استفاده از کوارتز به عنوان سنگ خام و تاثیرات آن بر استراتژی فن‌آوری دست‌ساخته‌های سنگی: مجموعه بررسی ۱۳۵۶ کلود تیبو در شمال تنگه هرمز

سپهر زارعی

چکیده

در بهار سال ۱۳۵۶ هیأت مشترک فرانسوی - ایرانی به سرپرستی کلود تیبو و محمدحسن قاجار اقدام به بررسی زمین‌شناختی در سواحل و پس‌کرانه‌های شمالی تنگه هرمز و دریای عمان واقع در نیمه شرقی استان هرمزگان کردند. در خلال این بررسی، مجموعه ۱۶۰ دست‌ساخته سنگی سطحی شامل سنگ‌مادرها، قلوه‌ابزارها، تراشه‌ها و تراشه‌ابزارها جمع‌آوری شد. متاسفانه با مرگ ناگهانی تیبو، انتشار گزارش این پروژه و مطالعه جامعِ یافته‌های آن هرگز انجام نشد؛ این مجموعه هم‌اکنون در بخش پارینه‌سنگی موزه ملی ایران نگهداری می‌شود. در این نوشتار، ویژگی‌های فن‌آوری و گونه‌شناختی دست‌ساخته‌های سنگی از جنس کوارتز مورد بررسی قرار گرفته است. مهم‌ترین ویژگی این مجموعه، صنعت سنگ‌مادر-تراشه بر روی قلوه‌سنگ‌های کوارتز است. به لحاظ فن‌آوری، تراشه‌برداری بر روی کوارتز با روش ضربه مستقیم و شیوه سندانی دوقطبی انجام شده که تولید تراشه‌های کوچک کوارتز، حاصل این شیوه است. علاوه بر این، قلوه‌ابزارها و سنگ‌مادر-ساتورها، قطعات رتوش‌دار شامل خراشنده، کنگره / دندانه‌دار، اسکنه و سوراخ‌کننده، ابزارهای ساخته شده از این سنگ خام هستند. مجموعه بررسی تیبو اطلاعات قابل توجهی از رفتار فن‌آورانه گروه‌های شکارگر-گردآورنده پلیستوسن در این بخش کمتر شناخته شده سرزمین ایران را در اختیار می‌گذارد. نوشتار حاضر به استفاده از کوارتز به عنوان سنگ خام در مجموعه حاصل از بررسی تیبو می‌پردازد.

واژگان کلیدی: سنگ خام، کوارتز، خلیج فارس، دریای عمان، پارینه‌سنگی، صنایع سنگی.

https://doi.org/10.22034/JINM.2021.253013

Quartz Usage as a Raw Material and Its Influences on the Strategy of Lithic Technology: The case of Thibault's 1977 Survey Collection, the Northern Littoral of Strait of Hormuz

Sepehr Zarei[a]

Abstract

The 1977 joint French-Iranian geological survey carried out by Thibault and Kadjar, gave rise to one of the important contribution to Paleolithic knowledge on the northern coastline of the Persian Gulf and the Oman Sea in pre-revolutionary years. During this survey, remarkable lithic collection composed of 160 artifacts with cores, pebble tools, flakes and flake-tools were collected above a sequence of successive pediment surface, but unfortunately, the final report of Paleolithic finds, was never published. The lithic collections kept at the Paleolithic Department of National Museum of Iran (NMI). In this paper, the techno-typological characteristics of the quartz as a raw material in this collection is presented. The most prominent feature of this collection is the core-flake industry on quartz pebbles and cobbles. Technologically, quartz flaking has been done by direct percussion and bipolar anvil technique. One of the characteristic features of this collection is using bipolar anvil technique that results in small flakes. In addition, pebble tools and core-choppers, retouched pieces including scrapers, notches/denticulated, burins and borers are tools made from this rock. This collection can be considered as a new insight into technological behavior of Pleistocene hunter-gatherers in this poorly known part of the Iranian plateau. This article investigates the use of quartz as a raw material in the Pleistocene epoch in the Thibault's collection.

Keywords: Raw Material, Quartz, Persian Gulf, Oman Sea, Paleolithic, Lithic industries.

a. Cultural Heritage, Tourism and Handicrafts Hormozgan Provincial Office, Bandar Abbas, 79137-53491, Iran
e-mail: szarei@hchto.ir

Introduction

While studies of lithic raw material procurement and usage in other parts of the world shed light on the strategies of Paleolithic human groups, so far not much attention has been paid to it in Iran. However, like other parts of Paleolithic researches, these studies have been done just in the Zagros region (Biglari 2004, 2007). Unfortunately, such technological and behavioral aspects of Pleistocene archaeology are poorly understood in the Southern Iran.

Use of quartz raw material is reported from several sites in the region (Hume 1976; Thibault 1977; Dashtizadeh 2012a, 2012b; Zarei 2019) indicate the importance of this rock in the Pleistocene lithic assemblages and the widespread use of quartz in the southern Iran Paleolithic sites (Fig. 1). However, and despite quartz general presence in the archaeological record, lithic studies have traditionally regarded it as a second-rate lithic resource, its use strictly conditioned by the scarcity of better quality or cryptocrystalline rocks in the surrounding territories (de Lombera-Hermida & Rodríguez-Rellán 2016).

The French-Iranian joint team with the supervision of Claude Thibault and Mohammad Hassan Kadjar surveyed the northeastern shores of the Strait of Hormuz in the Hormozgan Province during April and May 1977. During this mission, remarkable lithic collection was gathered on the surface of a succession of pediment surfaces (Thibault 1977; Dufaure 1978). Unfortunately, the final report of this survey was never published due to the untimely death of Thibault. The lithic collection kept in the Paleolithic Department of the NMI, has been studied by the author for a Master thesis (Zarei 2015, n.d.). This paper is focused on quartz usage as a raw material in this lithic collection.

Quartz characteristics

Quartz is one of the most abundant minerals in the earth's crust chemically defined as SiO2, silicon dioxide. It has a hardness of seven in Moh's Hardness Scale that is a significant component of many igneous, sedimentary, and metamorphic rocks. Pure quartz is clear in colour, but there are other varieties of quartz that occur in a rainbow of colours (Wenk & Bulakh 2004).

The most common fracture for the production of lithics is the conchoidal fracture exhibited by some rocks like quartz (Rapp 2009), that is a hard but brittle mineral which makes it suitable for forming into stone tools and subsequent use. In terms of fracturing, almost all quartz does not have a tendency to break along structural planes in the crystal structure, but is instead characterized by conchoidal fracturing, which means that its fracture surface has a curved shape. Quartz can be divided into cryptocrystalline and macrocrystalline forms. Cryptocrystalline forms include flint, chert, and jasper, and are described as rocks instead of minerals. The conchoidal fracturing of the cryptocrystalline materials happens at the micro-scale of the individual quartz crystals and at the macro-scale, following a fractal pattern. Macrocrystalline forms include primary outcrops (quartz veins) and secondary deposits (alluvial or colluvial rock crystal); while these fall under umbrella of lithics and stone tools in archaeological parlance, they are in fact minerals. The fracturing at the micro-scale is conchoidal, but a fractal pattern may or may not be produced depending on how the crystals have aggregated (Driscoll 2010; de Lombera-Hermida & Rodríguez-Rellán 2016). Because of its hardness, mechanical and physical properties macrocrystalline quartz was heavily used in the Pleistocene and Holocene lithic technologies. Besides, the different varieties are available, and its brightness and whitish colour make it a high perceivable resource in the territory, favouring its identification and collection (de Lombera-Hermida & Rodríguez-Rellán 2016).

