Prehistoric Interactions with the Rocky Landscape in Sara Southeast of Ha'il, Northern Saudi Arabia: Archaeological Site Settings and Contexts

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[The region of Ha'il in northern Saudi Arabia is identified as a key area of prehistoric variabilities in landscape and context; however, the dearth of direct field study keeps some parts unexplored. To address these issues, our team conducted an archaeological survey on a rich and unstudied district in Sara area, brimming with prehistoric sites. This paper aims to discuss the variabilities of prehistoric group interactions with local landscape based on the environment diversities during Middle Pleistocene and Holocene. Data was collected from a focused archaeological survey in Sara, 60 km southeast of Ha'il. Nine new archaeological sites presented variable evidence of hunter-gatherers and pastoral groups interactions. Therefore, the data recovered from this area provided a fresh perspective on Paleolithic, Neolithic, and Iron Age sites from the basaltic fields landscape, offering new insights into the Ha'il region's heritage and presenting a promising potential for long-term research on prehistoric archaeology.]

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1. *Introduction*

Prehistoric archaeology in Arabia has expanded rapidly following major discoveries that underscore the region's importance to Southwest Asian prehistory. Arabia preserves evidence for the dispersal of *Homo-erectus* and *modern human* migrations out of Africa during the Middle and Late Pleistocene (800–20 ka), marked by Acheulean and Middle Paleolithic traditions, followed by Neolithic (agro)-pastoral communities and Bronze Age villages during the sixth–first millennia BCE (Alasmari 2019; Andreae *et al*., 2020; Groucutt *et al*., 2021; Guagnin *et al*., 2023; McMahon *et al*., 2024; Parker, 2010; Stewart *et al*., 2024).

Recent discoveries of Holocene stone monuments-mustatils, pendants, kites, and large walls have prompted new research into environmental adaptation and landscape use (Kennedy *et al*., 2023; Nassr *et al*., 2023a; Thomas *et al*., 2025; Wasse *et al*., 2024). Rock art sites featuring life-sized depictions of camels, cattle, and wild fauna illuminate Holocene pastoralist lifeways (Charloux, 2018; Guagnin *et al*., 2025). Paleoenvironmental remains from ancient rivers and lakebeds offer crucial data on climatic shifts, though their scarcity underscores the need for further study (Groucutt *et al*., 2021; Stewart *et al*., 2020). Research progress has been hindered by a lack of stratified sites and organic material preservations, erosion, desertification, and modern disturbances of archaeological sites, which together obscure site chronologies and paleo-environment reconstructions (Bailey *et al*., 2015; Crassard *et al*., 2013; Guagnin *et al*., 2022). Hence, there are many large areas that remain unexplored, posing numerous outstanding questions.

The Ha'il region has yielded numerous prehistoric and paleoenvironmental remains, particularly in the Jubbah Basin and Nefud Desert (Fradley *et al*., 2022), but extensive areas –especially volcanic mountains and basaltic fields (rocky districts) southwest of Ha'il– remain largely unstudied. Despite extensive discoveries of prehistoric sites in this region there is a dearth of chronology, general distribution maps, along with the scarcity of discussion the human interactions with environment diversities.

Ha'il lies within the extension of exposed Pre-Cambrian rocks (Arabian Schield), composed of volcanic and plutonic rocks, dominated by the Aja and Salma Mountain ranges (Ali *et al*., 2022). The northern and western parts of Ha'il are an extension of the Nefud Desert, where Pleistocene and Holocene sediments documented with full of prehistoric remains (Breeze *et al*., 2017). These parts have been greatly affected by geological and environmental hazards, including sand shifts and erosion of sandstone outcrops (Hereher, 2016). The southern and eastern parts of Ha'il, where the present study area is located, are defined by extensive basaltic fields (*harrat*) with scattered volcanic highlands, granite hills, and alluvial plains (Al-Sehly *et al*., 2017).

This study explores a new area within these rocky fields, mainly basaltic, beyond the well-known Nefud Basin to offer a fresh perspective on Ha'il's prehistoric landscape, clarifying how topography, raw materials, and environmental factors shaped prehistoric settlement patterns in northern Arabia.

2. *An Overview of Pleistocene and Holocene Archaeology in the Region of Ha'il*

Ha'il possesses a rich record of Quaternary and prehistoric archaeology spanning the Acheulean, Neolithic, and Bronze Age periods (Macholdt *et al*., 2018; Scerri *et al*., 2021). Early surveys identified major rock art sites such as Jubbah, Shuwaymis, Yatib, and Shamli offering insights into Holocene environmental change and human adaptation (Anati, 1968; Jennings *et al*., 2013). Subsequent research has greatly expanded knowledge of the region's prehistoric landscapes (Nassr and Elhassan, 2020; Orbaşli, 2013; Petraglia, Breeze, and Groucutt, 2019; Shipton *et al*., 2018).

The Jubbah Basin has yielded numerous prehistoric sites. Paleolithic sites with Acheulean traditions occur along paleolake margins (Scerri *et al*., 2015; Scerri *et al*., 2021), some associated with Middle to Late Pleistocene deposits. Its varied landscape, including mountains, paleolakes, depressions, sabkhas, and dunes (Groucutt *et al*., 2014), suggests strong potential for further Pleistocene discoveries.

Despite numerous Paleolithic sites, large areas remain unexplored and lack stratified material or absolute dating. Only a few Jubbah sites have OSL-dated layers, though organic remains are absent (Groucutt *et al*., 2021). Most excavated assemblages show Middle and Late Acheulean characteristics. The Nefud Desert has yielded extensive Pleistocene archaeology, highlighting Acheulean expansion from central to northern Arabia during the Middle Pleistocene, with fossils and footprints associated with Paleolithic artifacts (Breeze *et al*., 2017). Volcanic landscapes near paleolakes, such as at An Nasim (MIS 9; 337–301 ka), attracted early occupations (Scerri *et al*., 2021).

The Middle Paleolithic is well represented in Jubbah, where Levallois industries contribute to understanding human dispersal and climate-driven adaptations (Jennings *et al*., 2016; Scerri *et al*., 2021). Several sites dated to MIS5 (211–75 ka) display Levallois technologies with stratified deposits and occasional faunal remains. Blade lithic production from late Middle Paleolithic and early Neolithic contexts suggests a transitional Epipaleolithic phase. Paleolithic records from Al Maraat Basin and Khall Amaysham 4 (KAM4) also provide key insights into the Middle Paleolithic.

Neolithic sites across multiple locations (fig. 1) reveal rich material spanning from the Pre-Pottery Neolithic to the Iron Age (Breeze *et al.*, 2015; Hilbert *et al.*, 2014). Holocene Paleoenvironment and archaeology studies of lithics, deposits, and rock arts highlight pastoral lifeways, plant and bone processing, and pigment use (Guagnin *et al.*, 2023; Lucarini *et al.*, 2023). Discoveries include the remains of hearths, animal bones, life-sized rock engravings of camels and Arabian oryx, and large stone structures such as pendants, mustatils, and hunting traps (Groucutt *et al.*, 2020; Guagnin *et al.*, 2025; Kennedy *et al.*, 2023; Nassr *et al.*, 2023a; Thomas *et al.*, 2021;).

