. Referring to the above introduction and despite all the efforts in understanding the Middle to Upper Paleolithic transition, up to date, except for Shanidar Cave in Iraqi Kurdistan and BawaYawan in the Kermanshah region, no other site produced both M.P. and U.P. chronological results in the Iranian Zagros Mountains (Fig. 1). In this article, we are presenting the new dating from the Middle Paleolithic sequence from Kaldar Cave. Dating the Upper Paleolithic sequence of Kaldar Cave using Thermoluminescence showed ages ranging from 23100 ± 3300 to 29400 ± 2300 B.P. The three C^{14} dates produced results in the ranges of 38650–36750 cal B.P., 44200–42350 cal B.P., and 54400–46050 cal B.P., respectively all at 95.4% probability (Bazgir et al. 2017). In our third excavation season, we achieved a new date from layer 5 which includes an outstanding Mousterian lithic assemblage. Apart from the new dating, here we also provide brief information on recovered lithic industry and Paleontological data from this excavation season.

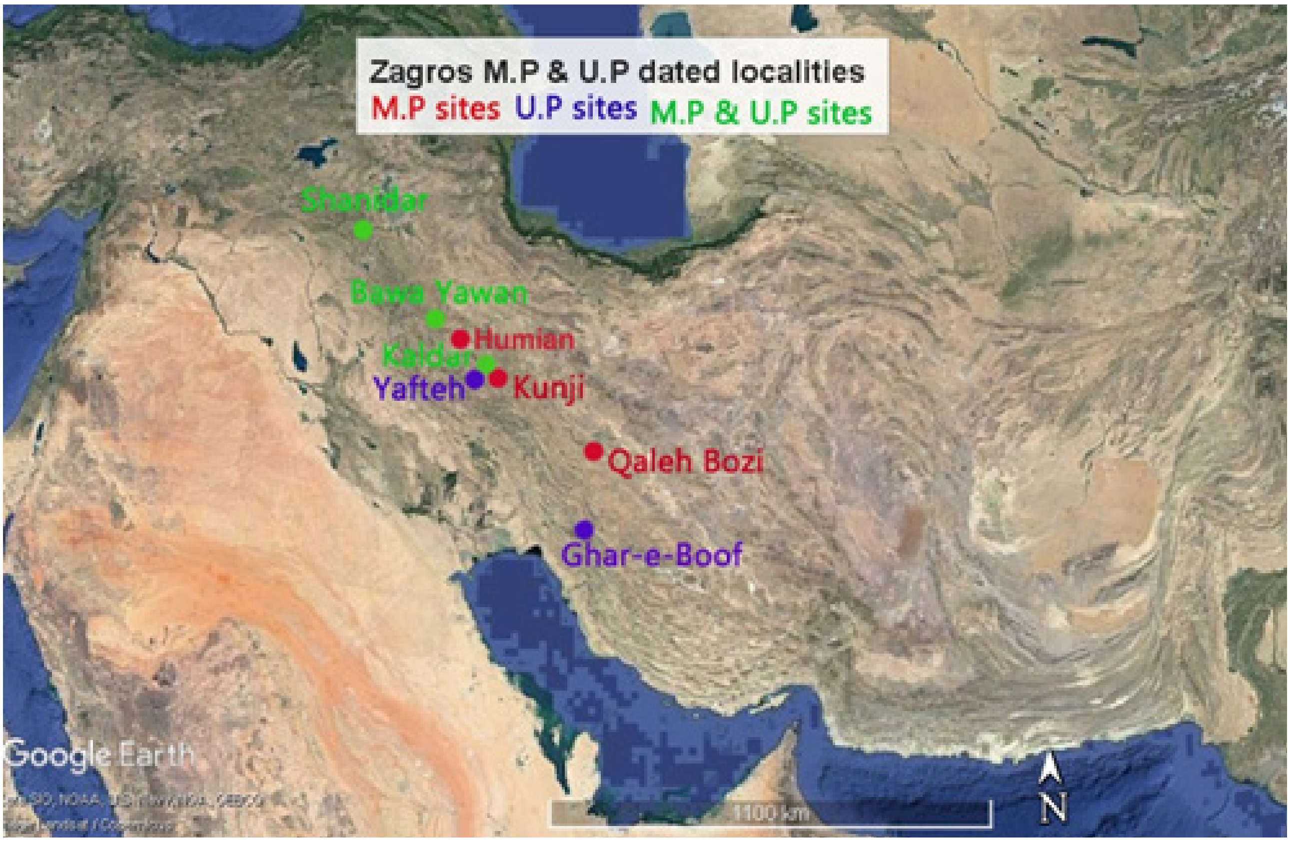

Fig. 1: Location of M.P. and U.P. dated localities within the Zagros Mountains; M.P. sites shown in red color, U.P. in purple, and M.P. & U.P. in green.

Dating

Thermoluminescence dating was performed on a heated sample from Layer 5 at the Research Centre for Conservation & Restoration of Cultural Relics of the Research Institute of Iranian Cultural Heritage (RICHT). The sample has successfully been dated. As in the previous study (Bazgir et al. 2017), the same method and procedure were applied to obtain the data. The outer surface (3 mm) of the sample was