In terms of knapping quickly, the regular internal flaws of xenomorphic quartz make it difficult and unpredictable to break, and, because of its high reflective qualities, it can be a challenge to interpret. Some knapping experiments suggest that toolmakers used freehand (core in hand) and bipolar anvil strategies to overcome the complexities of xenomorphic quartz reduction (Pargeter & Hampson 2019).

The 1977 Joint French-Iranian Geological Mission

Under the French C.N.R.S. and the Geological Survey of Iran joint field mission included the following: C. Thibault as Quaternary geologist and Paleolithic archeologist; Jean-Jacques Dufaure as geomorphologist and Jacques Mercier and M. H. Kadjar, both structural and regional geologists, in April 1977 along the Hassan Langi to Roudan road section, Thibault began picking up lithics material left behind on a pediment surface superposed on a magnificently exposed reverse fault. The lithics collected by Thibault in the greater Minab region, were discovered at the surface of a sequence of pediments. The French team was essentially concentrated from Shamil-Hassan Langi, Roudan road and south of Minab. But the Sadich numbers refer to the Kadjar's observations and sample collections. He carried out this survey alone from Jask to Chabahar (Fig. 1). Unfortunately, with the untimely death of Thibault in a car accident during a mission in Algeria, a final publication concerning these Paleolithic finds was no longer possible (Zarei n.d.), but accompanied with a preliminary field report (Thibault 1977). Dufaure, also wrote a detailed review and synthesis of his observations (Dufaure 1978).

After two decades, a new French team came back to the Minab area during the month of

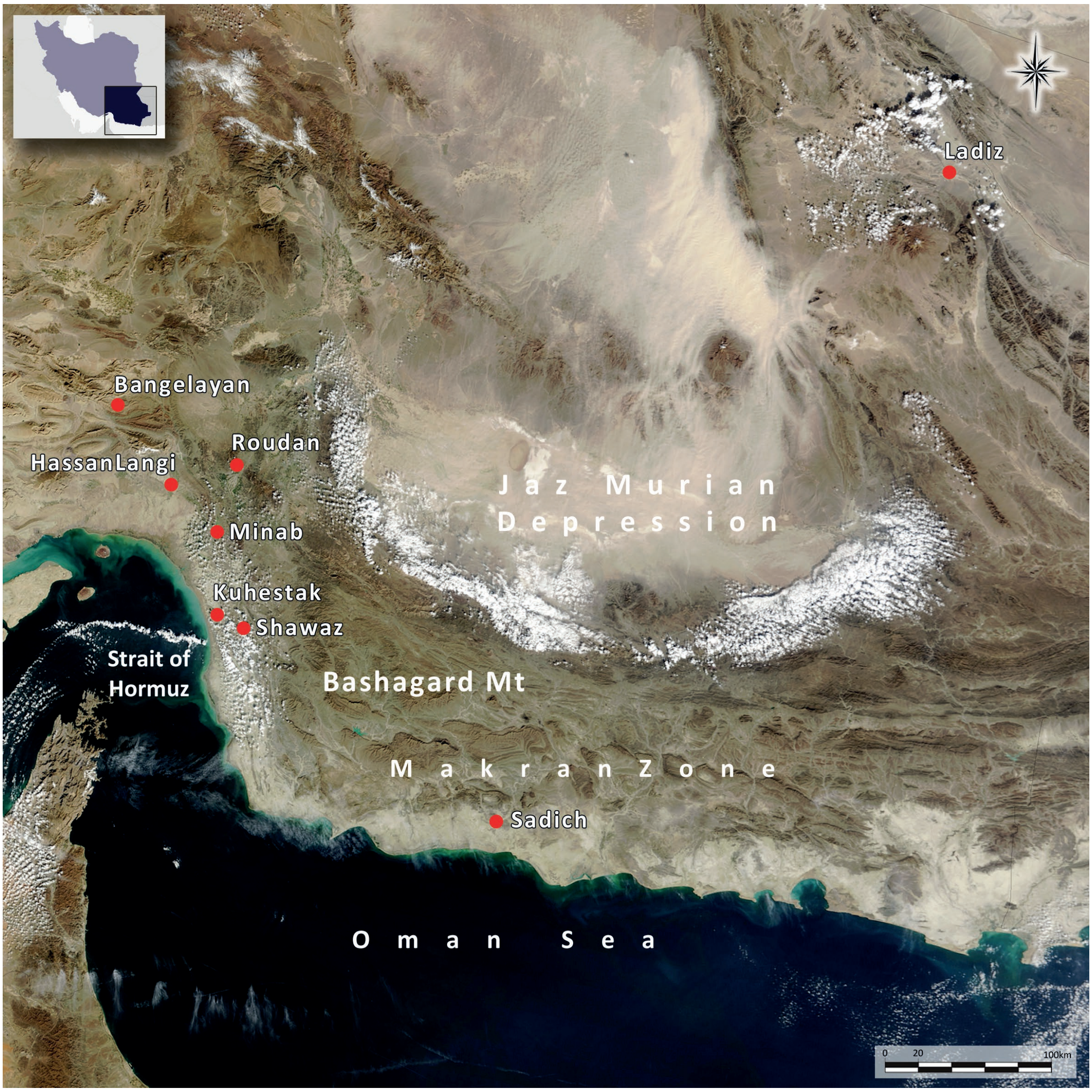

Fig. 1. Map of Southeastern Iran showing the location of sampling in east Hormozgan and other Paleolithic sites mentioned in text.

February 2000, 2001 and 2005 to set up a GPS network for Neotectonic studies. Regard and colleagues also measured in situ produced 10Be in quartz boulders exposed on the top surfaces of Late Quaternary sequences (Regard et al. 2005; Zarei n.d.). Beside these, they estimated the ages of these deposits based on Dufaure observations (1978) and with the archaeological data and chronologies collected and processed by Thibault (1977). Consequently, four geomorphic levels with four different ages ranging were determined as following: Qt2a is an alluvial terrace dated between 5 and 9 kyr ago; Qt2 corresponds to terraces or fan surfaces assigned to the Epi-Paleolithic industries, dated at 13.6 ± 1.1 10Be kyr ago; Qt1a displays Mousterian industries 100-50 kyr ago; Qt1 according to the industries it displays, the highest level is assigned to the Late Acheulian age (300-100 kyr ago).

With the initial establishment of Center for Paleolithic Research (later Paleolithic Department) in 2000 and officially starting this center, all lithic artifacts were taken out from warehouses of museum and organized at this center. Meanwhile, Thibault's collection was obtained and transferred to the Paleolithic Department and then was briefly studied by Biglari and Shidrang (2006).