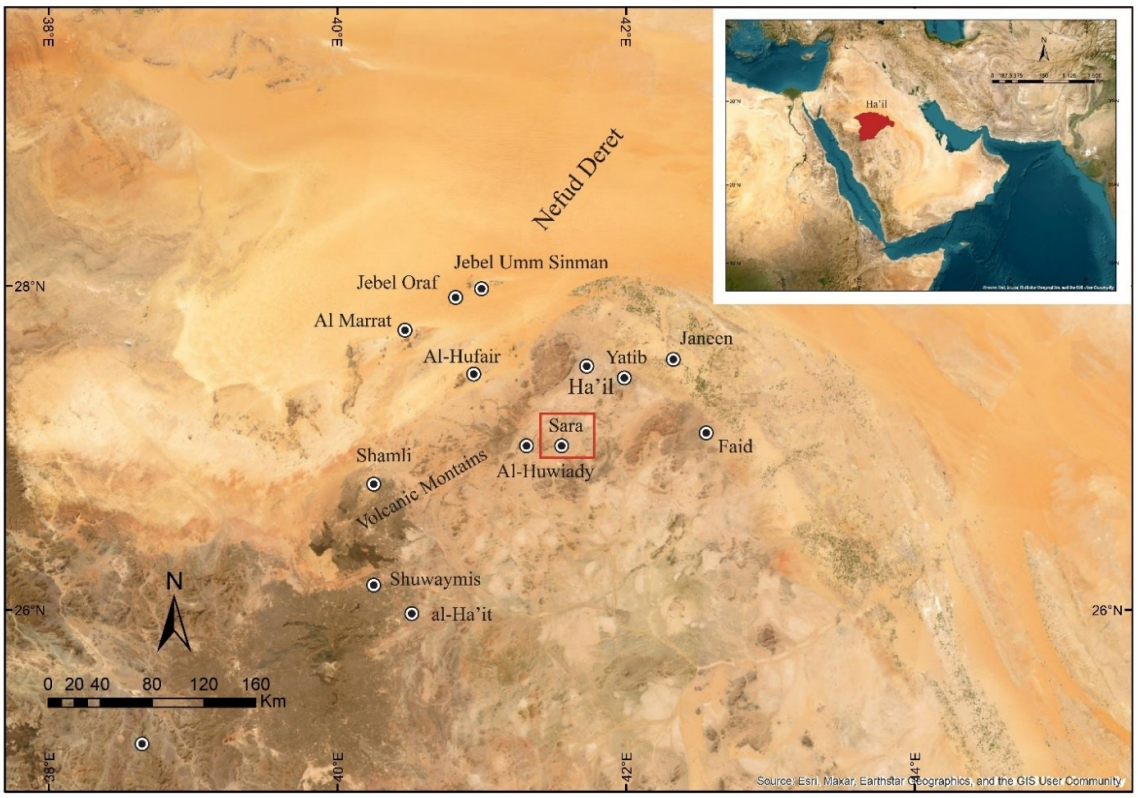

Fig. 1: The region of Ha'il landscape diversities with the distribution of the major prehistoric sites mentioned in the text, and the location of the Sara area in the southern part of Ha'il

3. *Method and Material*

The Sara archaeological district, first noted by Charles Hopper (1878) and later visited by the Saudi Heritage Commission, is one of Ha'il's major rock art areas, located about 60 km southeast of Ha'il within a rocky landscape of mountains, basaltic fields (harrats), deep water channels, and open plains.

This study primarily embraces a comprehensive methodology, combining extensive desktop archaeology based on Google Earth maps, followed by a comprehensive reconnaissance survey of the area landscape to explore the targeted sites identified from satellite imagery, and a ground-based archaeological survey derived from the distribution of artifacts on the surface or archaeological features extensions. The topographical variations supported by our previous experience in the area guided us in identifying ancient water channels, rocky mounds, plains, and other landscapes where Pleistocene and Holocene sites have usually been found in northern Arabia. The aerial desktop archaeological survey in Sara revealed a large stone structure (mustatil) along with several pendants at the foot of volcanic mountains. These were the principal features that prompted the archaeological surveys in this area. Resultantly, the ground surveys carried out to

investigate the topographical aspect, encompassing the presence of kites, stone structures, isolated mounds near oases or inactive water channels, and foothills of mountains.

The ground archaeological survey, carried out in May 2024, started by visiting the targeted areas to document all the noteworthy archaeological features, including stone structures or any outstanding antiquities, rock arts, knapped rocks, and surface artifacts. The archaeological site is identified according to the quantity and quality of finds on the surface, such as groups of stone structures accumulated in an area less than three km, rock arts in mountains, or lithic distribution averaging more than 20 lithics within an area of 100 m². All recovered archaeological and paleo-environment materials were documented in the field. The discoveries were recorded by describing their setting within the archaeological site, conditions, measurement, landscape, and location from primary or secondary positions. The small artifacts, including lithics, were documented by metric measurements and descriptions in the field and subsequently returned to their original position on the site using handheld GPS (Global Position System) devices. Lithics classification based on the core reductions and flake size and scar shape, whereas the Acheulean identified based on the presence of mode 2 including bifaces and large cutting flakes or cores, deep flake scars and the form from lanceolate tool shape and pointed ends. As well as worked buts and cutting edges. The Middle Paleolithic recognized by the presence of mode 3 from prepared Levallois cores, cutting round edges, and points. These criteria compared to the Paleolithic context in northern Arabia (Rose, 2022; Shipton *et al*., 2018).

Comparison study with Pleistocene and Holocene archaeology in Arabia carried out to classify the archaeological sites and presenting the major characteristics and their significance for long term research of Quaternary.

The survey identified nine archaeological sites (fig. 2; table 1) representing diverse contexts and chronologies. Sara 1 contains large mustatils and pendants with scattered Holocene lithics, indicating Neolithic occupation comparable to sites in AlUla and Khaybar (Kennedy *et al*., 2025). Sara 2, 3, 5, 6, and 7 yielded Acheulean and Middle Paleolithic artifacts similar to Jubbah Basin traditions (Groucutt *et al*., 2014). Sara 4 features rock art panels and Thamudic inscriptions from the Late Holocene, depicting Nubian ibex, camels, birds, and lions, belonging to Phase VI schematic human and animal figures with geometric motifs and early Arabian script (Khan, 2013). Sara 9 includes pendants and stone-ring structures resembling Bronze Age features at al-Ha'it and AlUla (McMahon *et al*., 2024).

