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Typological and Structural study of Pottery from Tell Aswad, Damascus, Syria: A Proposed Chronology Based on Thermoluminescence/Optically Stimulated Luminescence (TL-OSL) Dating

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Abstract

One of the most significant Neolithic sites in southwestern Syria is Tell Aswad. This site was excavated by DeContenson and Stordeur, and a limited number of pottery sherds were recovered. The excavators initially attributed the pottery sherds from Tell Aswad to the Pre-Pottery Neolithic (PPN) period. However, typological studies conducted by the authors revealed that these sherds can be assigned to the Neolithic, Chalcolithic, Bronze Age, and historical periods. The primary objective of this research is to establish a typology of Tell Aswad pottery based on form and manufacturing techniques. Additionally, the study aims to determine the precise dating of the Tell Aswad pottery using both pottery analysis and the thermoluminescence dating method. To achieve this, the research seeks to address the following questions: How can the Tell Aswad pottery be explained in terms of typology and structure? How can an absolute dating be provided for Tell Aswad, determined using the thermoluminescence technique? In this study, a typological analysis based on form and construction techniques, combined with thermoluminescence testing, was conducted. The pottery findings from Tell Aswad were analyzed based on their form and construction techniques. The results revealed that the pottery from this site exhibits a limited variety in terms of form and decorative techniques. However, in terms of construction techniques, it appears that the potters of Tell Aswad possessed a high level of expertise in pottery-making. Based on the thermoluminescence dating results, it can be concluded that while settlement in Tell Aswad began during the Pre-Pottery Neolithic (PPN) period, the pottery findings represent occupation periods ranging from the Neolithic up to the historical period.

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1. Introduction

Tell Aswad is located 3 km southeast of Damascus (DeContensen, 1972: 187). The site was first discovered in 1967 by Henri DeContensen and subsequently excavated from 1971 to 1972. From 2001 to 2010, Bassam Jamous and Daniel Stordeur conducted further excavations at Tell Aswad (Stordeur, 2003a: 3). A total of 73 pottery sherds were identified during these excavations. Based on the excavation results and the pottery findings, DeContensen proposed that the site dates back to the Neolithic period. However, despite the excavations carried out by Stordeur and Bassam Jamous, the lack of typological analysis of the pottery and necessary laboratory studies has led to the site being classified as Neolithic based solely on the conclusions of DeContenson and Stordeur (DeContenson, 1972; 1985; 1992; Stordeur, 2003b: 3). This conclusion was made without a detailed examination of the pottery or any testing.

In the typology and workshop evaluations conducted by the authors, it was determined that some of the pottery sherds were wheel-made, indicating that they belong to both prehistoric and historical periods. To establish a precise dating for Tell Aswad, 73 pottery samples, representing all identified sherds, were selected for typological study, and 12 pottery samples were chosen for thermoluminescence (TL) dating. The TL/OSL dating tests were carried out using the RISO TL/OSL DA-203 device at the Atomic Energy Commission Laboratory in Syria.

This research focuses on the pottery findings from Tell Aswad and addresses the following questions: How can the pottery from Tell Aswad be explained in terms of typology and structural analysis? How can absolute dating be determined using thermoluminescence dating tests on the pottery from Tell Aswad? The study aims to conduct a typological analysis of the pottery alongside laboratory tests. The objectives are twofold: first, to identify the manufacturing techniques used in producing the pottery, and second, to determine the time period during which the pottery was made.

2. Research background

In 1967, Henry DeContenson began archaeological investigations at Tell Aswad. His excavations revealed that the settlement underwent three distinct phases: PPNA (Pre-Pottery Neolithic A), Old PPNB (Pre-Pottery Neolithic B), and Middle PPNB. The results of his excavations were published in 1972 and 1973 (DeContenson, 1972; 1973).