Lithics

Lithics were kept in plastic bags with added tags written in French. Each contained the following information: location, date of collection, the large letters CT with a number (CT= Claude Thibault). Such an example is: "CT1 Roudan Road". Additionally, some the sample bag tags included more details such as typology (i.e. denticulate/notch on quartz), cultural attribution (i.e. Acheulian), or notes on sampling location (i.e. Würm terrace). Overall, due to lack of a detailed accompanying report and incomplete tag information, the exact sample locations are unknown. Thibault's (1977) manuscript report and sketches kept at the University of Bordeaux have been used for this study.

It should be noted that several lithics in the original samples were transferred by Thibault to the University of Bordeaux in France, and are currently maintained there (Zarei n.d.). This smaller part of the collection, whose exact number is not known, is not included in the present study. In addition, one artifact was also on display in the Paleolithic gallery of the NMI and therefore could not be accessed. So F. Biglari generously provided the author with pre-display images of this artifact and its techno-typological information that are included in the database.

Initially, the collection which consists of 430 lithics, were divided into 6 general categories based on the locations in the tags which include: Minab-Roudan Road, Minab, Sadich, Hassan Langi, and two untitled locations. These locations contain 22 sampling points based on the combination code of the tags. Due to the presence of geofacts in the initial observation, the geofacts and lithic artifacts were separated, which resulted in the identification of 160 lithics (37.2%) and 270 geofacts (62.8%) (Tab. 1, Figs. 2 and 3).

Minab-Roudan Road. The Minab-Roudan road begins from Bandar Abbas to the Minab-Roudan intersection situated 65 km east of Bandar Abbas, 28 km north of Minab and 27 km west of Roudan. From this intersection eastward, the road crosses a mountainous terrain and connects the Minab plain to the Roudan drainage basin. Although the sampling locations along this approximately 30 km road were not specified, but based on written codes on tags, eight sampling points including CT4, CT5, CT7, CT16, CT22, CT23, CT24 and CT28 were separated. Based on the Bordeaux documents and samples tags, these lithics were collected on Middle Pleistocene and Late Upper Pleistocene pediment surfaces rising eastwards on either side of the Minab-Roudan intersection. A total of 180 pieces were collected, which included 89 lithic artifacts and 91 geofacts.

Minab. Minab city, part of Minab County, is in the middle of the 400 sq. km fertile Minab plain. Topographically it can be divided into three units: A relatively high region with heights ranging from 1500 to 1000 m asl; an intermediate region ranging from 1000 to 500 m asl; a wide lowland floodplain with heights from 500 m to sea level (National Geographical Organization 2004). The Minab River is the

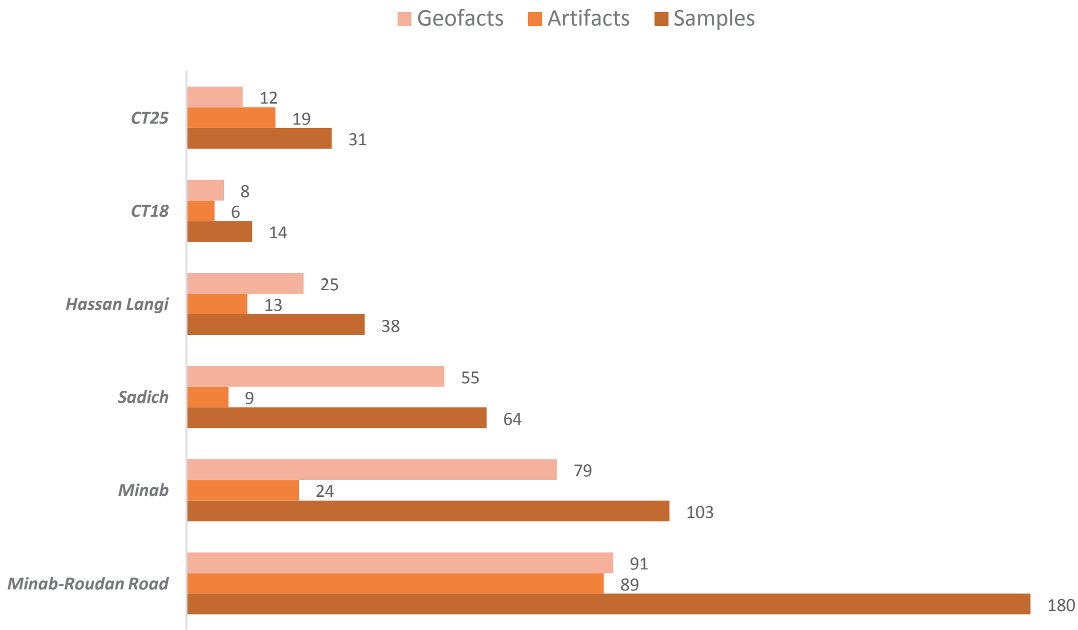

Fig. 2. Locations and ratio of sampled artifacts and geofacts.

Fig. 3. Quartz geofact examples, Minab-Roudan Road (CT4).

Locations	Tags' code	Samples	Artifacts	Geofacts
Minab-Roudan Road	CT4	33	16	17
	CT5	3	-	3
	CT7	8	2	6
	CT16	53	17	36
	CT22	11	5	6
	CT23	11	4	7
	CT24	48	32	16
	CT28	13	13	-
Minab	609	24	4	20
	618	22	1	21
	CT9	11	3	8
	CT17	27	4	23
	CT19	8	5	3
	CT20	11	7	4
Sadich	?	57	7	50
	658	1	1	-
	706 / O.L	5	1	4
	726	1	-	1
Hassan Langi	CT1	7	3	4
	CT2	31	10	21
?	CT18	14	6	8
?	CT2	31	19	12
Total		430	160	270

Table 1. Locations and sampling points.

dominant drainage system with two tributaries: The Roudan and Jaghin which transversely erode the folded coastal mountain range and enter the Strait of Hormuz on a gentle slope. Six sampling points with tag numbers: 609, 618, CT9, CT17, CT19 and CT20, were separated. Comparing the manuscript and tag numbers, this collection was sampled on the Middle Pleistocene pediment surface. Despite that four ages have been set for Minab road surfaces (Regard et al. 2005), but due to the lack of sampling locations, it is not possible to establish a logical relationship between the lithics of this collection and these levels. In this area, a total of 103 lithics were collected, of which 24 were lithic artifacts and 79 geofacts.

Sadich. Sadich is the name of a river that originates from the heights of Bashagard in the east of Hormozgan and then flows along North-South axis route to the Oman Sea. Also, 14 kilometers north of the Oman Sea, near the Sadich riverbed, Sadich village is located on the Jask-Chabahar road, approximately 94 km east of Jask and 198 km west of Chabahar. Based on the code written on the tags, four sampling points including 658, 706/O. L, 726, and an unknown point (?) were separated. In this area, 64 pieces have been collected, including 9 lithic artifacts and 55 geofacts.

Hassan Langi. The village of Hassan Langi is located along the river with the same name. It is located 60 km east of Bandar Abbas and 35 km west of Minab. At this location, material was collected close to Hassan Langi near the Roudan road at two separate sampling locations with numbers CT1 and CT2. Overall, 38 pieces were collected, including 13 lithic artifacts and 25 geofacts.