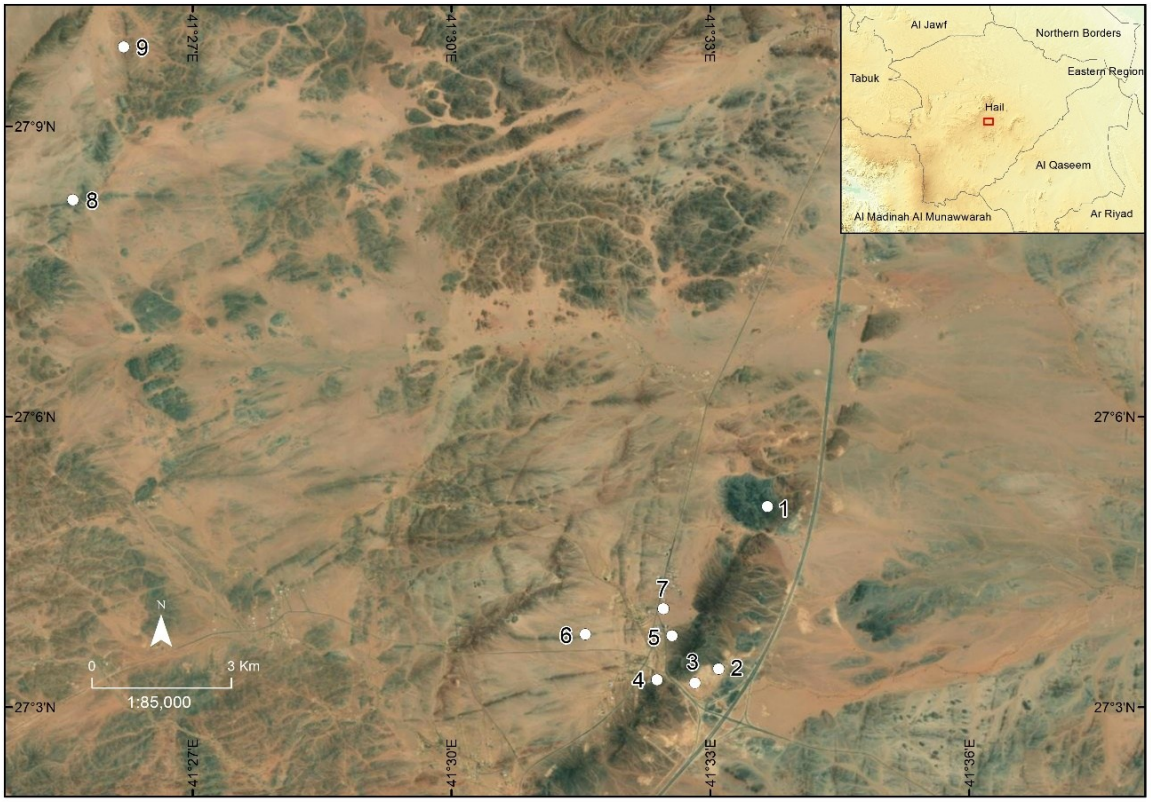

Fig. 2: The new archaeological sites discovered by ground archaeological survey in Sara area (sites Sara 1 – 9)

Surface lithics selected for meteric measurements in the field reveal Acheulean and Middle Paleolithic activity, dominated by Acheulean Mode 2 tools -handaxes, knives, cores and flakes, and Middle Paleolithic Levallois cores and flakes, consistent with finds from Jubbah, Al-Huwaidy, and Faid (Scerri *et al*., 2021; Nassr *et al*., 2022).

The variety of stone structures suggests Neolithic and Bronze Age occupations, consistent with recent Holocene discoveries across northern Saudi Arabia (Dalton *et al*., 2022; Hatton *et al*., 2024; Kennedy *et al*., 2025; McMahon *et al*., 2024). The rock art highlights Sara's importance making it comparable to UNESCO-listed sites at Jubbah and Shuwaymis (Jennings *et al*., 2013; Ramadan *et al*., 2022).

Site ID	N	E	H	Size (LXW meters) / survey area	Artifact / structures distributions	Date Proposed	Diagnostic finds
Sara 1	27º 04' 22.8''	41° 33' 55.5''	1145	600x400	2 structures in 100 m²	Neolithic	Mustatil
Sara 2	27° 03' 24.9''	41° 33' 13.7''	1137	200x200	20 artifacts in 100 m²	Middle Paleolithic	Levallois points
Sara 3	27° 03' 11.3''	41° 32' 55.2''	1147	300x250	25 artifacts in 100 m²	Lower and Middle Paleolithic	Bifaces and Levallois cores
Sara 4	27° 03' 16.6''	41° 32' 29.9''	1165	300x250	10 rock arts units in 5 m²	Iron Age	Depictions and Thamudic rock arts
Sara 5	27° 03' 40.1''	41° 32' 36.6''	1184	400x250	20 artifacts in 100 m²	Lower Paleolithic	Bifaces
Sara 6	27° 03' 45.1''	041 31' 36.5''	1173	350x300	20 artifacts in 100 m²	Lower Paleolithic and Neolithic	Bifaces and Stone structures
Sara 7	27° 03' 59.6''	41° 32' 33.9''	1176	200x150	20 artifacts in 100 m²	Middle Paleolithic	Levallois cores and points
Sara 8	27° 08' 11.3''	41° 25' 51.5''	1239	300x300	22 artifacts in 100 m²	Lower Paleolithic	Bifaces
Sara 9	27° 09' 41.9''	41° 26' 13.6''	1240	600x400	5 structures in 100 m²	Bronze Age	Ring-stone structures and Pendants

Table. 1: archaeological sites gazetteer in Sara area

4. *Results*

4.1. *Pleistocene Archaeology*

The archaeological sites that presented Pleistocene archaeology are found mainly on the basaltic field landscapes. Five sites (Sara 2, 3, 5, 7, 8) document Acheulean and Middle Paleolithic occupation of the basaltic landscape. There are 4 sites showed Acheulean archaeology referred to Middle Pleistocene time and indicated of special interactions of the Lower and Middle Paleolithic groups with basaltic field landscapes and nearest depressions. These sites are located on crater margins between mountain series, overlooking water channels and isolated mounds covered by

basaltic outcrops, with Sara 3 representing the major Acheulean occupation on flat basaltic mounds (*harrat*) near depressions. Their geology comprises Precambrian igneous and metamorphic rocks of the Proterozoic Arabian Shield with Phanerozoic sedimentary outcrops (Ali and Alshammari, 2021).

Acheulean sites consist of extensive handaxes, cores, flakes, and knives across basaltic mound surfaces and outcrop margins along inactive water channels. Lithic distributions vary from concentrations to scattered single finds (fig. 3). Wadi erosion has displaced artifacts near depression margins, indicating environmental changes and long-term desertification. The sites are open-air Paleolithic occupations resembling the landscape of the Paleolithic site found at Al-Huwaidy (Nassr *et al*., 2022). The lithics were made from relatively fine-grained local basalt and cherts, exhibiting typical Acheulean characteristics, which are well known in Paleolithic sites in Al Marrat and Jubbah basins (Groucutt *et al*., 2021; Shipton *et al*., 2014). Surface lithics are highly weathered, though flakes from recent shafts show fresh surfaces with original patina, while lithics in channel profiles suggest possible stratified Acheulean material.

