Bull. Iraq nat. Hist. Mus.
(2021) 16 (3): 231- 251. https://doi.org/10.26842/binhm.7.2021.16.3.0231

PETROLOGY AND PROVENANCE OF THE NATURAL STONE TOOLS FROM Al-DALMAJ ARCHAEOLOGICAL SITE, MESOPOTAMIAN PLAIN, IRAQ

Aqeel A. Al- Zubaidi*♦ Varoujan Sissakian** and Hassan K. Jassim***

*Department of Geophysics, Al-Karkh University of Sciences, Baghdad, Iraq.
**Department of Natural Resources Engineering and Management, University of Kurdistan Hewler, KRG, Erbil, Iraq.
***Department of Geology, College of Science, University of Baghdad, Baghdad, Iraq.
♦Corresponding author: aazubaidi@yahoo.com

Received Date: 29 Nov. 2020, Accepted Date: 23 February 2021, Published Date: 20 Jun 2021

ABSTRACT

Many stone tools were found on a hill south of the Hor Al-Dalmaj which is located in the central part of the alluvial plain of Mesopotamia, between the Tigris and Euphrates Rivers. The types of rocks from which the studied stone tools were made are not found in the alluvial plain, because it consists of friable sand, silt, and clay. All existing sediments were precipitated in riverine environments such as point bar, over bank, and floodplain sediments. The collected stone tools were described with a magnifying glass (10 x) and a polarized microscope after they were thin sectioned. Microscopic analysis showed that these stone tools are made of sedimentary, volcanic igneous and metamorphic rocks, such as: sandstones, limestones, chert, conglomerate, rhyolite, basalt, mica schist, and quartzite.

The current studied stone tools were used by ancient humans as pestles, querns, scrapers, and knives. The present study showed that these tools were transported from outside the alluvial plain of Mesopotamia. A stone tool at the archaeological site of Al-Dalmaj indicates that there were some trade routes that connected this site with its surrounding; in addition to the economic, and that might occurred cultural exchanges during the Neolithic Period.

Key words: Archeology, Mesopotamia, Neolithic, Rocks, Stone tools.

INTRODUCTION

A stone tool is any tool that is made either partially or entirely out of stone. Most of the stone tools are related to the prehistoric cultures in particular the Stone Age that are extinct nowadays (Davidson and Nowel, 2010). Archaeologists often study the stone tools as lithic

analysis, whereas Ethno archaeologists study the cultural implications of using and manufacturing of stone tools (Paul and Karen, 2015). Throughout the history, ancient human has used different types of stones to make a wide variety of different tools; such as arrow heads, spear points and querns. Stone tools of chipped type can be made from aphano-crystalline materials like chert, flint, chalcedony, obsidian, basalt and quartzite (Al-Ani, 1986). This process is called "Lithic reduction". More complex forms of reductions are blades that can be changed to different types of tools like scrapers, knives, sickles and microlith (Internet data, 2020).

The oldest discovery of stone tools belongs to the Lower Palaeolithic Period that were studied from east central Africa (Coates, 1952), then they were transported to Asia and Europe (Clark, 1961; Kottak, 2006) via Mesopotamia and other related areas during Palaeolithic Period. Ancient human collected subrounded- rounded gravels from river channels and terraces to prepare their stone tools (Waelkens, 1992). The mixing between stone tools using for grain crop cultivation and herded of sheep may refer to end of Neolithic Period (Bienkowski and Millard, 2000). Gravels and hard rocks are not available within the Mesopotamian Plain where Al-Dalmaj site is located; because the plain is covered by Holocene fluvial, deltaic, lacustrine and estuarine sediments, which comprises sands, silts, muds and clays, they range in thickness from few centimeters to few meters (Yacoub, 2011).

This study aims to identify the types of the collected stone tools; their petrology and functions which were found at Al-Dalmaj archaeological site in order to determine the source area of the stones and the trade routes that were passed through the site; and also to estimate the approximate age of the stone tools. Besides indicating whether the tools were transported to the site or the stones which were used for the construction and stone tools were transported to the site.

MATERIALS AND METHODS

Many stone tools have been found in northern Iraq (Braidwood and Howe, 1972), near Haditha Dam at Wadi Al-Fihaimi and Baijan Island (Al-Ani, 1986), at the Western Desert of Iraq; near Tel Al- Nasr (Al-Zubaidi, 2012) (Map 1); as well as in Iran (Biglari and Shidrange, 2006), and the Arabian Peninsula (Smith, 2018).

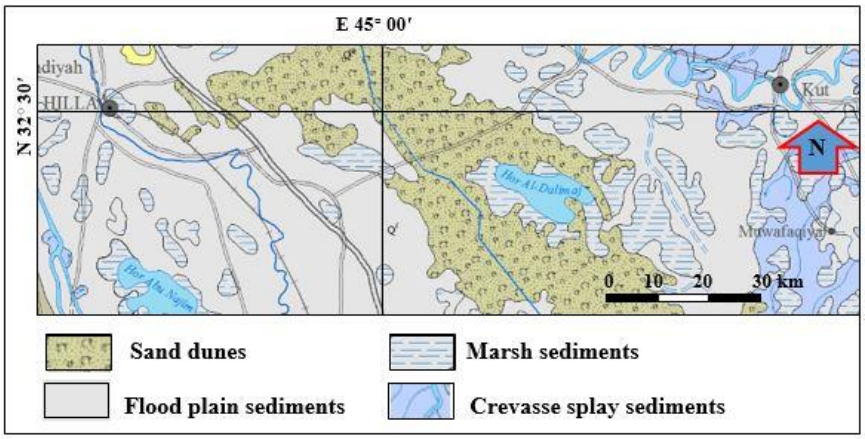
Map (1): Location map of Iraq (Encyclopaedia Britannica, 2012), and shows the approximate locations of some archaeological sites mentioned in the text are added by the authors.