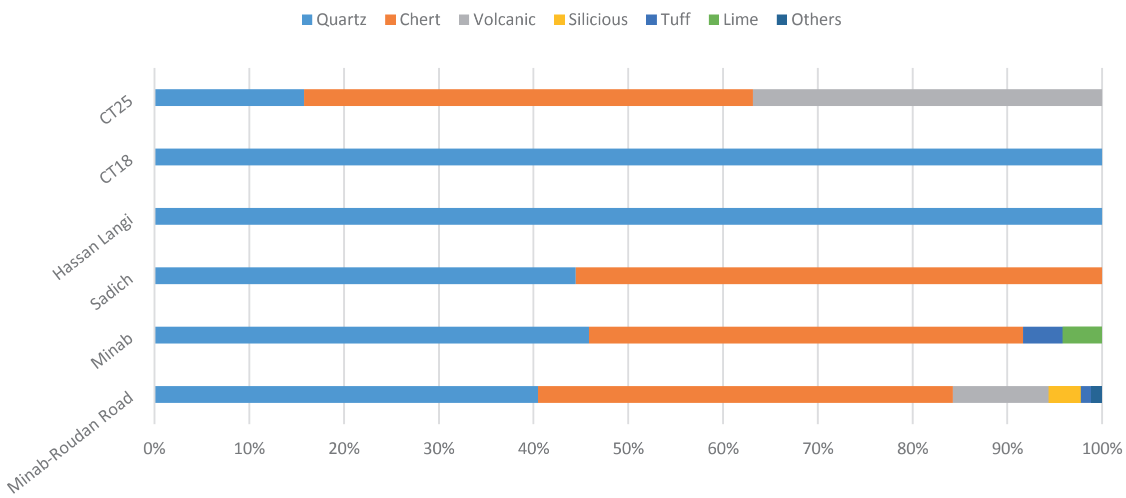

Fig. 4. Percentages of used raw material types in assemblages.

CT18. This collection, specified by CT18, has no place name or provenience on the tag; therefore, it was studied as "CT18 Location". In this area, 14 pieces have been collected, including 6 lithic artifacts and 8 geofacts.

CT25. This collection, specified by CT25, has no place name or provenience on the tag; therefore, it was studied as "CT25 Location". In this area, 31 pieces have been collected, including 19 lithic artifacts and 12 geofacts.

Quartz as a Raw Material

The Minab-Roudan Road collection consists of six raw material groups including chert, quartz, volcanic rocks, tuff, and other siliceous rock types. After chert with 43.82%, quartz is in second place with 40.45%. The Minab collection consists of 4 raw material groups which include quartz, chert, tuff and limestone. Quartz and chert have the highest share of 45.84%. The Sadich collection consists of two raw material groups including quartz and chert. After Chert with 55.56%, quartz is in the second place with 44.44%. Only quartz has been used as raw material in the Hassan Langi and CT18 collection. The CT25 collection consists of 3 raw material groups including chert, quartz and volcanic rocks. After chert and other lava rocks, quartz is ranked third with 15.77%. Quartz is from fine to medium grained, in white and yellow colors. Most samples of this rock type are transparent or semi-transparent. Due to the sampling of the artifacts from open-air sites and occurrences, most samples can be seen to have light to heavy patina, along with weathering and desert varnish, that the result is a shiny and greasy surface. All of the samples of this rock type are made of medium-to-small-sized cobble and pebble (Fig. 4).

The regional drainage in the Minab area is from the northeast, (east of the Zendan fault southwest of Jaz Mourian) which during the Early Pleistocene, must have first contributed to large tracks of laterally coalescing alluvial fans under tectonic and climatic control. These contained a mixture of rocks composed of siltstone, sandstone, limestone, radiolarite chert, quartz rock, shale, and a mixture of basic and intermediate composition volcanic rocks (National Geographic Organization 2004). Later, these original coarse sediments were subjected to horizontal planation with the formation of a sequence of today remnant pediment surfaces (Dufaure's "glacis", 1978) developed under specific climatic conditions in a highly mobile tectonic environment. It was these coarse material surfaces which provided the raw material for our collection, as well as, in the Makran flysch.

Quartz Industries

Over 45% of the Thibault's collection (n= 160) is comprised of quartz (n= 73), which is the highest rate of raw material in the whole collection. The core technologies and techniques used including direct percussion (95/4%) and the bipolar anvil technique (4/6%) that were heavily influenced by the raw material. In the Minab-Roudan Road collection freehand and bipolar anvil techniques were used. The bipolar technique, as observed in this study, follows that described in which a pebble is held in a vertical position on a stone anvil and struck with a hammerstone. This method allows the production of significant recurrent series of flakes, up to a point predetermined, from raw materials or blocks whose shapes could be exploited by classic percussion only with difficulty (Mourre 2004). The choice of bipolar debitage on quartz is frequently attributed to raw material constraints and is considered to require less skill than freehand percussion. However, the bipolar technique indicates the ability of hominins to find technical solutions for breaking ovoid quartz nodules that are difficult to break with freehand percussion, and to produce pieces suitable for use (Despriée et al. 2018). The small size of the quartz pebbles combined with the absence of natural striking platforms on their rounded surfaces resulted in the failure to flake. The pebble split into two or more segment-shaped pieces which calls 'split cobble cores' (Barham 1987). Except for two cases of soft hammer use, hard hammer is used in identifiable cases. In the Minab, Sadich and CT25 collections, only direct percussions technology were identified, all of which used hard hammer. In the Hassan Langi and CT18 collections, two main technological groups were used which in order of usage are direct percussion and bipolar anvil.

Morphologically, the quartz direct percussion platforms can often take the same form as the chert comparison collections, having a convex ventral platform edge (Driscoll 2010). Among the 17 identified striking platforms, 14 are plain, 2 are linear and 1 is cortical. The dimension of butts are: plain 9.28- 34.98 mm length and 4.3-11.66 mm thickness, linear 11.56-24.15 mm length and 1.22-2.77 mm thickness, and cortical 17.21 mm length and 11.45 mm thickness; the mean average thickness and width for striking platforms is 8.28 mm and 18.79 mm. The bipolar flake platform are generally characterized by a rounded platform with the steep side on the ventral face of the flake.

Cores

The 22 flake cores are identified from all quartz lithics. General form of cores are divided into 3 groups including unifacial (n= 12), bifacial (n= 9) and amorphous (n= 1). Based on striking platforms and flake scar directionality, cores are classified into unifacial unidirectional (n= 9), unifacial unidirectional-convergent (n= 1), unifacial semi-centripetal (n= 1), unifacial multiple (n= 1), bifacial bidirectional (n= 4), bifacial multiple (n= 3), bifacial unidirectional (n= 2), and amorphous bidirectional (n= 1).