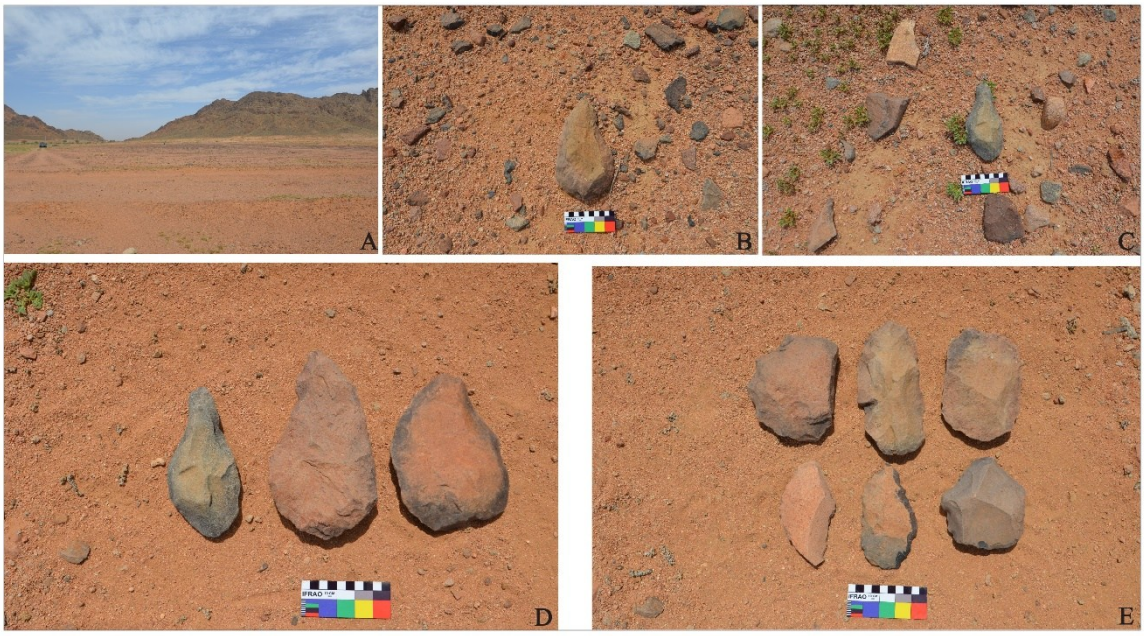

Fig.3: Sara 3 Paleolithic site: A) General view looking east, B-C) Different types of Handaxes in eroded (secondary) position, D: Acheulean handaxes of varying sizes and raw materials, E) Acheulean and Middle Paleolithic artifacts different in size, flaking scars, and presence of retouched edges

The assemblage is dominated by handaxes of varying sizes and cores for producing large cutting tools (LCTs) with multiple flake removal scars on facetted and cortical platforms. Handaxes-ovate, foliate, and typical types-as well as knives and scrapers reflect intensive workshop activity (fig. 4), comparable to sites at Al-Huwaidy and Faid (Nassr *et al*., 2023b; Nassr *et al*., 2025). Lithics made from fine-grained local basalt and chert exhibit typical Acheulean characteristics known from Al Marrat and Jubbah basins (Groucutt *et al*., 2021).

Fig.4: Acheulean handaxes, scrapers, and knifes, with Middle Paleolithic cores (lower row) from Sara 3, showing lithic diversity and weathering

At Sara 3, Acheulean and Middle Paleolithic artifacts co-occur. The assemblage comprises approximately 85% Acheulean (Mode 2) tools and 15% Middle Paleolithic (Mode 3) artifacts-Levallois and Mousterian points and flakes. On average, every 20 artifacts include 10–12 handaxes, 7 flakes or cores, and 2–3 Middle Paleolithic pieces. Technological and typological features suggest Middle to Late Acheulean and early Middle Paleolithic dating (table 2). Large cutting bifaces from Sara 8, characterized by convergent/semi-convergent tips, cutting edges, thick butts, and deep flaking scars, indicate hard hammer percussion on local basalt blanks and pebbles (fig. 5). Sites Sara 5, 7, and 8 provide additional evidence of Acheulean occupations involving hunting and raw material gathering in basaltic fields and can be compared to those from Nefud (Scerri *et al*., 2021).

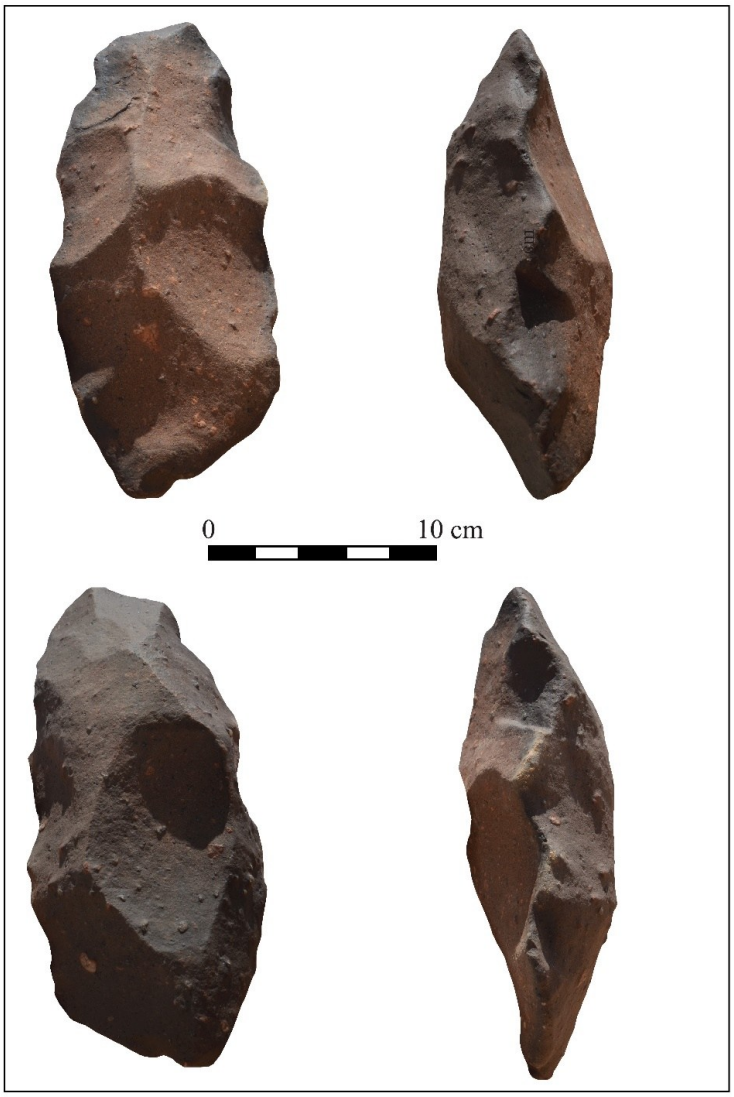

Fig.5: Weathered large cutting handaxe from Sara 8 showing the flake scars on basalt

Sara 2 represents Middle Paleolithic occupation. The site comprises small basaltic mounds with isolated sediment mounds along the main Sara water channel. Past earthworks revealed paleo-soil deposits and bedrock 3–4m below surface. The surface and channel profiles contain Middle Paleolithic points, flakes, and cores made from chert, rhyolite, and quartz (fig. 6).

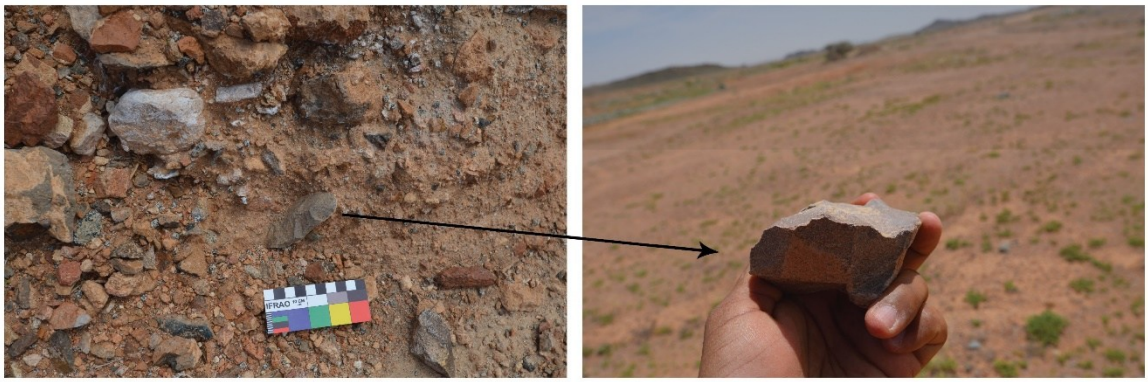

Fig. 6: Middle Paleolithic core discovered at 50 cm depth in water channel profile, buried by clay and sandstone, indicating possible stratified material

A notable find includes a finely flaked biface with pointed end, worked with soft hammerstones, featuring sharp edges and concave shape resembling foliate handaxes (fig. 7) uncommon in Ha'il but similar to late Acheulean productions at An Nasim and western Nefud (Breeze *et al*., 2017).