The locations of most of the archaeological sites have been chosen by the ancient human depending on many aspects such as; when they provided essential daily needs of natural resources like food, water, stones to prepare stone tools, building materials and protection from any potential enemies (Eder and Patzak, 2004; UNESCO, 2008; WHC, 2008). Stone tools are very common in the Iraqi Western Desert, especially where the Umm ErRhadhuma, Akashat, Dammam and Ratgah formations are exposed. This is attributed to thick beds and/ or nodules of chert in the mentioned formations. For instance, Al-Bassam (2007) collected tens of stone tools from Ga'ara Depression and surroundings within the Western Desert; and he dated them as Palaeolithic age when ancient human used local chert to form various types of tools and weapons.

Geology

Al-Dalmaj archaeological site is located within the fluvial plains of the Tigris and Euphrates rivers that consist of silt, clay and very fine sand; with aeolian sand surrounding the site as well as Hor Al-Dalmaj. Gravels and hard rocks occur in river and valley channels,

surrounding the Mesopotamian Plain and are exposed as different stratigraphic units at the Low Folded Zone and at the Western and Southern deserts of Iraq (Sissakian and Fouad, 2012). Therefore, the rock fragments and/ or gravels found in the site means they were transported by ancient human. Structurally, the site is located in the Mesopotamian Zone; without any surface structural features (Fouad, 2012). The site is located within marsh sediments surrounded by sand dunes and flood plain sediments (Map 2).



Map (2): Geological map of Hor (Marsh) Al-Dalmaj and surrounding (After Sissakian and Fouad, 2012).

Topography

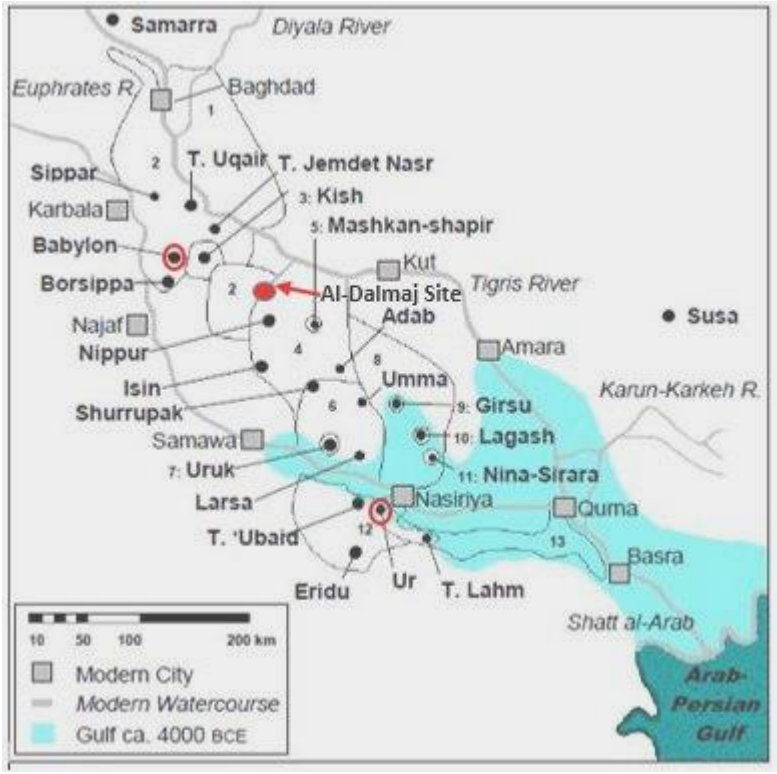
The Mesopotamian Plain is a vast low land, about 116000 km^2, surrounded by Makhoul and Himreen mountains at the northeast and east; Western and Southern deserts at the west, southwest and south; Wadi Tharthar at the northwest and Arabian Gulf partly at the south. The highest point is about 140 meters (a. s. l.) in Fatha Vicinity on the top of Makhoul Mountain, whereas the lowest point is about 1 meter (a. s. l.) in the extreme southern margin along the Arabian Gulf (Yacoub, 2011). Whereas, at the site, the elevation ranges from (13-23)m. (a.s.l.). Within this wide and flat Mesopotamian Plain, tens of hills exist almost everywhere with different heights (5-12 m.), they all are archaeological sites; locally called "Iashan", among them is Al-Dalmaj archaeological site (Pl. 1).

Plate (1): Ruins of the Al-Dalmaj Archaeological site.

Al-Dalmaj Archaeological Site

Generally, the Mesopotamian Plain is considered as the cradle of civilization in which the studied Al-Dalmaj archaeological site is located. The Mesopotamia witnessed great civilization growth at about 6200–6500 years ago. The studied Al-Dalmaj archaeological site is a hill with a height of about 10 m., and base diameter of about 1- 2 km., with a lot of pottery and stone tools scattered on the slopes and surrounding area (Pl. 2). It is located at the south-eastern part of Hor Al-Dalmaj from where it was named. According to the documents of the State Board of Antiquities and Heritage (SBAH, 2010), the site is related to the Sumerian – Islamic periods and most probably was connected between many ancient towns, such as: Ur at the south, and Babylon in the north. Ur, is located about 400 km. south of the capital Baghdad (Map 3), known as the city of Sumerian civilization and home of profit Abraham, has the first temples called Ziggurat of Ur that was built before more than 4000 years ago, which is still standing (Sissakian *et al*., 2015). Another ancient civilization to the northwest of Al-Dalmaj Archaeological Site is Babylon, about 80 km south of Baghdad (Map 3).

Different stone tools in addition to pottery fragments are scattered on the surface of a hill near Hor (Marsh) Al-Dalmaj. Ten samples were collected from the site and described; besides measuring their dimensions and identifying their functions; these samples were also thin sectioned and examined by polarized microscope, to identify their petrography, mineralogy, rock name and provenance (Tab. 1).