In 1979, Van Zeist conducted research on ancient plant and legume remains at Tell Aswad, concluding that the subsistence economy of the Neolithic inhabitants was based on the cultivation of cereals, including barley, wheat, chickpeas, and lentils. His findings were published in 1979 (Van Zeist & Bakker-Heeres, 1979). In 1995, DeContenson published the results of his studies on the archaeological artifacts found at Tell Aswad, including stone tools, architecture, and plant remains, and compared them with those from Tell Al-Ghoraifa (DeContenson, 1995). From 2001 to 2010, Danielle Stordeur and Bassam Jamous conducted excavations at Tell Aswad. Based on their findings and the examination of artifacts such as arrowheads and ornaments, they concluded that Tell Aswad dates to the Old, Middle, and Late PPNB Neolithic periods (Stordeur, 2001: 3).

Stordeur published the results of these excavations in the *AAAS journal* in 2002, 2003, 2005, 2006, 2007, and 2010 (Stordeur, 2002; 2003; 2005; 2006; 2007; 2010). Other archaeological studies have also been conducted at the site. For example, in 2006, Stordeur and Jamous examined flint stone tools discovered at Tell Aswad, including blades, Jebili point arrowheads, Jericho point arrowheads, hilt blades, serrated blades, small blades, and sickles (Stordeur & Khawam, 2006a: 21–22; Stordeur & Khawam, 2007). In 2007, Helmer and Gourichon analyzed the animal bones discovered at Tell Aswad. They determined that the Neolithic-period fauna at Tell Aswad comprised 26 species of birds and aquatic animals, such as ducks, as well as 20 species of mammals, including goats and sheep (Helmer & Gourichon, 2007; 2008). In 2017, Helmer and Gourichon further concluded that goat, sheep, and cattle farming were integral to the economy of the site's inhabitants (Helmer & Gourichon, 2017). Also in 2007, Delerue examined obsidian tools unearthed at Tell Aswad and determined that the obsidian originated from Nimrud Dagh, Bingol, and Golg Dagh (Delerue, 2007). In 2008, Stordeur and Jamous studied the architectural remains of Tell Aswad and concluded that the structures at the site featured a circular, semi-subterranean design and were constructed using thatch and reeds (Stordeur & Jamous, 2008-2009: 9-10). Hala Al-Rashi analyzed the ornaments, figurines, and clay objects found at Tell Aswad, publishing her findings in 2010 (Al-Rashi, 2010). In 2013, Orange et al. conducted EDXRF and SEM-EDS laboratory analyses on obsidian tools from Tell Aswad to determine their origin. They concluded that SEM-EDS testing could differentiate between obsidian from Nimrud-Dagh and that from Bingol (Orange et al., 2013). Rima Khawam studied the plastered skulls from Tell Aswad, publishing her conclusions in 2014 and 2015 (Khawam, 2014; 2015). In 2016, Baker, Khawam, and colleagues investigated the relationship between cause of death and burial practices in the Neolithic period at Tell Aswad, based on paleopathological lesions identified on human skeletons. They concluded that individuals who died from disease were buried around the site, and the burial process occurred in multiple stages. Special attention was given to the interior of the burial sites and the limited but valuable grave goods that symbolized the deceased (Baker *et al.,* 2016).

In 2018, Douche and Willcox compared Neolithic plant and grain remains from Tell Aswad in southern Syria with those from Jaadat al-Maghara in northern Syria (Douche & Willcox, 2018). In 2021, Baker, Chamel, and Dutour examined skeletons from Tell Aswad for lesions associated with tuberculosis (TB). They identified TB lesions in a child skeleton from the PPNB period, specifically Serpens Endocrania Symmetric (SES) lesions, attributed to chronic tuberculous meningitis. Baker et al. concluded that tuberculosis was present in the Levant during the Neolithic period, coinciding with the advent of agriculture and animal domestication (Baker *et al.,* 2021).

3. Tell Aswad

The Tell Aswad site is located in the Damascus Basin plain, between Lake Al-Otaiba and Lake Al-Hayjaneh (DeContenson, 1972: 187). It sits at an elevation of 606 meters above sea level and covers an area of 5 hectares (250 x 250 m²), (DeContenson, 1989: 32). The site comprises 18 layers, listed from oldest to most recent (Table 1).