Fig. 7: Finely flaked biface discovered at the site of Sara 2 indicates of late Acheulean and Early Middle Paleolithic tradition in the site

4.2. *Holocen Archaeology*

Holocene sites (Sara 1, 4, 6, 9) occur within basaltic field landscapes. Mustatils, pendants, rock arts, and lithics indicate diverse occupation types during Late Prehistory and Iron Age: settlements, small camps, mass hunting traps, and necropolises. Small circular or oval stone structures suggest the area was occupied during the Neolithic period as temporary hunter camps similar to Neolithic sites at Jubbah (Jebel Oraf; Guagnin *et al*., 2023). The survey targeted basalt dykes and water channel margins (fig. 8).

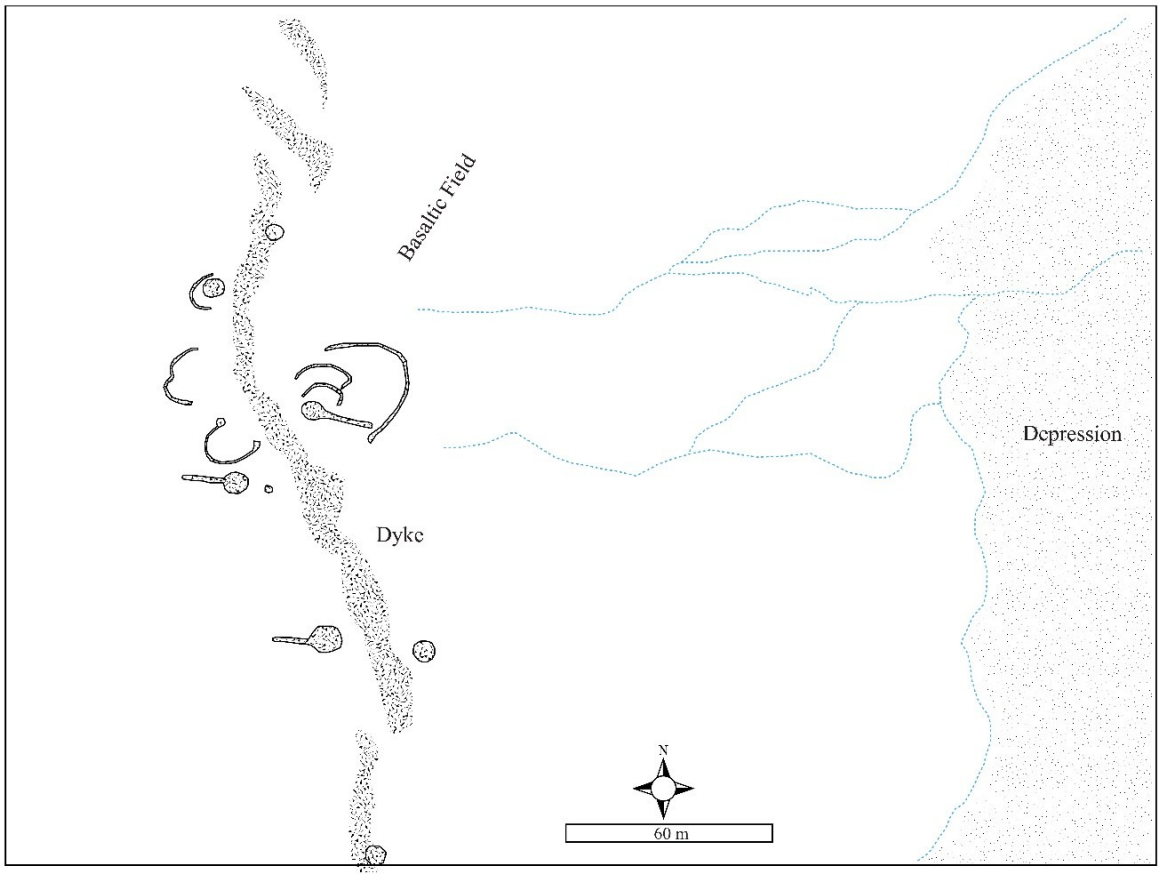

Fig. 8: Survey area at Sara 9 showing different types of stone structures and pendants scattered along the dyke and basaltic field, lithic distributions on the margin of water channels and depression

Sara 9 contains approximately twelve monumental stone structures along two kilometers, including pendants, tumuli, stone-ring structures, and rocky walls (fig. 9). Pendants vary in size with the largest having a 17m tail and 9m diameter tomb and the smallest a 7m tail and 4m diameter head. All structures use local large basalt rocks. Stone-ring structures and walls near pendants may represent dwelling remains or small hunting traps. these structures resemble Neolithic and Bronze Age sites across the Ha'il region, particularly Jubbah and al-Ha'it (Groucutt *et al*., 2020; Nassr *et al*., 2023a; Thomas *et al*., 2025).