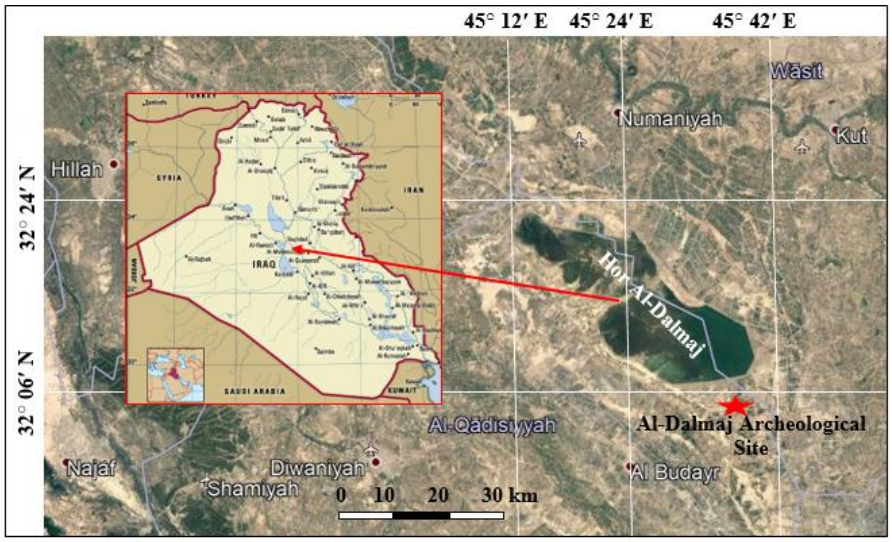
Map (3): Major archaeological sites of the Mesopotamian Plain showing some archaeological sites and hypothetical extent of the Arabian Gulf ca. 4000 B.C. (After Pournelle, 2003).

To fulfill the aims of the current study, the following materials were used:

1. Geological maps of different scales.
2. Topographical maps of 1:100000 scale.
3. Satellite images.
4. Relevant published articles and books.
5. Reviewing SBAH's (2010) documents to determine the approximate age of the study site.

Many field trips were carried out to Al-Dalmaj Archaeological Site to achieve the natural survey and sample collection. Ten samples of stone tools were collected, described and thinned sectioned, then examined petrographically and mineralogically using a polarized microscope to indicate the types of rocks from which the collected stone tools were made.

Location: The studied Al-Dalmaj Archaeological site is located near the Hor (Marsh) Al-Dalmaj within the middle part of the Mesopotamian Plain, Iraq. At the northeast is Kut City along the Tigris River and at the west is Hilla City along the Euphrates River (Map. 4). The coordinates of the studied Al-Dalmaj Archeological Site are: 32˚ 04' 31" N and 45˚ 36' 87" E.



Map (4): Google Earth image showing the location of Hor (Marsh) Al-Dalmaj and the Al-Dalmaj Archeological Site.

Occurrence and uses of stones

The ancient human in the Mesopotamia have made many stone tools; such as pestle, quern, millers and hand axe to use them for daily needs such as: grinding of wheat, hunting, attacking animals, defending from enemies, using them as knives, colored stain and others. Large numbers of stone tools were found at many archaeological sites at Mesopotamian and surrounded areas, such as: Shanidar, Zawi Chemi, Karim Shahir, Jarmo, Tel- Shamshara, Yarim Teppa, Tell- Satto, Al- Mugzaliya, Wadi Al- Fihaimi, Baijan Island and Tel Al- Nasr (Map 1). Stone tools are made from many types of rocks such as: quartzite, limestone, sandstone, gneiss, basalt, granite and chert, in addition to gravels (Braidwood and Howe, 1972; Al-Ani, 1986). From these rocks and gravels, many tools were manufactured like hand axe, pestles, millers, querns, grinders and others. These stone tools were made during the lithic Period by the ancient human (Al-Ani, 1986). The stone tolls with a lot of pottery fragments are scattered over the slopes of the hill which represents the archaeological site and near surroundings. However, the existing sand dunes (Map 2) have covered large parts surrounding the site and may be hindering a lot of details of the site.

RESULTS

Provenance (Source area)

Ten samples were collected from the site and described; besides measuring their dimensions and identifying their functions. The ten samples were also thin sectioned and examined by polarized microscope, to identify their petrography, mineralogy, rock name and provenance (Tab. 1).

According to the hand specimen and polarized microscopic study of the ten collected stone tools, the samples include sedimentary, igneous and metamorphic rocks such as: fossiliferous

limestone (mainly gastropods), quartzite, dolomitic limestone, basalt, conglomerate, rhyolite, mica schist, sandstone, and chert (Tab. 1). The studied rocks were compared with the surrounding exposed rock units and gravels of river deposits, terraces and alluvial fans to estimate the source areas from where they were transported.

Table (1): Stone tolls: Description, dimensions, functions and rock name of the stone tools collected from Al-Dalmaj Archaeological Site.

No.	Description	Dimensions (cm)	Functions	Rock names
1	It has low- middle hardness; upper surface is even with some voids resulted from gastropod chambers, while the lower surface is uneven.	12 X 9 X 5	Hand grinder may be used for grinding soft wild seeds and plants.	Fossiliferous limestone (gastropoda)
2	It is very hard stone and has wide cone shaped, the narrow end has convex surface.	12.5 X 11 X 8.5	Pestle or quern used for grinding hard wild seeds.	Quartzite
3	It is very hard stone, one side is thick may be used as a handle, while the other side is narrow like blade.	5.5 X 4.5 X 4.5	Scraper may be used to remove the fat from animals leather.	Dolomitic limestone
4	It is hard stone, part or half of oval shape with two flat sides.	5.5 X 5.5 X 4	Pestle or grinder, may be used for grinding hard wild seeds.	Basalt
5	Very hard stone, one side is thick may be used as a handle, while the other side is narrow like blade.	8.5 X 5 X 3.3	Scraper, may be used to remove the fat from animals leather.	Conglomerate
6	It is very hard stone, one side is thick may be used as a handle, while the other side is narrow with sharp end but broken.	11.5X5.6X5	Knife, may be used for cutting meet and leather.	Rhyolite
7	It is hard stone, part or half of oval shape with two flat sides.	7.5 X 6.5 X 2.7	Pestle or grinder, may be used for grinding of hard wild seeds.	Andesite
8	It is middle to hard stone, has almond or oval shaped, wide at the middle part and becomes narrow on both ends.	10 X 6 X 4	Pestle, may be used for grinding of hard seeds.	Fossiliferous limestone (nummulitic)
9	It is middle to hard stone, almond or oval shaped, wide at the middle part and becomes narrow on both ends.	9 X 5 X 3.5	Pestle, may be used for grinding plants and soft seeds.	Sandstone
10	It has dense texture, conchoidally fractured, high specific gravity and very hard (hardness = 7).	5.5 X 4 X 3.3	Scraper may be used to remove fat from animal's leather.	Chert

Description of the Stone Tools

The collected ten stone tools from Al-Dalmaj archaeological site are described hereinafter, using hand lens and polarized microscope examination.