While technically quartz does not form a cortex, the term cortex is used hereto described the exterior surface of quartz which becomes altered due to weathering, natural abrading, and so forth (Driscoll 2010), about 78% of cores are mostly cortical; it means that in most of the cores did not yield a lot of flakes, and only half of the surface is flaked and then released. The chaîne opèratoire is rather short, both for cobbles and pebbles, generally resulting in the production of two to four (or six at the most), using the unidirectional reduction of one to three striking platform. The most likely explanation for these short reduction sequences are related to the characteristics of the raw material, and to the final aim of production and raw material availability (Despriée et al. 2018). 81% of these cores are made of pebble and the other on cobble. The dimensions of cores are: 24.63–104.97 mm length, 24.2-91.1 mm width, and 9.92–40.5 mm thickness. In addition, the average weight is 25.41 gr, which is between 7.7–231.8 gr. Only one unifacial multiple flake core is exceptionally prepared. A bipolar anvil flake core with 26.23 mm length, 28.06 mm width, and 10.8 mm thickness, has 7 removal scars. The only core knapped by centripetal method, is a discoid/semi-centripetal core from Minab-Roudan Road (CT23) with 52.5 mm length, 42.1 mm width and 23.6 mm thickness in size, and has 8 removal scars larger than 5 mm (Fig. 5 and 6).

Debitage

Debitages (n= 39) consists of flakes and blade. Flakes with 38 have the highest number, of which 34 pieces are complete and 4 pieces are proximal fragments. The direct percussion pro-

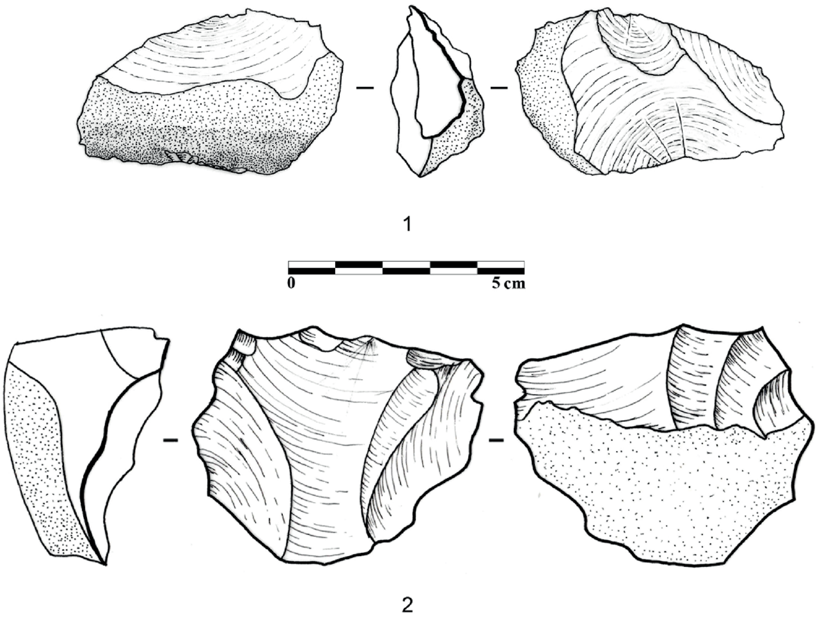

Fig. 5. 1) bifacial-bidirectional core, Sadich 2) discoid/semi-centripetal core, Minab-Roudan Road (CT23).

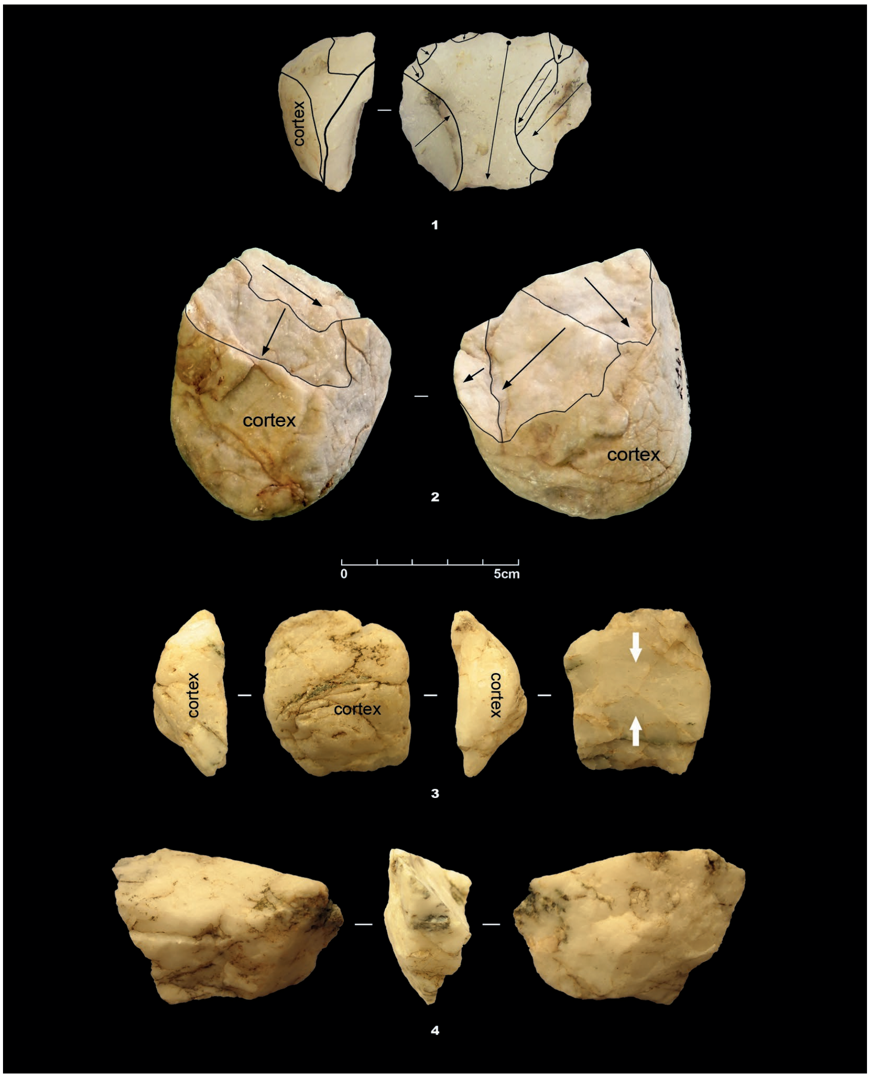

Fig. 6. 1) discoid/semi-centripetal core, Minab-Roudan Road (CT23); 2) bifacial core-chopper, Sadich; 3) bipolar anvil core, CT18; 4) thick flake on quartz, Hassan Langi (CT1).

duced larger, thicker complete flakes with greater length/width ratio (Fig. 6), but the complete bipolar flakes are smaller. Among the identifiable pieces, 7 flakes are reduced by bipolar technique that include 18.5% of the entire debitages. The lengths of these flakes are between 25.95-38.45 mm and their widths are 24.74-51.93 mm. Except for one step type, terminations are dominated by feather type and no plunging termination for bipolar flakes; it has experimentally found that most quartz flake terminations are feather (Driscoll 2010). The medio-lateral cross sections are triangular (n= 15), trapezoid (n= 13), semicircle (n= 5) and convex (n= 5), which 54% are left in symmetry, 26% are right and 20% are medial. 60% of flakes are cortical, that's more than half of them are primary and secondary flakes. Except two linear and one cortical, all butts are plain. Just one blade with plain butt is recognized with trapezoid medio-lateral cross sections and even medio-lateral symmetry, that is proximal fragment and because of broken distal, it cannot be measured. Based on the characteristic features of collection, this piece does not seem to be a technical blade, but just a morphological form. For both bipolar and direct percussion, lower frequent bulbs were detected. It should be noted that bipolar debitage generally produced more straight flakes and is unique in allowing for the extraction of thin and maximally sized flakes from exceptionally small cores (Driscoll 2010; Pargeter & de la Peña 2017).