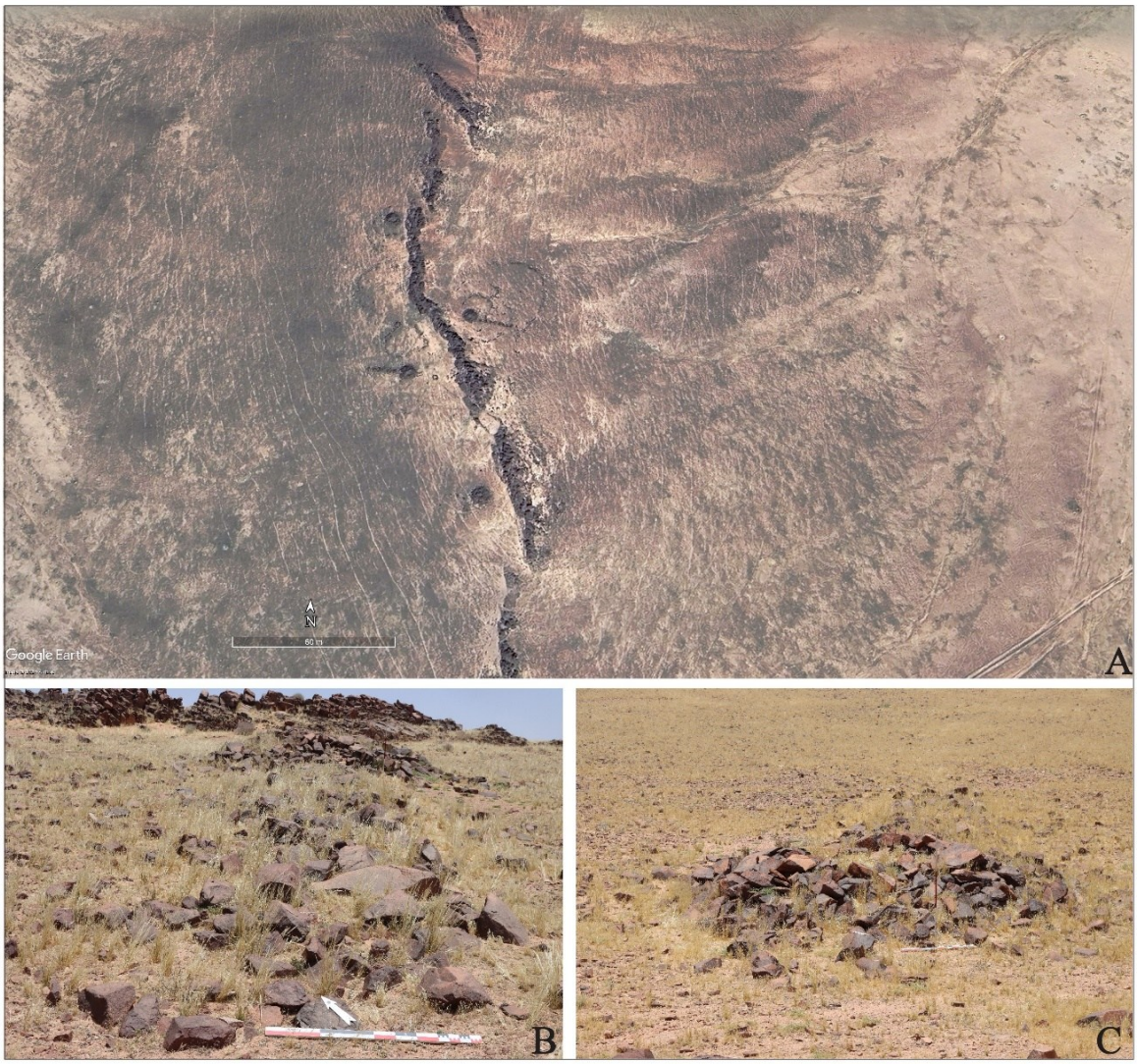

Fig. 9: Stone structures at Sara 9: A) Aerial view showing pendants and structures (Google Earth), B) Pendant tail constructed from local basalt, view from south, C) Intact pendant head, view from north

Sara 1 is set amidst high volcanic mountains, deep water channels, and wide flat plains. A large mustatil constructed from local basalt extends from mountain top to inactive water depression edge, covering 17,931m² and measuring 380m long with varying width (63m mid-section, 20m at platforms). Platforms feature small stone-ring structures resembling towers or hunter-trap rooms. Walls measure 2–4m wide and 30–50cm high (figs. 10–11). This mustatil resembles structures at Jubbah, Al-Hufair, al-Ha'it, and AlUla dated to Neolithic and interpreted as hunting, herding, and ritual structures (Kennedy *et al*., 2023; 2025).

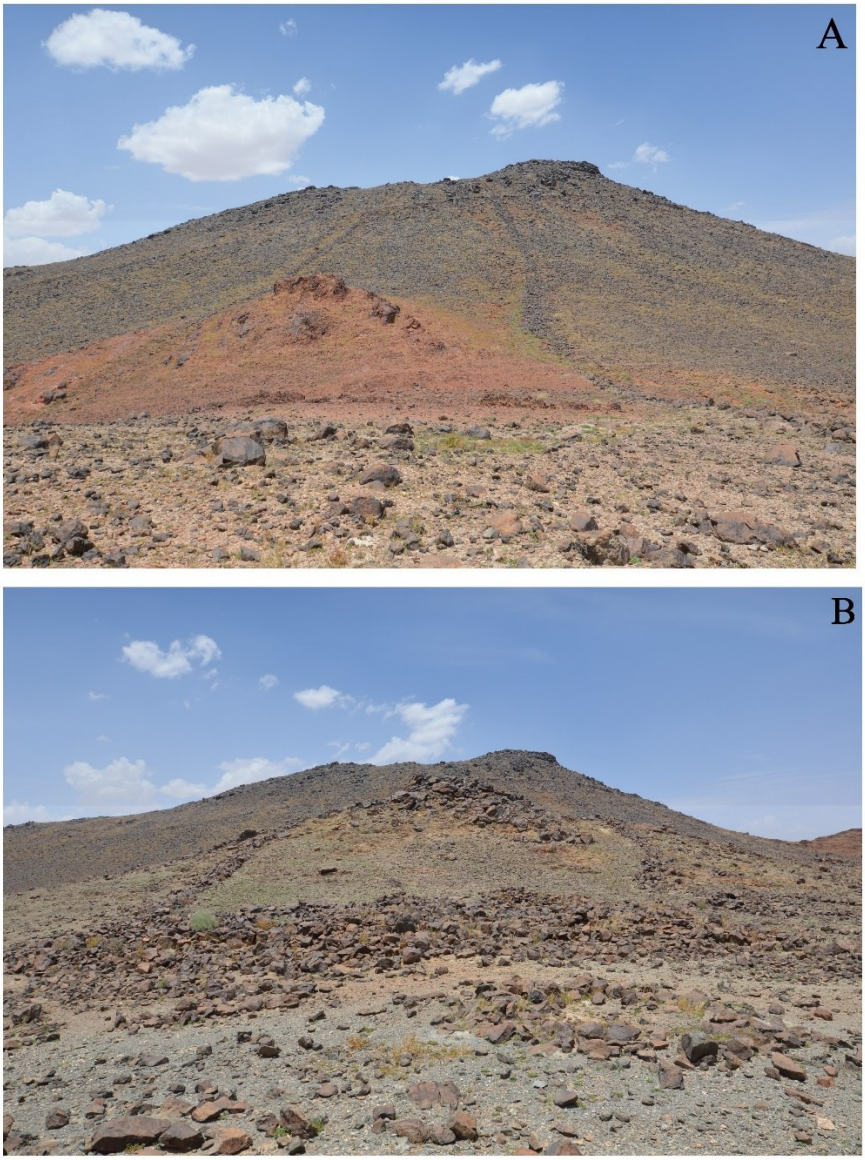

Fig. 10: Mustatil at Sara 1: A) Western section on mountain top, B) Eastern section descending to lower area and eastern platform

A large guiding wall located 160m south comprises two platforms covering 755.99m². It is comprising two large platforms, one opening into the mountaintop and the second leading to an oasis bed. Its design is comparable to constructed dams and large-scale hunting traps.

Comparing the form of guiding wall is resembling meandering kites in northern Arabia and Jordan, which is interpreted by previous research as the earliest type of kite, which was developed into the bag kite type and later to the star shape kite (Betts and Burke 2021; Fradley et al. 2022).

Additionally, this site is further enriched by several other stone structures, including pendants and remnants of oval and ring-stone structures with scattered of lithic artifacts. However, most of them have suffered significant damage over time.