Table 1: Cultural layers of Tell Aswad (Stordeur&Jamous. 2008-2009: 8-9)

Period	Layers
Old PPNB period	layers B12 to B9
Transition period from Old PPNB to Mid PPNB	layers B8
Middle PPNB period.	Layers B7 to B1
Late PPNB period	Layers B0 to B-5

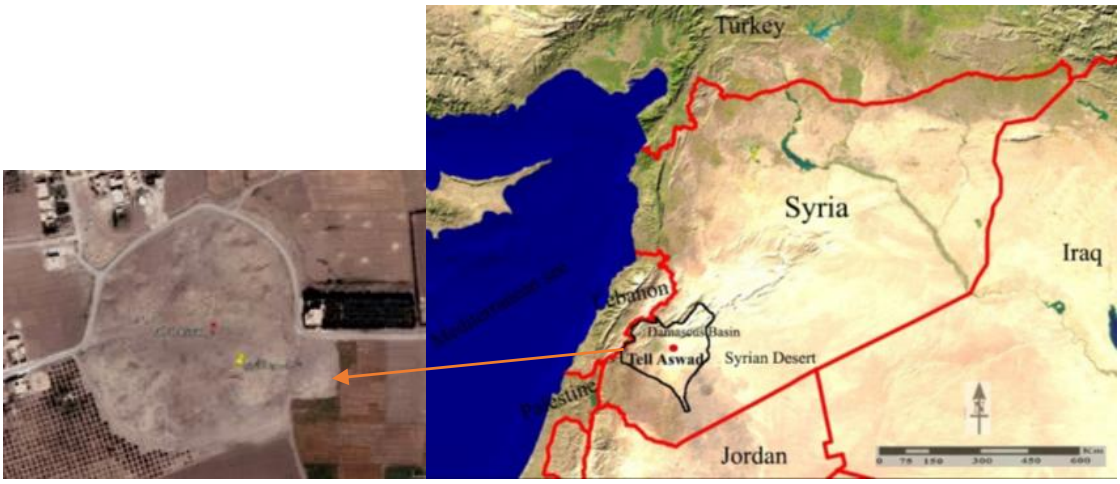


Fig. 1: Geographical Location of Tell Aswad (Authors, 2024).

3-1. Characteristics of Tell Aswad

With the onset of settlement during the Old PPNB period, the architecture at Tell Aswad featured circular, semi-subterranean structures made of clay and reeds (Stordeur & Jamous, 2008-2009: 9-10). During the transition from the Old PPNB to the Middle PPNB, adobe began to be used for building houses. The Middle PPNB houses were oval and varied in size, while the New PPNB structures were rectangular and constructed with regularly shaped adobe bricks (Stordeur, 2008: 9-10). A total of 2,708 flint tools were recovered from Tell Aswad, including Jebili point arrowheads, Jericho point arrowheads, blades, and sickles (Stordeur & Khawam, 2006b: 21-22). Additionally, obsidian tools, believed to have been sourced from Nimrud-Dagh, Bingol, and Golg-Dagh, were also found (Delerue, 2007: 151). A total of 305 figurines were recovered from Tell Aswad, including both human and animal figurines. The animal figurines represented cows, sheep, pigs, and gazelles (Ayobi, 2014: 27). Additionally, 239 ornaments made of stone, bone, raw clay, and shells, including beads, necklaces, and bracelets, were identified at Tell Aswad (Al-Rashi, 2010). The subsistence economy of the Tell Aswad settlement in its early stages involved the cultivation of cereals such as wheat, lentils, chickpeas, and barley. Walnut, pistachio, and almond trees were also grown using rainfed agriculture (Van Zeist & Bakker-Heeres, 1982). In addition to cereal cultivation and fruit collection, the inhabitants relied on hunting deer and wild boar, as well as fishing. During the second phase of the settlement, cereals and legumes like lentils, chickpeas, peas, flax, and vegetables were cultivated (Van Zeist & Bakker-Heeres, 1982:

168–191). Excavations of Tell Aswad's garbage pits revealed significant quantities of animal bones, including those of 26 bird species, aquatic animals such as ducks, and 20 mammal species, including goats and sheep (Helmer & Gourichon, 2007: 121).

3-2. Instrumental Analysis

A total of 73 pottery sherds have been unearthed in Tell Aswad. No comprehensive studies or laboratory analyses have been conducted on these sherds before. The excavators of Tell Aswad, DeContensen, and Stodeur have attributed this site to the Neolithic period.