Fossiliferous limestone (Gastropoda-rich): It is a sedimentary rock composed of micrite matrix, which includes gastropod and globigerinal foraminifera; in addition to voids. Calcite cement was observed inside the gastropod chambers. Moreover dolomite rhomb's is found, which refers to late diagenetic processes (Pl. 2). Such rocks most probably are derived from

the Cretaceous and Tertiary rock units, which are exposed at the north and north eastern parts of Iraq.

Plate (2): Stone tools of fossiliferous limestone (gastropoda), calcite cement and voids (left), thin section under polarized microscope (right).

Quartzite

Quartzite rock beds are exposed within the Khabour Formation (Cambro-Ordovicain) (Al-Juboury *et al*., 2021) north of Iraq, on the Khabour valley at Ora- Kaista anticline (van Bellen *et al*., 1959; Jassim and Goff, 2006). Quartzite gravels of the Tigris River deposits and terraces are derived from quartzite beds and were found near Qayara town, south of Mosul city (size about 50 cm) and reached to Fatha gorge along the Tigris River (size about 20 cm). Polarized microscopic study of thin section of this sample showed that the quartz crystals interlocked to each other (Pl.3) and became very hard so they were used most probably as a pestle or quern at Al-Dalmaj Archaeological Site. Quartzite rocks were used during Palaeolithic age to manufacture stone tools (Ebright, 1987). The sources of the quartzite gravels or rocks were transported most probably from Fatha and Qayara, south of Mosul and/ or from its source area at Khabour valley.

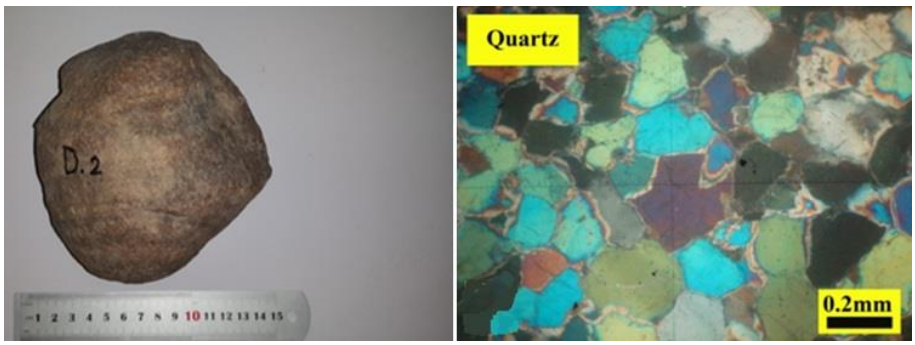


Plate (3): Stone tools of quartzite (left), thin section under polarized microscope (right), showing interlocking quartz grains with tangential contacts.

Dolomitic limestone

It is composed of micrite, which is altered to microsparite and sparite in addition to some pores (Pl.4). Pore shapes are like fossil traces; which may be resulted after dissolution of fossils (moldic porosity). Dolomitic limestone is exposed at the southern and western desert, west of Mesopotamian Plain, in addition to northeast, north, northwest of Mesopotamian Plain. Dolomitic limestone as gravels were found within the Tigris River terraces south of Mosul city and its tributaries such as: Greater Zab, Lesser Zab, Rawanduz and Sirwan rivers (north and northeast of Mesopotamian Plain) which have high contents of carbonate gravels, more than 70% of the rocks; and also occur within the BaiHassan Formation (Pliocene – Pleistocene), represent about 30% of the rocks (Al-Juboury *et al*., 2001; Jassim and Goff, 2006). In addition to gravels of ephemeral streams on the east and west of Mesopotamian Plain. Dolomitic limestone gravels were transported most probably from the river channel and terraces north and northeast of the Mesopotamian Plain; or from ephemeral streams in east and west of the Mesopotamian Plain to make a scraper and were used at the studied site.

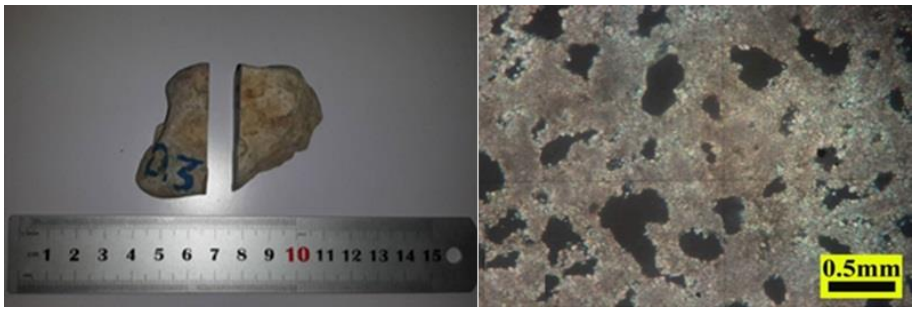


Plate (4): Stone tools of dolomitic limestone (left), thin section under polarized microscope (right), showing dolomitic limestone with common pores.

Basalt

Basalt rocks are exposed at small areas of the northeast Iraq (Buday and Jassim, 1987); Harrat Al-Sham that extends from Syria- Jordan- Saudi Arabia (Ibrahim, 1993); northeast Syria (Turkmani and Al- Shar′a, 2009); southeast Turkey and northeast Iran (Tehran *et al.*, 2010). The studied basalt is composed of glass, plagioclase feldspar, olivine, pyroxene and magnetite, in addition to large voids up to 1.5 mm (Pl. 5). Basalt of the northeast Iraq has low hardness; therefore, cannot be suitable to made pestle or other artefacts. The collected basalt sample was may transported most probably from Harrat Al-Sham source area or from Jordan, which are very suitable for pestle and grinder; or from northeast Syria or southeast Turkey there are many basalt stone tools (pestle and grinder) on Al-Dalmaj archaeological hill; they are characterized by their gray or dark gray colors (Pl.5).