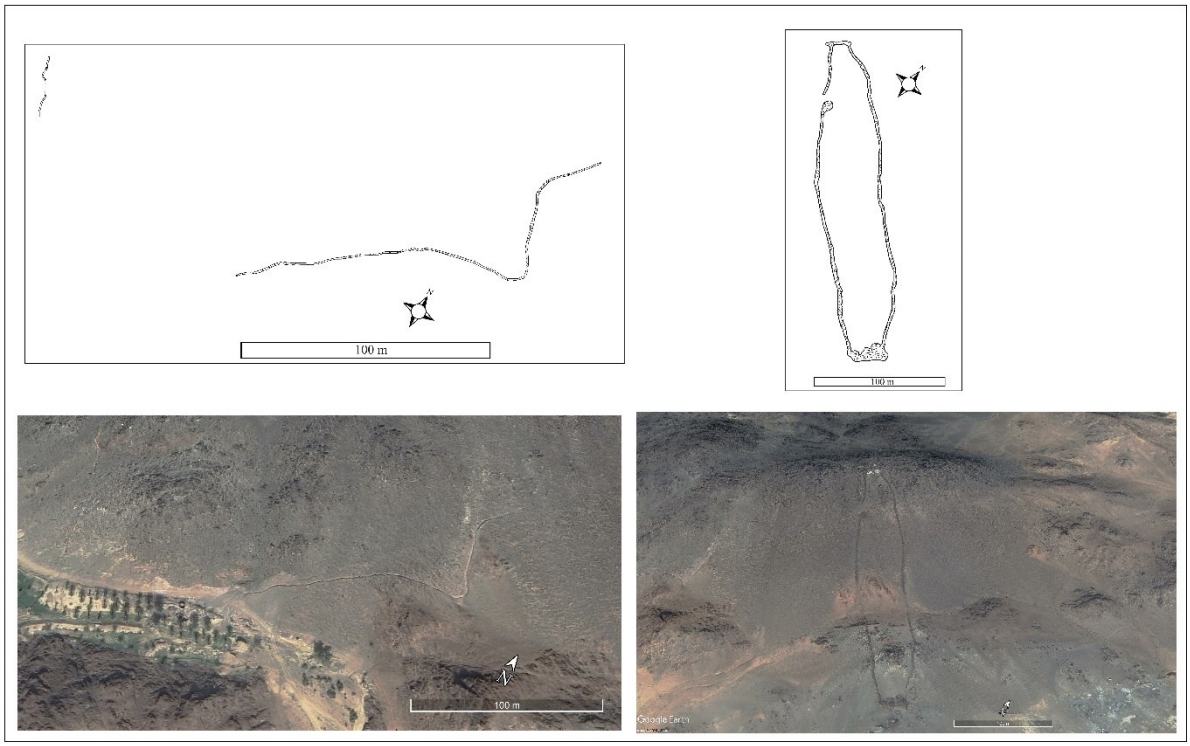

Fig. 11: The monumental stone structure (mustatil) and wall found at the site of Sara 1

Sara 4 contains over 30 rock art panels across the mountainside, comprising Thamudic inscriptions and depicting camels, Nubian ibexes with stripey coats and swept-back horns, Arabian oryx, birds, dogs, humans, and lions (fig. 12). Nubian ibex depictions resemble Iron Age rock art from Jubbah Basin (Jennings *et al*., 2013). Multiple Thamudic inscription panels appear, some covered by sandstone boulders. Notable is a lion depiction visible from a distance facing the mountain's northern side, accompanied by camel and Arabian oryx engravings (figs. 13–14). The rock art distributions indicated repeated occupation of the area. Multiple panels of Thamudic inscriptions with vertical and horizontal lines cover part of the animal rock arts; however, many of them have been damaged by erosion and sandstone boulder collapse. These traditions date to the Iron Age and resemble rock art at Jubbah, Shuwaymis, and al-Ha'it, suggesting shared artistic heritage (Khan, 2013; Guagnin *et al*., 2023).

Fig. 12: Sara 4: A) General view from north, B) Sara wadi landscape from mountain top, C) Nubian Ibex depictions of varying sizes, D) Rock art panels distributed across mountain, view from north

Fig. 13: Rock art diversity at Sara 3: A) Nine-line Thamudic inscription, B) Lion, camels, Arabian oryx and ibex depictions

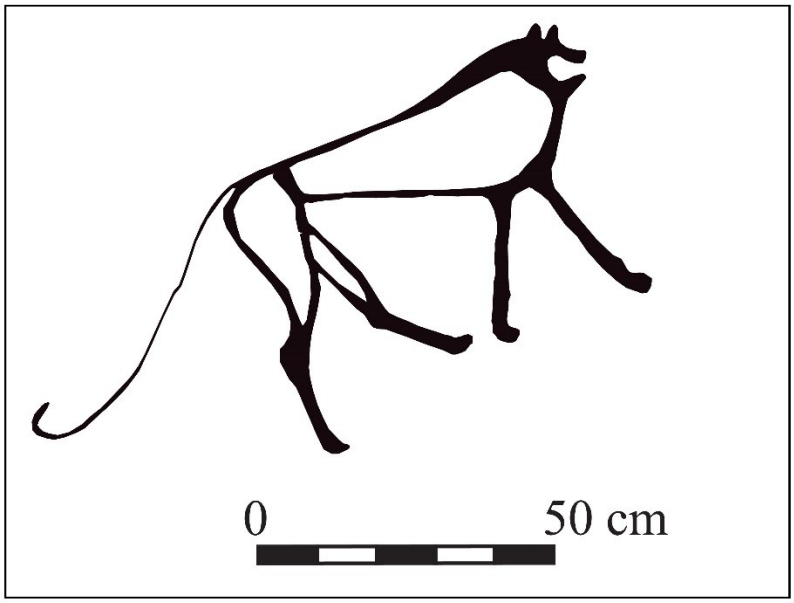

Fig. 14: Lion of Sara – the area's most prominent rock art

5. *Discussion*

The Sara survey significantly expands the archaeological record of the Ha'il region, revealing that prehistoric occupation extended well beyond the sedimentary Nefud Desert into the volcanic and *harrat* landscapes.

Paleolithic sites cluster strategically along ancient water channels and at the foot of basaltic fields, where access to water and raw materials supported sustained settlement and tool productions. The dense surface scatters of stone tools, cores, and flakes suggest these locations functioned as workshop areas for tool manufacture, hunting activities, and daily tasks. The assemblage is dominated by Acheulean traditions, particularly at Sara 3, where extensive exploitation of local basalt and chert is evident. Large bifaces and LCTs were produced from basalt cobbles using multiple platforms and hard-hammer techniques. The typology –typical, ovate, and foliate handaxes– supports a Middle to Late Acheulean attribution (400–200 ka), comparable to assemblages from Jubbah, Nefud desert, Saffaqah in northern and central Saudi Arabia (Shipton *et al*., 2018; Scerri *et al*., 2018) and Paleolithic archaeology in Jordan (al-Nahar & Clark, 2009). The Acheulean tradition at Sara reveals the important role of local raw material in shaping lithic technology. The presence of large cutting tools and cores is distinct from those previously known in the Jubbah basin and Nefud desert, reflecting how the coarse grain structure and large cobble size of basalt enabled production of robust cutting tools through direct hard-hammer percussion, highlighting Sara's unique contribution to understanding how Paleolithic groups adapted to rocky landscapes.

The co-occurrence of Acheulean and Middle Paleolithic traditions at Sara reveals gradual technological development rather than abrupt replacement, with shifts influenced by climate change and subsistence strategies. This regionally variable pattern challenges models of uniform

Mode 2 to Mode 3 progression, suggesting instead that Middle Pleistocene Arabian populations maintained flexible technological repertoires responsive to local ecological conditions (Shipton *et al*., 2014; Scerri *et al*., 2021) –a pattern observed across multiple Middle Pleistocene contexts in both Africa and Arabia (Tryon *et al*., 2005).