Fourier-transform infrared spectroscopy (FTIR) to examine the slip of pottery sherds. FTIR spectroscopy was carried out using a Nicolet 6700 FTIR spectrometer with KBr pellets. All Spectra were collected in the range of 4000-400 cm-1 at 4 cm-1 resolution with 64 numbers scans.

pottery sherds were examined by Scanning Electron Microscope (SEM) To study morphological structure. Segments of 5 mm length were carefully selected from samples and before the examination, the samples were coated with a thin layer of gold. SEM examination was conducted using a TESCAN VEGA II apparatus.

Thermal Gravimetric Analysis (TGA) was carried out for the samples in Mettler instrument (TG50) thermalanalyzer. The tests were carried out in a nitrogen atmosphere, purged (30 ml/min) using sample weights of 10-15 mg at a heating rate of 10° C/min. The resolution of the balance is given, as 1 microgram for weights less than 100 milligrams, and the temperature precision of the instrument is ± 2°.

X-ray fluorescence (XRF) used to investigate the composition of pottery. The samples were irradiated by a 109Cd radioisotope source (~9 108 Bq) for 1000 s (tripled samples), and the measurements of the X-ray fluorescence outgoing from the samples were carried out with an X-ray spectrometer mounting a Si(Li) detector with an energy resolution (Full-Width-half-maximum) of about 180 eV at 5.9 keV for the Mn-Kα X-Ray.

The TL measurements were performed using an automated RISØ TL/OSL reader model DA-20, equipped with calibrated beta (90Sr/90Y) and alpha (241Am) sources with a dose rate of 0.135 Gy/s and 0.045 Gy/s respectively, a photomultiplier tube (PMT), model 9235/0158/1498AMP, made in USA. The samples were placed on a controlled heated tray, and were heated to 500°C in N2 with temperature rising at rate of 5°C/s.

4. Typology of Tell Aswad Pottery

4-1. Typology of Tell Aswad Pottery Based on the Type of Pottery Sherds

A total of 73 pottery sherds were recovered from Tell Aswad (Table 2), including 44 body sherds, 11 handle sherds, and 18 rim sherds. Since no complete vessels or sherds related to the base of the vessels were found, the pottery sherds were divided into three categories: rims, bodies, and handles (Chart 1). Body sherds do not provide sufficient information about the shape of the vessels, so the typology focuses on analyzing the forms of rims and handles.

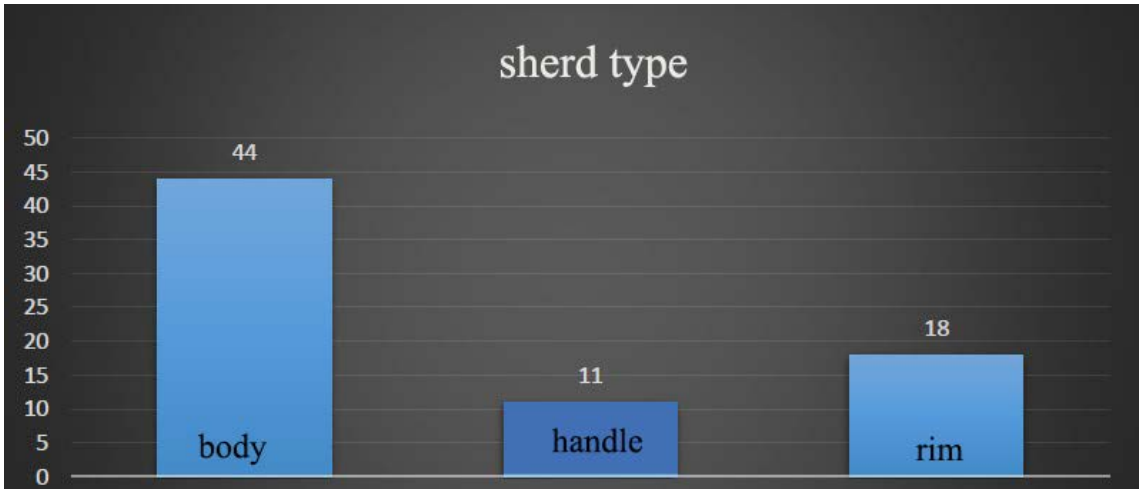


Chart 1: Classification of pottery sherds discovered from Tell Aswad (Authors, 2024).