Tools

Several groups of artifacts provide evidence of retouch or series of short removals in order to create a cutting edge or a point (n= 12) include pebble tools and retouched flake.

Some pebbles and cobbles with scars on one surface can be characterized as core-choppers (or pebble tools). In this way that a single cortical surface was used to detach two or three parallel flakes to create a more or less straight or pointed edge. Four pebble tools were identified in this group, including three core-choppers and a pointed core-chopper. These are made of riverbed quartz cobbles. Pointed core-chopper with 232.5 gr. weight, is manufactured with 4 unifacial removal scars to create a sharp tip and nearly 75% of its surface is cortical (Fig. 6 and 7).

A total of eight retouched flakes were identified among the whole series (Fig. 8). From a technological point of view, the retouched blanks are flakes and natural flakes. In dominant cases, the flakes bear some cortex. Retouch is marginal or long mostly at the distal end, from semi-abrupt to abrupt and one crossed-abrupt, and we can distinguish a regular retouched edge and a denticulated edge. The most cases retouch is generally continuous, and except one inverse case, always direct. Three scrapers made on quartz flake are identified. A transverse scraper that is 41.83 mm long and 40.78 mm wide, lacks cortex and all of dorsal face has been flaked. At the distal end, long and parallel semi-steep retouches can be seen. On the ventral surface, a bladelet-like removal scar is present. An oblique scraper with length 51.33 mm and a width of 66.62 mm was also identified. One of tools made on natural flake is an end-scraper. A notch/denticulate was identified with dual patina; so that notches are produced with a light and bright patina on a flake with a yellow and glossy patina. This difference in surfaces can be attributed to the use of this tool in two stages; this tool is the result of the second step. A notched which is made of quartz, is roughly 25% cortical and 40.97 mm long and 25.94 mm wide (fig. 9). Another tool on natural flake is a borer with 41.33 mm long and 31.39 mm wide. The only burin in the whole collection is made on a natural quartz with a length of 45.88 mm and a width of 17.54 mm. A thick quartz flake with an inverse retouch was also identified which is 28.48 mm long and 35.96 mm wide. (Fig. 7 and 8)

Discussion

In the Thibault's Minab collection, quartz has a highest percentage that is mostly in pebble size and rarely in cobble size. After that, the highest frequency of the used raw material is chert that is in the form of pebble or blocks. Numerous harder, more resistant cobbles are available from the stone pavement collections of the Minab plain and Makran flysch surfaces for such activities.

More than 62% of the 430 artifacts collected are geofacts, in such a way that the num-

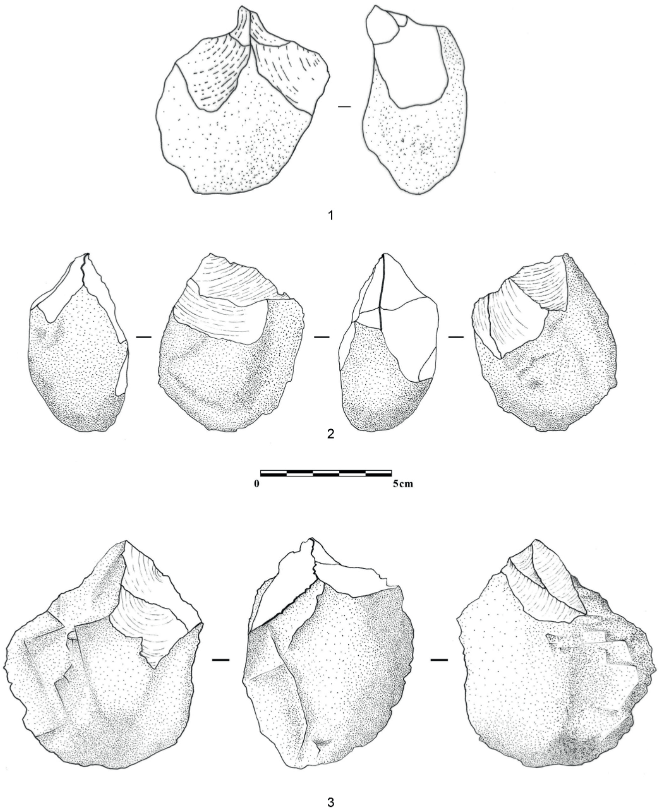

Fig. 7. 1) pointed core-chopper, Minab-Roudan Road (CT23); 2) bifacial core-chopper, Sadich; 3) bifacial core, Minab-Roudan Road (CT28).

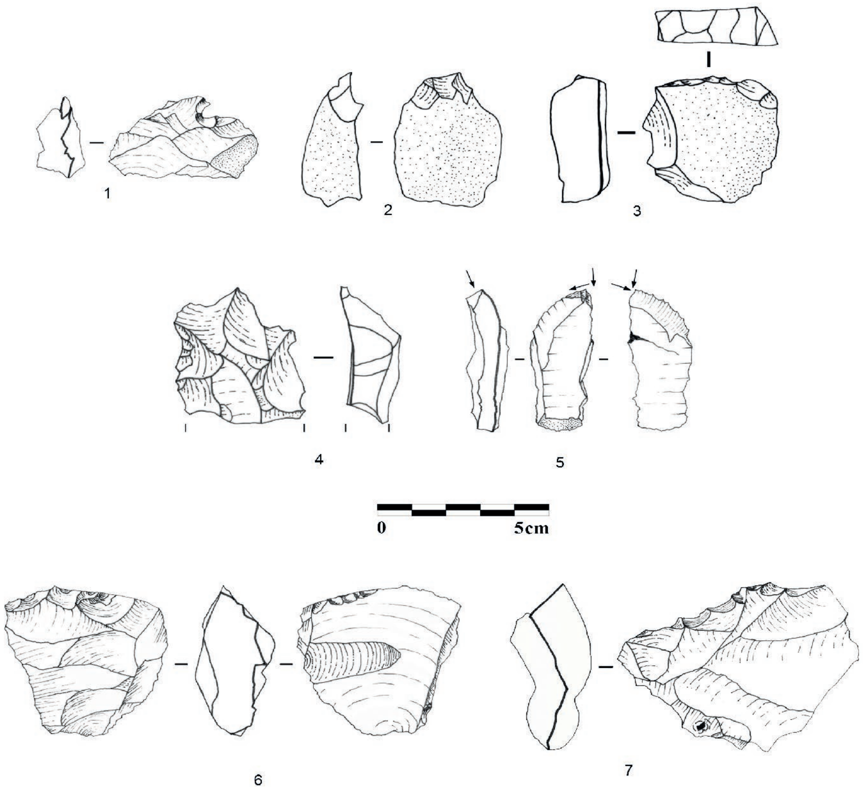

Fig. 8. 1) notched, CT18; 2) borer on natural blank, Minab-Roudan Road (CT16); 3) end-scraper on natural flake, Minab (CT20); 4) distal end of notched/denticulated flake, Minab-Roudan Road (CT24); 5) burin on natural flake, Hassan Langi (CT1); 6) transverse scraper, Hassan Langi (CT2); 7) oblique scraper, Minab-Roudan Road (CT22).