removed for sample preparation and instrumentation. To account for the alpha radiation contribution to the natural dose measurements, the fine grain technique is used (ibid). Alpha radiation travels an extremely short distance in heated objects (approximately 25 μm63). Thus, we used grains less than 10 μm in size. The sample was crushed and treated with 10% HCl to remove carbonates and organic material. Then, the sample was washed with distilled water and then with acetone. Finally, the grains were suspended in acetone and deposited on aluminum discs that were 10 mm in diameter and 0.5 mm in thickness. The TL measurements were performed using an ELSEC7188 instrument. The potassium contents of the sample were determined by fame photometry. To determine the contributions from U and T, the "pairs" technique was used; thus, the dose rate was measured using a 7286 low-level alpha counter 64. External dose rates were measured by in situ dosimetry 65. To determine the external dose (the radiation level of gamma rays in the environment or the environmental dose of the studied layer), three environmental dosimeters containing crystals of calcium fluoride (CaF2) were placed in layer 5 for 31 days (Fig. 2). After measuring and calculating, the average numerical value of 0.55 mGy/a (milligrams per year) was obtained, which was used in the final calculations to determine the age of the flint. Measurements of the water content and fading test were considered (Table 1).

The obtained data comes from a heated flint from Layer 5, at the bounder with layer 4 (Fig. 3).

Fig. 2: Location of the Dosimeters Shown Within the Section.