Table 2: Catalog of pottery sherds discovered from Tell Aswad (Authors, 2024).

No	Context	Sherd type	Pottery type	Forming	Firing Level	Temper	Length	Width	Thickness	External Slip Color	Internal Slip Color	Core Color
1	435	Handle	Coarse Ware	Handmade	High Fired	Organic and Mineral	7.5cm	3.2cm	2.cm	4.2YR 7.1/4.8	4.2YR 7.1/4.8	7.5YR 5.3/2.5
2	435	Handle	Coarse Ware	Handmade	Medium fired	Organic and Mineral	4.2cm	3.1cm	1.5cm	0.3YR 7.3/6.3	0.3YR 7.3/6.3	3.3YR 5.9/9.2
3	293	Rim	Medium Ware	Wheelmade	High Fired	Organic and Mineral	6cm	5cm	1cm	4.2YR 7.1/4.8	4.2YR 7.1/4.8	7.1YR 7.0/3.3
4	454	Rim	Medium Ware	Wheelmade	High Fired	Organic and Mineral	3.5cm	3cm	1.3cm	0.7YR 6.9/4.6	0.7YR 6.9/4.6	6.6YR 8.0/5.1
5	292	Body	Medium Ware	Nested pottery	Medium Fired	Organic and Mineral	4.5cm	3.8cm	1cm	5.8YR 7.3/4.0	6.9YR 7.6/2.2	6.9YR 7.6/2.2
6	292	Body	Medium Ware	Handmade	High Fired	Organic and Mineral	10.5cm	6.5cm	2cm	5.8YR 7.3/4.0	5.8YR 7.3/4.0	6.6YR 8.0/5.1
7	472	Body	Medium Ware	Handmade	High Fired	Organic and Mineral	10.3cm	7.2cm	3cm	4.2YR 7.1/4.8	0.3YR 7.3/6.3	0.7YR 6.9/4.6
8	453	Body	Medium Ware	Handmade	Medium Fired	Organic and Mineral	5cm	3.2cm	1.3cm	7.3YR 7.1/5.9	7.3YR 7.1/5.9	7.3YR 7.1/5.9
9	292	Handle	Medium Ware	Handmade	High Fired	Organic and Mineral	12cm	4cm	1cm	5.6YR 8.5/4.0	5.6YR 8.5/4.0	5.6YR 8.5/4.0
10	446	Rim	Medium Ware	Handmade	Medium Fired	Organic and Mineral	5.5cm	5cm	2cm	0.3YR 7.3/6.3	2.1YR 6.1/8.2	0.3YR 7.3/6.3
11	292	Rim	Medium Ware	Wheelmade	High Fired	Mineral	5.5cm	3.7cm	0.7cm	4.2YR 7.1/4.8	4.2YR 7.1/4.8	5.5YR 7.5/6.7
12	Surface	Rim	Medium Ware	Handmade	High Fired	Mineral	4.5cm	3.2cm	1cm	9.0YR 7.9/5.9	9.0YR 7.9/5.9	9.0YR 7.9/5.9
13	292	Rim	Medium Ware	Wheelmade	High Fired	Mineral	3.5cm	3cm	0.8cm	4.2YR 7.1/4.8	4.2YR 7.1/4.8	4.2YR 7.1/4.8
14	292	Body	Medium Ware	Handmade	High Fired	Organic and Mineral	11cm	9cm	3cm	5.8YR 7.3/4.0	4.2YR 7.1/4.8	5.8YR 7.3/4.0
15	292	Body	Medium Ware	Handmade	High Fired	Organic and Mineral	11cm	8cm	2cm	6.6YR 8.0/5.1	0.7YR 6.9/4.6	7.1YR 7.0/3.3
16	292	Rim	Medium Ware	Handmade	Medium Fired	Organic and Mineral	9cm	6.3cm	4cm	4.2YR 7.1/4.8	4.2YR 7.1/4.8	7.5YR 5.3/2.5
17	292	Body	Coarse Ware	Handmade	Medium Fired	Organic and Mineral	7cm	6.3cm	1.5cm	3.3YR 5.9/9.2	3.3YR 5.9/9.2	3.3YR 5.9/9.2
18	292	Body	Medium Ware	Handmade	High Fired	Organic and Mineral	6.5cm	5.4cm	1cm	3.3YR 5.9/9.2	6.2YR 7.4/5.8	6.2YR 7.4/5.8
19	292	Rim	Medium Ware	Handmade	Medium Fired	Organic and Mineral	8.2cm	5.5cm	1cm	0.3YR 7.3/6.3	0.3YR 7.3/6.3	7.5YR 5.3/2.5
20	292	Body	Medium Ware	Handmade	High Fired	Organic and Mineral	10cm	9cm	1cm	5.8YR 7.3/4.0	6.6YR 8.0/5.1	6.6YR 8.0/5.1
21	315	Body	Medium Ware	Handmade	High Fired	Organic and Mineral	5cm	4.5cm	0.5cm	4.2YR 7.1/4.8	5.1YR 8.1/3.4	5.6YR 8.5/4.0