Plate (5): Stone tools of basalt (left), thin section under polarized microscope (right), showing the main minerals in the basaltic rocks.

Conglomerate

It may be related to conglomerates of the Gercus Formation (Middle- Late Eocene) or Kolosh Formation, which also contains shale, mudstone, claystone and sandstone. The Gercus Formation is exposed in the Gercus region southeast of Turkey and widely in Iraq at the High Folded Zone with thickness about 850 meters near Dohuk northeast Mesopotamia (van Bellen *et al*., 1959); or may be related to the Dibdibba Formation (Pliocene – Pleistocene) or the Hussayniyat Formation (Early Jurassic) west of the Mesopotamia Plain (Jassim, 2016). The studied conglomerate stone tool is composed of chert granules (2-4 mm.) cemented by calcite (Pl. 6), and is hard enough to be used as a scraper.

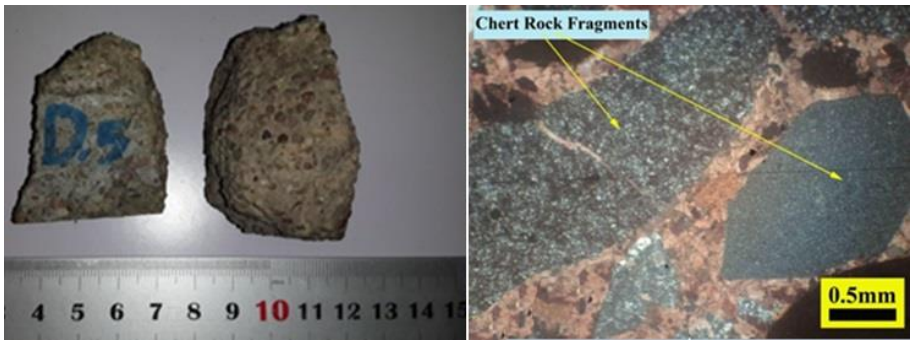


Plate (6): Stone tools of conglomerate (left), thin section under polarized microscope (right), showing chert rock fragments.

Rhyolite

Rhyolite is extrusive igneous rock occurred in the north and northeast of the Mesopotamian Plain as gravels within the Bai Hassan Formation (Pliocene – Pleistocene), channel deposits and terraces along the Tigris, Euphrates, Greater Zab, Lesser Zab, Adhaim and Diyala rivers, and also occur near the Iraqi- Iranian borders (Jassim and Goff, 2006). Rhyolite rocks are exposed at south of Turkey within Silvan Formation (Middle Miocene) and near Malatya, southeast of Turkey, located near the Euphrates River's tributary (Leo *et al*., 1978). The studied rhyolite sample is composed of phenocrystalline (quartz and feldspar) and matrix

(sanidine feldspar and glass) (Pl. 7). The studied rhyolite stone tool was transported most probably from the nearby area of gravels occurrences of the channel deposits of the Lesser Zab River or from the gravels of the Bai Hassan Formation to AL-Dalmaj site to be used as a hand axe.

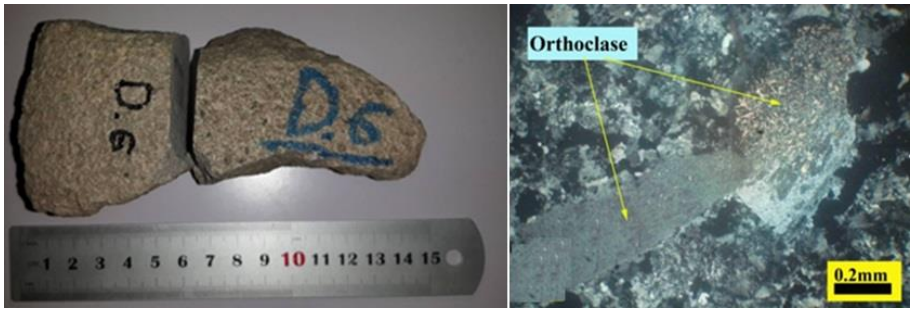


Plate (7): Stone tools of rhyolite (left), thin section under polarized microscope (right).

Andesite

Andesite is exposed at the Zagros Belt in Iran and southeast of Turkey and occurs as gravels within channel deposits of rivers and within the Bai Hassan Formation (Pliocene – Pleistocene). The studied sample consists of feldspar, quartz and rare mica (biotite and muscovite) (Pl. 8). It is intermediate igneous rock originated from cooling of the magma. The stone tool of the andesite was transported most probably from the channel deposits of rivers and/ or the Bai Hassan Formation from northeast of the Mesopotamian Plain to be used as a pestle at the studied site.

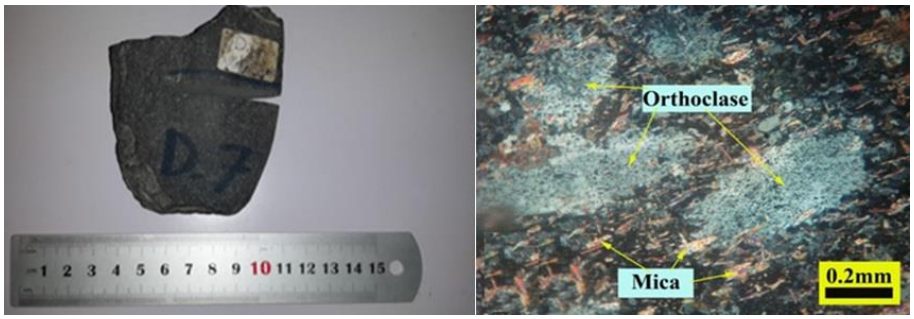


Plate (8): Stone tools of andesite (left), thin section under polarized microscope

Fossiliferous limestone (nummulite-rich)

Fossiliferous limestone beds are exposed at different areas west of the Mesopotamian Plain; such as the Dammam Formation (Eocene), Euphrates Formation (Lower Miocene), and north and northeast of the Mesopotamia Plain at the High Folded and Imbricate zones within different geological formation (Sissakian and Saed, 2012), in addition to the gravels at channel deposits of many rivers and streams located northeast and west of the Mesopotamian Plain. The studied sample is composed of micrite and microsparite, contains nummulite (Pl.9).