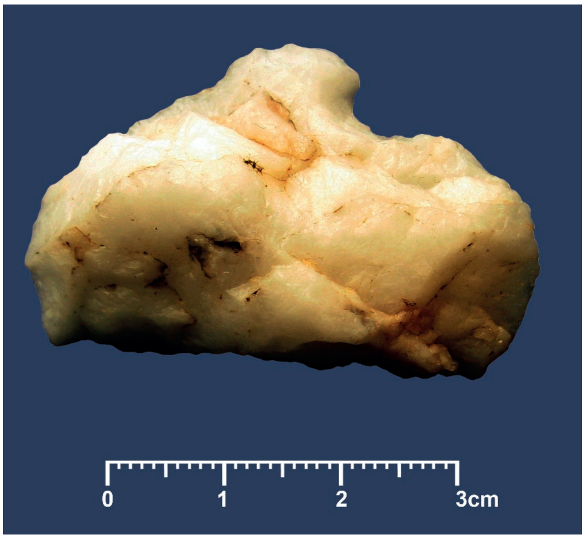

Fig. 9. notched, CT18.

ber of geofacts in each place is more than the number of artifacts in that place; just in the CT25, the percentage of artifacts is higher than in geofacts. The reason for this can be considered as natural fractures, and the physical properties of rocks such as quartz; the difficulty of reading the quartz implements has definitely contributed to the misidentification and misclassification of quartz artifacts in the framework of the archaeological typologies, favouring -therefore- imprecise interpretations of the lithic assemblage (de Lombera-Hermida & Rodríguez-Rellán 2016).

This collection is characterized by core-flake industry on local quartz aimed at producing pebble tools, fragments of pebbles and flakes. Direct percussion and bipolar anvil on pebbles produce pointed half-pebbles and pointed pebble fragments. The bipolar anvil reduction has been considered as one of the most widespread techniques for reducing the fragmentation of the knapping products and providing greater efficiency in terms of cutting edge length per mass (de Lombera-Hermida & Rodríguez-Rellán 2016). On the other hands, small quartz nodules encourage the use of bipolar technique because they can be more difficult to knap with freehand strategy (Pargeter & de la Peña 2017). Besides, in Pargeter & de la Peña (2017) bipolar and freehand reduction experiments on milky quartz demonstrate that bipolar reduction is a significantly quicker method of reduction rock and of obtaining cutting edge than freehand reduction.

Shaping is a secondary reduction sequence. It is mainly represented by core-choppers and unifacial/bifacial pebble tools that reported form adjacent areas in the recent Minab Plain (Dashtizadeh 2012a) and Roudan Plain (Dashtizadeh 2012b) surveys, Bangelayan in the north of Bandar Abbas, and Kuhestak and Shawaz in the east of Strait of Hormuz (Zarei 2019). Retouched flakes are rare and, when present, they are mainly lightly retouched scrapers, notched or denticulates, always modified on flake edges and in three cases on natural flakes.

The core-flake industry of the study region is comparable to the Lower Paleolithic Ladizian industry that it is characterized by the presence of core-choppers, a high frequency of flakes, and tools made from it such as notched/denticulated, burin, borer, as well as a lack of large cutting tools such as cleavers and hand-axes (Hume 1976). It should be noted that this raw material is completely rare in the Zagros assemblages. From a general point of view, if we compare the technological characteristics of this collection to other east Iranian quartz-dominated assemblages (Ariai & Thibault 1975-1977; Biglari and Shidrang 2006; Hume 1976), first of all we observe consistent technical behavior characteristic of the earliest lithic skills, and secondary, strategies strongly influenced by raw materials that collected from a secondary position very close to the site. Across Arabia, different types of raw material have been detected including quartz (Rose 2006), however care needs to be taken to distinguish geofacts from artifacts especially in core-flake and Oldowan industry (Groucutt & Petraglia 2012), but this is confirmed in the Acheulean sites; for instance Saffaqah site at Dawadmi in central Arabia, represented one of the largest controlled Middle Acheulean collections in the Middle East, that preferred raw material was andesite in accordance with the presence of the dike, followed by granite, quartz and rhyolite (Petraglia et al. 2009).

Besides, semi-centripetal cores, and scrapers on flakes especially transverse and oblique scrapers are characteristic features of quartz usage in the Middle Paleolithic. The discoid/semi-centripetal core from Minab-Roudan Road

(CT23), semi-centripetally prepared and flaked. In central and northern Saudi Arabia at Jebel Abyad Middle Paleolithic quartz artifacts was reported characterized by preferential Levallois core with centripetal preparation, discoid core, thick flakes with faceted platforms, and centripetal scar patterns. Also at Jebel Katefeh quartz was reduced from single platform cores, which in some cases continued to be reduced in a Levallois-like manner both bidirectional and centripetal, sometimes producing predetermined flakes. Retouched flakes are rare, with the small number present mostly consisting of side retouched flakes (Groucutt et al. 2014, 2016), which is absent in the Thibault's collection. It should be noted that in some African Middle Stone Age sites, various levallois methods and retouched toolkits are quartz-dominated (Mercader et al. 2008). Nevertheless, within the some Arabian Nubian Middle Paleolithic findspots and Complex, quartz while in some cases readily available, were seldom used, possibly hinting at raw material preferences (Hilbert et al. 2016).

Conclusion

The most prominent feature of this collection is the core-flake industry of the Lower Paleolithic. It was noted that at the present study, the artifacts of apparent bipolar origin were made of quartz. In this collection, flaking has been done by direct percussion as well. The bipolar technique mostly on pebbles, results in the production of small flakes. This study confirms that the bipolar technique was an expedient debitage, well adapted to rounded quartz pebbles. A high percentage of these debitages remain as simple flakes, and a small percentage are retouched into tools. Quartz in the Middle Paleolithic is defined by semi-centripetal cores, and scrapers on flakes especially transverse and oblique scrapers. The study of the finds of this survey provided an opportunity to get acquainted with the lithic industries of Pleistocene communities in the coastal strip of southern Iran. It is consequently clearly part of the technical skills of eastern Iran territories and was a flexible technique indicating a high degree of Pleistocene human cognition and the ability to adapt to various raw materials of mixed quality. Although the collection is very small and covers a wide geographical area, the different aspects gathers in this collection show a wide range of technological adaptive strategies aimed at overcoming the mechanical and technical peculiarities of quartz.

References

Ariai, A. & C. Thibault
1975-1977 "Nouvelles précisions a propos de l'outillage paléolithique ancien sur galets du Khorassan (Iran)", *Paléorient*, 3: 101-108.

Barham, L. S.
1987 "The Bipolar Technique in Southern Africa: A Replication Experiment", *The South African Archaeological Bulletin*, 42(145): 45-50.

Biglari, F.
2004 "Preliminary Observations on Middle Paleolithic Raw Material Procurement and Usage in the Kermanshah Plain, the Case of Do-Ashkaft Cave", In *Persian Antiques Splendor, mining crafts and archeology in ancient Iran*, vol. I, T. Stollner, R. Slotta & A. Vatandoust (eds.), Deutsches Bergbau-Museum Bochum, Bochum, pp. 130-138.