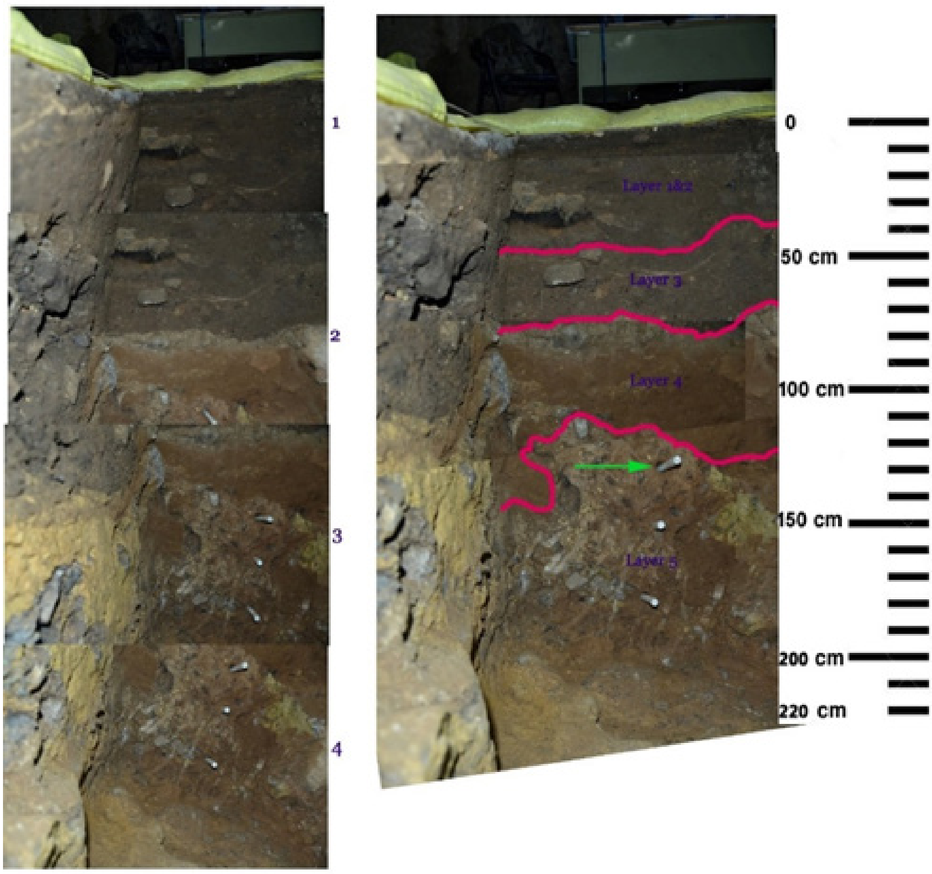

Fig. 3: The Location and Associated Depth of the Dated Flint Indicated by the Green Arrow.

Although dating more samples would make it more precise to estimate the transitional time, however, in terms of the stratigraphic hierarchy, the obtained date from this season is fully consistent with the earlier dates from layer 4.

Table 1: Results of the Numerical Amount of Radioactive Elements in the Sample, Equivalent Dose, and Obtained Age of the Flint

Sample	Specification	Th (ppm)	Ur (ppm)	K%2	Equivalent dose (ED)	Age
Flint B	Layer 5 - S3	0.64	1.04	0.55	70.14	63044±6120

Lithic Industry

The recovered lithic assemblage from this season from layer 5 at Kaldar Cave clearly shows an outstanding Mousterian technology. The lithic artifacts are dominated by tools using the Levallois technique and show a high number of pointed and elongated tools mostly in the form of flakes and points. The retouched Mousterian points also consisting a considerable percentage of the assemblage. The technological analysis of the Middle Paleolithic lithic assemblage of Kaldar Cave shows a high proportion of pointed elements, which may have been the main goal of the tool-making strategy at Kaldar Cave. Analyses in progress tests are aimed at testing hypotheses on the possible use of these pointed objects in hunting (Fig. 4). The Upper Paleolithic lithic industry at Kaldar Cave includes diagnostic technological elements for the Baradostian or Zagros Aurignacian, such as Arjeneh points, carinated pieces, and different blade and bladelet cores. This layer has a unique blade and bladelet assemblage, that might be considered to be an index for the Baradostian within the Iranian Zagros and even beyond.

Fig. 4: Selected Artifacts from Middle Paleolithic of Kaldar Cave 3rd season.

Fig. 5: Selected Artifacts from Upper Paleolithic of Kaldar Cave 3rd Season.

Here, a small selection of the lithic industries from layers 5 and 4 are shown (Fig. 5). A paper that provides a detailed study on the industries is in preparation.