The collected fossiliferous limestone sample was collected and transported most probably from stream deposits west of the Mesopotamian Plain or from the other exposed area. The sample has enough hardness to be used as a pestle or other artefacts in the studied site.

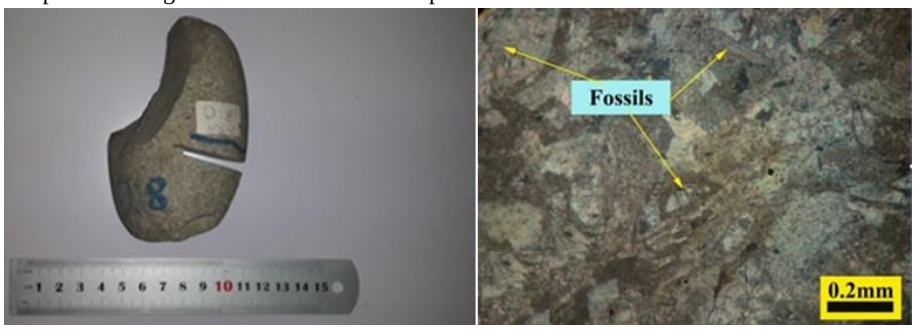


Plate (9): Stone tools of fossiliferous limestone (nummulite) (left), thin section under polarized microscope (right).

Sandstone

The collected stone tool sample is composed of cross- bedded, medium to fine grained sandstone (Pl.10). Such stone may be related to the sandstone beds of the Injana Formation (Late Miocene), which is exposed in Hamreen anticline and other folded areas northeast of the Mesopotamian Plain and it comprises sandstone, siltstone and mudstone (Buday, 1980; Jassim and Goff, 2006). The sandstone beds range in thickness from one meter to several meters. The maximum thickness of the formation reaches up to 900 meters near Kirkuk City (Jassim *et al.*, 1984). The stone tool of sandstone sample (Pl. 10) was used as a pestle and other stone tools at Al-Dalmaj site and surrounded areas of the Mesopotamian Plain.

Plate (10): Stone tools (pestle) made of sandstone

Chert

The main sources of the chert gravels in the Mesopotamian Plain are the Bai Hassan Formation (Pliocene – Pleistocene), which is exposed in Derbendikhan, south of

Sulaymaniyah City, Tag Tag anticline northeast of Erbil City; alluvial fans of Baiji-Sammaarra (North of Baghdad City), Mandli and Badra (east of the Mesopotamian Plain); channel sediments of the Tigris River and its tributaries Greater and Lesser Zab rivers (North and northeast of the Mesopotamian Plain); or from the Dammam and Umm ErRadhuma formations on the south and west of the Mesopotamian Plain. The studied gravel samples are up to cobble size (64-256 mm.); and they compose of abundant chert, carbonate rocks in addition to igneous and metamorphic rocks (Jassim and Goff, 2006). The studied chert stone tool (Pl. 11) was used most probably as a scraper and other tools at Al-Dalmaj site and surrounding areas of the Mesopotamian Plain.

Plate (11): Stone tools (scraper) made of chert.

According to the State Board of Antiquities and Heritage (SBAH, 2010) the history of the site belongs to the Sumerian – Islamic periods. In the current study; however, we have used the types of the collected and studied stone tools (Pls. 2-11), in an attempt to date approximately the age of the stone tools depending on the functions and ornamentations of stone tools. However, different colored pottery and building bricks can be seen in the site (Pls. 12, 13).

Plate (12): Ruins of Al-Dalmaj Archaeological site showing the colored pottery handles and other fragments of pottery that indicate younger age as compared to the stone tools.

Plate (13): Ruins of Al-Dalmaj Archaeological Site showing the sun dried bricks and other fragments of pottery.

DISCUSSION

Al-Dalmaj Archaeological Site was occupied by the ancient human as indicated from the studied stone tools in the site (Pls. 1-10). The involved collected ten samples of the stone tools are found to be made from different rock types which are not exposed in the site and the whole Mesopotamian Plain; since it is entirely composed of different sediments of Quaternary age (Map 2). Therefore, all those stone tools were transported from outside of the site. The stone tools; however, were made in the site or transported to the site after being shaped for different uses is a matter of debate; there is no any clear evidence for any of both mentioned alternatives.

At many location of the Iraqi Western Desert, a lot of chipped rocks were found; this may indicate that a lot of stone tools were made in situ. No such chips were seen in the studied site. However, the thick Aeolian sand dunes that cover the surrounding of the site (Map 2) most probably have hindered such chips, or they were made outside of the site and transported there. It is more likely that the stone tools were made outside of the site and transported there for their daily uses.

The stone tools made from basalt are most probably transported from Harrat Al-Sham (Syria-Jordan-Saudi Arabia), because they are the nearest locations to the site where basalt is exposed widely, in addition to using it for building and stone tools in Qasr Azraq, Jordan according to field survey. Those made from chert are most probably transported from the Southern and Western deserts because they are the nearest locations to the site where chert is exposed widely in many geological formations as beds and/ or concretions. For the stone tools made from other rock types, it is not possible to indicate from where they were transported, since such rocks are exposed surrounding the Mesopotamian Plain. Therefore, there should be different routes from the site to the source areas of the transported stone tools, which means the site was along main transportation routes.

The age of the stone tools found in the site is another aspect for debate. According to the documents of State Board of Antiquities and Heritage (SBAH) the age of the site is

determined to be Sumerian-Islamic. The presence of different type of grinder, pestle and quern, made of many rock types, in Al-Dalmaj site, such as: fossiliferous limestone (gastropoda), quartzite, basalt, andesite, fossiliferous limestone (nummulite) and sandstone may refer to using them for grinding of wheat and barley, which were obtained from cultivation. While the presence of a knife and scraper that made of dolomitic limestone, conglomerate, rhyolite and chert may be referred to using them for meet cutting and leather cleaning of sheep. According to Bienkowski and Millard (2000), the mixing between farming with grain crop cultivation and herded the sheep, in Al-Dalmaj Site, may refer to the end of Neolithic Period.