2007 "Approvisionnement et utilisation des matières premières au Paléolithique moyen dans la plaine de Kermanshah (Iran): le cas de la Grotte Do-Ashkaft", *Aires d'approvisionnement en matières premières et aires d'approvisionnement en ressources alimentaires, Approche intégrée des comportements*, M.-H. Moncel, A.-M. Moigne, M. A. & C. Peretto (eds.), Proceedings of the XV UISPP World Congress (Lisbon, 4-9 Septembre 2006) Vol. 5, BAR International Series 1725, pp. 227-239.

Biglari, F. & S. Shidrang
2006 "The Lower Paleolithic Occupation of Iran", *Near Eastern Archaeology*, 69 (3-4): 160-168.

Dashtizadeh, A.
2012a "New Evidence of Early and Middle Paleolithic Periods from Minab Coastal Plain, Hormozgan: an Alternative Look into the Importance of Coastal Migration", In *Abstracts the 11th Annual Symposium of Iranian Archaeology*, Tehran: Research Center of ICHTO, ICAR, p. 192 (in Farsi).

2012b "New Finds from Hormuz Strait, Dasht-e Roudan: an Alternative view to the Pleistocene Societies Migration", In *Abstracts the 11th Annual Symposium of Iranian Archaeology*, Tehran: Research Center of ICHTO, ICAR, p. 189 (in Farsi).

de Lombera-Hermida, A. & C. Rodríguez-Rellán
2016 "Quartzes Matter: Understanding the Technological and Behavioral Complexity in Quartz Lithic Assemblages", *Quaternary International*, 424: 2-11.

Despriée, J., M.-H. Moncel, M. Arzarello, G. Courcimault, P. Voinchet, J.-J. Bahain & C. Falguères
2018 "The One-million-year-old Quartz Assemblage from Pont-de-Lavaud (Centre, France) in the European Context", *Journal of Quaternary Science*, 33(6): 639-661.

Driscoll, K.
2010 *Understanding Quartz Technology in Early Prehistoric Ireland*, Vol. 1 & 2, Ph.D. dissertation, University College Dublin.

Dufaure, J.-J.
1978 "Glacis de piedmont et compression Quaternaire en Iran du Sud-Est (région de Minab)", *Travaux de la RCP 461 du CNRS*, pp. 92-111.

Groucutt, H. S. & M. D. Petraglia
2012 "The Prehistory of the Arabian Peninsula: Deserts, Dispersals, and Demography", *Evolutionary Anthropology*, 21: 113-125.

Groucutt, H. S., C. Shipton, A. Alsharekh, R. Jennings, E. M. L. Scerri & M. D. Petraglia
2014 "Late Pleistocene Lakeshore Settlement in Northern Arabia: Middle Paleolithic Technology from Jebel Katefeh, Jubbah", *Quaternary International*, 382: 215-236.

Groucutt, H. S., P. Breeze, N. A. Drake, R. Jennings, A. Parton, T. White, C. Shipton, L. Clark-Balzan, A. Al-Omari, P. Cuthbertson, O. M. C. Wedage, M. A. Bernal. A. Alsharekh & M. D. Petraglia
2016 "The Middle Paleolithic of the Nejd, Saudi Arabia", *Journal of Field Archaeology*, 41(2): 131-147.

Hilbert, Y. H., R. Crassard, J. I. Rose, J. M. Geiling & V. I. Usik
2016 "Technological Homogeneity within the Arabian Nubian Complex: Comparing Chert and Quartzite Assemblages from Central and Southern Arabia", *Journal of Lithic Studies*, 3(2): 411-437.

Hume, G. W.
1976 *The Ladizian: An Industry of the Asian Chopper-Chopping Tool Complex in Iranian Baluchistan*. Philadelphia: Dorrance.

Mercader, J., T. Bennett & M. Raja
2008 "Middle Stone Age Starch Acquisition in the Niassa Rift, Mozambique", *Quaternary Research*, 70: 283-300.

Mourre, V.
2004 "Le débitage sur enclume au paléolithique moyen dans le sud-ouest de la France", In *Le Paléolithique Moyen*, P. Van Peer, D. Bonjean & P. Semal (eds.), Acts of the XIVth UISPP Congress, University of Liège, BAR S1239, pp. 29-38.

National Geographical Organization
2004 *National Gazetteer of the I.R. of Iran Hormozgan Province: Minab Township*. Tehran: National Geographical Organization Publication (in Farsi).

Pargeter, J. & P. de la Peña
2017 "Milky Quartz Bipolar Reduction and Lithic Miniaturization: Experimental Results and Archaeological Implications", *Journal of Field Archaeology*, 42(6): 551-565.

Pargeter, J. & J. Hampson
2019 "Quartz Crystal Materiality in Terminal Pleistocene Lesotho", *Antiquity*, 93(367): 11-27.

Petraglia, M. D., N. Drake & A. Alsharekh
2009 "Acheulean Landscapes and Large Cutting Tools Assemblages in the Arabian Peninsula", In *The Evolution of Human Populations in Arabia: Paleoenvironments, Prehistory and Genetics*, M. D. Petraglia & J. I. Rose (eds.), Dordrecht: Springer Science + Business Media B. V., pp. 103-116.

Rapp, G.
2009 *Archaeomineralogy*, 2nd ed., Springer-Verlag Berlin Heidelberg.

Regard, V., O. Bellier, J.-C. Thomas, D. Bourlès, S. Bonnet, M. R. Abbassi, R. Braucher, J. Mercier, E. Shabanian, S. Soleymani & K. Feghhi
2005 "Cumulative Right-Lateral Fault Slip Rate Across the Zagros-Makran Transfer Zone: role of the Minab –Zendan fault system in accommodating Arabia-Eurasia convergence in Southeast Iran", *Geophysical Journal International*, 162 (1): 177-203.

Rose, J. I.
2010 "New Light on Human Prehistory in the Arabo-Persian Gulf Oasis", *Current Anthropology*, 51 (6): 849-888.

Thibault, C.
1977 *Préhistoire de la région de Minab (Iran).* Rapport dact., Institut de Préhistoire et de Géologie du Quaternaire, Université de Bordeaux 1, Talence.

Wenk, H.-R. & A. Bulakh
2004 *Minerals*, Their Constitution and Origin, Cambridge University Press.

Zarei, S.
2015 *Lithic Industries of the Pleistocene Communities in Minab Plain, North of Hormuz Strait (Revisit on the Assemblage of C. Thibault Survey, 1977).* M.A. thesis, Zahedan: University of Sistan & Baluchestan (unpublished) (in Farsi).

2019 "Paleolithic Researches in Northern Persian Gulf and Oman Sea: New Finds in Hormozgan", In T*he 7th International Congress of Young Archaeologists - Abstracts*, H. Khosheghbal & A. Aarab (eds.), Tehran: University of Tehran, RICHT, ICAR, p. 262 (in Farsi).

n.d. "The Pleistocene Occupations of the Northern Littoral of Strait of Hormuz and Oman Sea: Revisiting Lithic Collection of Thibault's Survey in Hormozgan, 1977", In *The Pleistocene Archaeology of Zagros, and the Neighbouring Regions*, F. Biglari, S. Shidrang & M. Mashkour (eds.), National Museum of Iran (in press).