Faunal Remains

Remains of large mammals recovered in the third excavation season at Kaldar Cave are much less abundant than lithics. Layers 1 to 3 yielded remains of Vulpesvulpes, a small Canis (probably domestic), a deer of the size of Damamesopotamica, Capreolus?, Capra, Bostaurus, and Hystrix. Layer 4 yielded: Carnivoraindet, Dama, a large deer of the size of Cervuselaphus, and Capra. Cervuselaphus has been documented in Kaldar Cave (Bazgir et al. 2017). The Capra remains do not include specimens that are diagnostic at the species level, but the specimens, including those from level 4 tend to be small. Species Capra aegagrus lives today in Iran and is somewhat smaller than other species, like Capra caucasica. In this field season, we did not recover the remains of large mammals from layer 5. The remains recovered during the last field season confirm that the fauna from the different levels of Kaldar Cave is consistent with Palaearctic affinities. The Zagros mountains form locally the southern border of the Palaearctic and did so also during the Late Palaeolithic. The climate or environment of the area had more affinities with the areas to the North than with the surrounding areas (East, South, West). The variety of deer species so far to the South is notable and suggests that the environment of the Khorram-abad valley was not very dry when layers 1 to 4 were deposited (Fig. 6).

1. Bostaurus right radius and ulna in distal view.
2. Capra cf. aegagrus third (or distal) phalanx, right of the axis of the foot, axial view.
3. Capra cf. aegagrus right upper molar, buccal view.
4. Capra cf. aegagrus third lower premolar, lingual view.
5. Canis sp. (probably domestic)
6. Chelonia cf. Testudo, ventral plate.
7. Hystrix left ulna, medial view.
8. Vulpesvulpes right ulna, lateral view.
9. Vulpesvulpes left edentulous mandible, lingual view.
10. Cf. Damamesopotamica distal part of first (or proximal) phalanx, left of the axis of the foot: a) plantar, b) axial view.
11. Cf. Damamesopotamica left lower canine, labial view.
12. Cervuselaphus first (or proximal) phalanx, left of the axis of the foot, axial view.

Discussion and Conclusion

Based on its suitable location within the Wild Life Century zone, Kaldarcontains almost untouched layers with intact living floors that make it one of the rare sites with potential for future goal-oriented excavations. A thick part of its Middle Paleolithic sequence (almost 80 cm) has yet to be dated. However, the current dates and earlier lithic data confirm that this locality had been occupied at least since the middle of the Middle Paleolithic era. To date, Kaldar Cave and Bawa Yawan rock shelter (Heydari-Gauran et al. 2021) are the only sites within the Iranian Zagros that produced both Middle and Upper Paleolithic dating. Available data from Kaldar also shows continuity from the Pleistocene into the Holocene, which makes it also interesting for research on the younger cultural developments. However, as discussed earlier, the absence of Epipaleolithic cultural remains at this locality is crucial. The obtained dates from the second excavation season have led us to abandon the Epipaleolithic designation we previously applied to the recovered bladelet assemblages (Bazgir et al. 2014, 2017). During this excavation season, we came closer to the idea that the site may not have been occupied during the Epipaleolithicera. The recovered lithic industry at this season shows the earlier features. A large number of the artifacts are in the form of points and pointed elements. The unique blade and bladelet assemblage from Kaldar could be considered as an index for the Baradostian/Zagros Aurignacian assemblage within Iranian Zagros and beyond.

The current state is that we are still far from assessing a precise transitional timing of the M.P. to U.P. The obtained dates from both the U.P. & M.P. sequences of the Zagros sites do not match or in some cases, are not even close to each other. For instance, in the case of Bawa Yawan, both of its U.P. and M.P. dates seem too young compare to the Humian 1, Shanidar, Kaldar, Ghar-e-Boof, and even Yafteh. The Kunji Cave M.P. date shows a comparatively much younger chronology. The

Fig. 6: Selected Bones and Teeth of Large Mammals from Kaldar Cave from the 3rd Excavation Season

moment of the M.P. to U.P. transition of the region is not yet exactly known and more precision could be obtained by dating the boundary between layers 4 and 5 of the Kaldar Cave and other sites sequences. We also recovered a fragment of a human skull from layer 4. Although DNA analysis confirmed its human nature, an initial attempt to date the specimen returned a nearly recent date, which is most probably due to contamination. For this reason, we prefer to wait for the next excavation and then try to find more human remains.

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