CONCLUSIONS

The current study concluded many findings such as: ancient human may have enough knowledge about the properties of rocks and how to exploit them in their daily works, particularly in pestle, quern, scraper and others. the stone tools are made of fossiliferous limestone (gastropoda-rich), quartzite, dolomitic limestone, basalt, conglomerate, rhyolite, andesite, fossiliferous limestone (nummulite-rich), sandstone and chert. Stone tools are made from different types of rocks; all of them are not exposed in the whole Mesopotamian Plain. Therefore, the stone tools were supposed to be transported from far areas out of the plain and the site was located along main transportation routes. The absence of flakes and/ or chips near the site also indicates that the stone tools were transported to the site. Furthermore, the presence of scraper referred to the abundance of sheep near the site and the presence of different type of grinder, pestle and quern, made of many rock types may refer to using them for grinding of wheat and barley, which were getting from cultivation.

Finally, the presence of knife and scraper may refer to using them for meat cutting and leather cleaning the sheep; and the mixing between grain crop cultivation and herded of sheep may refer to the end of the Neolithic Period.

ACKNOWLEDGMENTS

The authors would like to thank the staff of the Iraq Natural History Research Center and Museum-University of Baghdad, for providing some facilities during the course of the study and also the Department of Geology, University of Baghdad for offering support to prepare the thin sections and offer permission to use the polarized microscope and to the State Board of Antiquities and Heritage (SBAH) for their help to review the archaeological documents. Thanks are also extended to Prof. Dr. M. K. Mohammad from Uruk Private University and Assist. Prof. Dr. Habib M. Shubber from University of Al-Qadisiya for their help in the field surveys and also for Prof. Dr. Munther A.Abdul Malik from Department of Archaeology, University of Baghdad for his help in determining the functions and dating of stone tools.

LITERATURE CITED

Al-Ani, I. T. 1986.Stone industries in Iraq until the end of the Neolithic Period. Master thesis, College of Arts, University of Baghdad, 226 pp.

Al-Bassam, K. 2007. Geology of the Iraqi Western Desert: Mineral Resources. *Iraqi Bulletin of Geology and Mining, Special Issue*, 1: 145 - 168.

Al-Juboury, A. I. Ghazal, M. M. and Al-Naqib, S. Q. 2001.Development and heavy minerals of the Tigris River terraces, North Iraq. *Dirasat (Pure Science), Jordan*, 28 (2): 245-259.

Al-Juboury, A., Howard, J. P., Vincent, S. J., and Nichols, G. 2021. Petrography, diagenesis and geochemistry of the Cambro-Ordovician Khabour sandstones, Western Iraq: Implications for reservoir quality and the impact of the Hirnantian glaciation, *Marine and Petroleum Geology*, 123:104733.

Al-Zubaidi, A. A. 2012. Natural stone and its archaeological importance at Tel Al- Nasr Site, Western Desert of Iraq. *Al-Adab Journal*, 99: 523-541 (In Arabic).

Bienkowski, P. and Millard, A. 2000. Dictionary of the ancient near east. British Museum. London, British Museum press, 342 pp.

Biglari, F. and Shidrange, S. 2006.The lower palaeolithic occupation of Iran. *Near Eastern Archaeology*, 69 (3-4): 160-168.

Braidwood, R. J. and Howe, B. 1972. Prehistoric investigation in Iraqi Kurdistan. Studies in Ancient Oriental Civilization, No. 31, the University of Chicago Press, 184 pp.

Buday, T. 1980. The regional geology of Iraq. Vol. 1: Stratigraphy and Paleogeoraphy. Dar Al- Kutub Publishing House, Mosul, 445pp.

Buday, T. and Jassim, S. Z. 1987. The regional geology of Iraq. Vol. 2: Tectonism, Magmatism and Metamorphism. Iraq Geological Survey Publications, Baghdad, Iraq, 352 pp.

Clark, G. 1961. World prehistory: An outline. Cambridge, 283 pp.

Coates, A. 1952. Prelude to history, a study of human origin and Palaeolithic Savagery. Greenwood Press Publishers, 289 pp.

Davidson, L. and Nowel, A. 2010.Stone tools and the evolution of human cognition. University of New England, University of Victoria (Australia), 11 pp.

Ebright, C. A. 1987. Quartz petrography and its implications for prehistoric use and archaeological analysis.*Archaeology of Eastern North America*, 15: 29- 45.

Eder, F. W. and Patzak, M. 2004. Geopark- geological attraction: A tool for public education, recreation and sustainable economic development. *Episodes*, 27 (3):162-164.

Encyclopaedia Britannica. 2012. Palaeolithic Period. Anthropology. Available at: https://www.britannica.com/event/Paleolithic-Period.

Fouad, S. F. 2012. Tectonic map of Iraq, scale 1:1000000, 3rd edition.Iraq Geological Survey Publications, Baghdad, Iraq.

Ibrahim, K. M. 1993. The geological framework for the Harrat Al-Sham Basaltic Super-Group and its volcan otectonic evolution. *NRA, Geological Mapping Division Bulletin*, 25: 1-33.

Internet Data. 2020. Stone tool, Wikipedia, retrieved on the 6th of August. Available at: https://en.wikipedia.org/wiki/Stone_tool.

Jassim, S. Z. and Goff, J. C. 2006. Geology of Iraq. Published by Dolin, Prague and Moravian Museum, Brno, 341 pp.

Jassim, S. Z., Karim, S. A., Basi, M. A., Al-Mubarak, M. A. and Munir, J, 1984. Final report on the regional geological survey of Iraq. Vol.3, Stratigraphy. GEOSURV, int. rep. no. 1147.

Kottak, C. P. 2006. Anthropology, the exploration of human diversity, 11th edition, McGraw Hill, 579 pp.