During the Holocene, the region continued to attract human occupation, evidenced by extensive monumental stone architecture. Mustatils, pendants, and ring structures occur across Sara 9 and nearby sites, resembling those recorded at al-Ha'it, AlUla, Khaybar, and Jubbah (Groucutt *et al*., 2020; Kennedy *et al*., 2023; Nassr *et al*., 2023a; McMahon *et al*., 2024). Typically dated to the fifth–third millennia BCE, these structures served diverse functions: funerary, hunting, ritual, pastoral, and occasionally domestic (Charloux *et al*., 2024; Kennedy *et al*., 2025;).

The Aerial Archaeology in the Kingdom of Saudi Arabia (AAKSA) project has documented approximately 800 mustatils across northwest Arabia, most interpreted as ritual sites based on faunal remains found in Mustatil chambers (Thomas *et al*., 2025), the large walls and kites interpreted as traps of mass hunting during the seasonal animal groups migrations. That is along with thousands of tombs including pendants and tumuli dated to the mid-third to early second millennia BCE. The pendants along Sara's dykes attest to Bronze Age occupation of the area, marking a significant stage in the development of Holocene monumentalism and reflecting increasing social organization and mobility among early pastoral communities.

Rock arts and Thamudic inscriptions at Sara 4 further indicate Iron Age occupation (1200–300 BCE). Engravings of Nubian ibex, camels, lions, and Arabian oryx mirror the rock art traditions of Jubbah and Shuwaymis and provide insights into symbolic expression and environmental change during the Late Holocene.

The distribution of archaeological sites reveals how the volcanic landscape shaped occupation patterns across millennia. Paleolithic groups favored the margins of depressions and basaltic slopes near ancient lakes, prioritizing access to water and lithic raw materials. In contrast, during the Holocene, Neolithic and Bronze Age groups exploited the highlands and basaltic fields for constructing hunting stone structures and mountain rock art panels, while utilizing flat plains and sedimentary mounds on the edge of depressions for other activities. Later communities constructed mustatils and pendants on elevated rocky terrain overlooking depressions, likely linked to ritual or pastoral activities.

This spatial patterning demonstrates how successive cultures –from Acheulean toolmakers to Bronze Age pastoralists to Iron Age communities– adapted to and utilized the distinctive volcanic landscape of northern Arabia. The diversity of occupation confirms that Arabia's prehistoric inhabitants were not confined to oasis environments but successfully colonized diverse ecological zones, adjusting their economic strategies, monument placement, and technological approaches to local conditions through the Middle Pleistocene to the Iron Age.

6. *Conclusion*

The archaeological discoveries in the Sara area significantly extend understanding of Quaternary archaeology in the Ha'il region, covering the Middle–Late Pleistocene and Middle Holocene. Three key contributions emerge. First, Sara demonstrates that prehistoric sites in the Ha'il region are not limited to the Nefud area but are also expanded in rocky areas. The abundance of Acheulean materials at sites such as Sara 3, 5, and 8, coupled with transitional Middle

Paleolithic elements, indicates that basaltic zones supported intensive, long-term occupation during fluctuating Pleistocene climates. Based on lithic typology and comparisons of rock arts with Jubbah, Nefud desert, Al-Huwaidy, and Khaybar, the sites likely date to the Middle–Late Acheulean (400–200 ka), Late Pleistocene Levallois tradition (60–20 ka), Neolithic–Bronze Age (sixth–third millennia BCE), and Iron Age (1200–300 BCE). The association of Middle Paleolithic artifacts with Acheulean tools implies prolonged occupation and the potential for stratified contexts. This landscape evidence suggests prehistoric expansion from the Nefud Desert into volcanic and basaltic zones, challenging previous assumptions that rocky terrains were marginal to prehistoric settlement.

Second, the coexistence of rock arts, mustatils, pendants, and hunt traps offers a valuable Holocene perspective, suggesting cultural continuity distinct from the Jubbah Basin. The diversity of archaeological phases demonstrates long-term occupation and makes Sara an important area for continued research. The spatial organization of monuments reflects sophisticated adaptation strategies and broader patterns of social complexity emerging across northern Arabia during this period.

Third, the widespread Acheulean and Middle Paleolithic materials, along with the preservation of late prehistoric stone structures, highlight the potential for refining regional chronologies. The concentration of dense artifact scatters at workshop sites such as Sara 3 suggests the possibility of stratified deposits that could yield secure stratigraphic sequences, while the distribution of monuments provides opportunities to investigate territorial organization and mobility patterns.

Future research aims to integrate stratigraphic excavation, OSL and C14 dating, and paleoenvironmental studies to reconstruct human adaptation and environmental change. Equally critical are public outreach and heritage awareness initiatives, as some sites show signs of modern disturbance. Given its rich prehistoric landscape and proximity to UNESCO World Heritage sites at Jubbah and Shuwaymis, Sara holds significant promise for advancing scientific understanding of Arabian prehistory and developing sustainable archaeotourism.

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Table. 2. Lithic classifications and metric measurements from the site of Sara 3

Lithic class	**Raw Material**		**Platform Type**		**Blank Type**		**Base (LxWxT cm) Max**	**Tip (LxWxT cm) Max**	**Mid width (cm) Max**	**Flakes removed Face 1 (Dor)- Max**	**Flakes removed Face 2 (Ven)- Max**	**Scars (LxW cm) Max**	**Cortex Max**
	Basalt	**Chert**	**Cortical**	**Faceted**	**Flake**	**Clast**							
Typical handaxes	7	3	4	6	4	6	8.5x7.4x3.8	13.5x4.5x0.8	10.4	24	16	7x5	10%
Ovate handaxes	6	2	2	6	2	6	8.9x9.9x 4.7	12.4x6.2x1.9	13.5	17	14	8x5	20%
Small handaxes	5	2		7	5	2	6.2x5.7x3.6	10.5x4.3x0.6	7.6	19	13	6x4	10%
Foliate	4	2	2	4	6		5.5x4.2x2.4	8.5x4.5x0.6	6.5	16	9	3x5	10%

handaxes													
Knives	3	4	3	4	6	1	7.5x6.4x2.5	10.4x5.6x0.8	9.5	13	8	7x4	15%
Other LCTs	8	3	6	5	8	3	11.5x9.8x5.9	13.4x7.8x3.8	11.6	10	8	8x5	30%
Levallois point	2	3		5	5		3.5x2.6x2.2	5.8x2.5x0.5	4.5	8	3	6x3	5%

Lithic class	**Raw Material**		**Size (LxWxT cm) Max**	**Flakes removed count Face 1 - Max**	**Flakes removed count Face 2 - Max**	**Scars (LxW cm) Max**	**Cortex Max**
	Basalt	**Chert**					
Acheulean Core	7	2	22.5x11.5	6	2	14x5	40%
Acheulean	6	2	18.2x9.5x3.8	4	2	9x5	30%

flake							
Scraper	7	2	16.5x8.5x3.6	7	4	8x6	30%
Disc	4	1	13.5x12.5x4.6	8	6	8x5	20%
Hammer	2		12.5x11.5	5	4	-	40%
Levallois core	4	2	16.5x11.5	8	5	9x5	20%
Levallois flake	6	3	7.5x4.3x1.5	4	2	7x4	5%