Leo, G. W., Onder, E., Kilie, M. and Avci, M. 1978. Geology and mineral reources of the Kuluncak-Sofular Area (Malatya K-39a1 and K39-a2 Quadrangles), Turkey. U. S. Government Printing Office, Washington D. C. 20402, 58 pp.

Paul, S. and Karen, H. 2015. Living Lithics: ethnoarchaeology in Highland Papua New Guinea". *Antiquity*, 77(297): 555 - 566.doi:10.1017/S0003598X00092619.

Pournelle, J. R. 2003. Marshland of cities: Deltaic landscapes and the evolution of civilization. Ph.D. Thesis, Project: Sealands archaeology and environment Program. University of South Carolina, USA.

Sissakian, V. K. and Fouad, S. F. 2012.Geological map of Iraq, scale 1:1000000, 4th edition. Iraq Geological Survey Publications, Baghdad, Iraq. Available at: http://ibgm-iq.org/ibgm/index.php/ibgm/article/view/263.

Sissakian, V. K. and Saed, Z. B. 2012. Lithological Map of Iraq, Compiled using GIS Techniques. *Iraqi Bulletin of Geological and Minning*, 8 (3): 1- 13.

Sissakian, V. K., Abdul Ahad, I. D., Al-Ansari, N. and Knutson, S. 2015. The geology of the archeological hills and monuments, examples from Iraq. *Journal of Earth Sciences and Geotechnical Engineering*, 6 (2): 1- 28.

Smith, K. 2018. Archaeologists find 300,000-year-old stone tools in Saudi Arabia. TECHNICA. Available at: https://arstechnica.com/science/2018/10/archaeologists-find-300000-year-old-stone-tools-in-saudi-arabia/

Tehran, M. A., Shahri, H. M. and Valipour, M. E. F. 2010.The Petrographic of Basalt in Northeast of Darood-Neyshapoor, NE Iran. The 1st International Applied Geological Congress, Islamic Azad University, Mashhad Branch Iran, p. 1193-1197.

Turkmani, A. S. and Al-Shar′a, M. 2009.Petrography and geochemistry of the recent basaltic rocks from the North East of Syria. *Damascus University Journal of Basic Sciences*, 25 (1): 97 - 116.

UNESCO. 2008. Global geoparks network: guidelines and criteria for national geoparks seeking UNESCOs assistance to join the global geoparks network, 10 pp.

van Bellen, R. C., Dunnington, H. V., Wetzel, R. and Morton, D. M. 1959. Lexique Stratigraphique International, III, Asie, fasc. 10a, Iraq. Centre National de la Recherche Scientifique, Paris, 333 pp.

Waelkens, M. 1992. Bronze Age quarries and quarrying techniques in the eastern Mediterranean and the Middle East. *In*: Waelkens, M., Herz, N. and Moens, Luc, (eds). Ancient stone: Quarrying trade and provenance. Interdisciplinary studies on stones and stone technology in Europe and Near East from the prehistoric to the Early Christian period. *Acta Archaeological Lovaniensia*, *Monographiae*, 4: 5-20.

WHC. 2008. Natural world heritage and biodiversity workshop, toward sustainable development in future Iraq. Kurdistan regional government-Iraq/ Ministry of Environment General Directorate of Awarness and Media, Erbil, 181 pp. (In Arabic).

Yacoub, S.Y. 2011. Stratigraphy of the Mesopotamia Plain. *In*: Geology of Mesopotamia Plain. *Iraqi Bulletin of Geology and Mining*, *Special Issue*, 4: 47 - 82.

Bull. Iraq nat. Hist. Mus.
(2021) 16 (3): 231- 251.

الصخارية ومنطقة المصدر للادوات الحجرية الطبيعية من موقع الدلمج الأثري، سهل مابين النهرين، العراق

عقيل عباس الزبيدي* ، فاروجان سيساكيان** و حسن كطوف جاسم***
*قسم الجيوفيزياء ، جامعةالكرخ للعلوم ، بغداد ، العراق.
**قسم هندسة وإدارة الموارد الطبيعية ، جامعة كوردستان هولير ، إقليم كوردستان العراق، اربيل، العراق.
*** قسم الجيولوجيا ، كلية العلوم ، جامعة بغداد، بغداد، العراق.

تأريخ الاستلام: 2020/11/29، تأريخ القبول: 2021/02/23، تأريخ النشر: 2021/6/20

الخلاصة

تم العثور على العديد من الأدوات الحجرية على تل أثري يقع جنوب هور الدلمج والذي يقع في الجزء الأوسط من السهل الرسوبي لبلاد ما بين النهرين، بين نهري دجلة والفرات. ان نوع الصخور المستخدمة في صناعة الأدوات الحجرية المدروسة غير موجود في السهل الرسوبي، لانه يتكون من ترسبات العصر الرباعي التي تتضمن رمل هش، وغرين، وطين. جميع الرسوبيات الموجودة مترسبة في البيئات النهرية مثل الجزر اللسانية، وفوق الضفة، و رواسب السهول الفيضية.

تم وصف الأدوات الحجرية التي تم جمعها بعدسة ذات قوة تكبير (10 X) و مجهر مستقطب بعد أن تم تقطيعها وتحويلها الى شرائح رقيقة (thin section). أظهرت الدراسة المجهرية أن الأدوات الصخرية المدروسة مصنعة من الصخور الرسوبية والنارية البركانية والمتحولة، مثل: الأحجار الرملية، والحجر الجيري، والصوان، والمدملكات، والريولايت، والبازلت، والميكاشيست، والكوارتزيات. تم استخدام الأدوات الحجرية المدروسة حاليًا من قبل الانسان القديم كمدقات، ومجارف، وكاشطات، وسكاكين. كما أظهرت الدراسة الحالية أن هذه الأدوات تم نقلها من خارج السهل الرسوبي لبلاد ما

بين النهرين. تشير الأدوات الحجرية في موقع الدلمج الأثري إلى وجود بعض طرق التجارة بين هذا الموقع والمناطق المحيطة به، بالإضافة إلى التبادلات الاقتصادية والثقافية خلال العصر الحجري الحديث.