22	315	Body	Medium Ware	Handmade	High Fired	Organic and Mineral	3.3cm	2.9cm	0.5cm	4.2YR 7.1/4.8	4.2YR 7.1/4.8	4.2YR 7.1/4.8
23	303	Body	Medium Ware	Handmade	High Fired	Organic and Mineral	4.1cm	3.5cm	0.5cm	6.0YR 6.3/3.0	2.2YR 6.0/1.8	2.2YR 6.0/1.8
24	303	Body	Medium Ware	Handmade	Very High Fired	Organic and Mineral	2.2cm	1.3cm	0.5cm	6.0YR 6.3/3.0	2.2YR 6.0/1.8	2.2YR 6.0/1.8
25	303	Body	Medium Ware	Handmade	High Fired	Mineral	3cm	2.8cm	0.5cm	3.2Y 9.3/1.2	3.2Y 9.3/1.2	0.1Y 8.8/3.0
26	315	Body	Medium Ware	Handmade	High Fired	Organic and Mineral	9.3cm	3.1cccm	1cm	5.1YR 8.1/3.4	5.1YR 8.1/3.4	5.6YR 8.5/4.0
27	315	Rim	Medium Ware	Handmade	Medium Fired	Organic and Mineral	3.2cm	2.6cm	0.5cm	5.6YR 8.5/4.0	5.6YR 8.5/4.0	2.2YR 6.0/1.8
28	292	Body	Medium Ware	Handmade	Medium Fired	Organic and Mineral	11.2cm	8.5cm	2.8cm	4.2YR 7.1/4.8	4.2YR 7.1/4.8	7.5YR 5.3/2.5
29	292	Body	Medium Ware	Handmade	High Fired	Organic and Mineral	6.6cm	5.8cm	1.6cm	2.2YR 6.0/1.8	7.5YR 5.3/2.5	1.7YR 5.9/5.3
30	292	Rim	Medium Ware	Handmade	High Fired	Organic and Mineral	6.2cm	2.8cm	2cm	7.5YR 5.3/2.5	–	1.7YR 5.9/5.3
31	Surface	Handle	Medium Ware	Handmade	High Fired	Organic and Mineral	9cm	2.5cm	3cm	5.6YR 8.5/4.0	5.6YR 8.5/4.0	9.5YR 7.5/2.1
32	Surface	Handle	Coarse Ware	Handmade	Medium Fired	Organic and Mineral	5.5cm	2.5cm	2cm	5.6YR 8.5/4.0	5.6YR 8.5/4.0	9.5YR 7.5/2.1
33	Surface	Body	Medium Ware	Handmade	High Fired	Organic and Mineral	7.2cm	4cm	0.7cm	5.8YR 7.3/4.0	6.6YR 8.0/5.1	6.6YR 8.0/5.1
34	Surface	Handle	Medium Ware	Handmade	High Fired	Organic and Mineral	6cm	3cm	1.6cm	4.2YR 7.1/4.8	4.2YR 7.1/4.8	9.5YR 7.5/2.1
35	269	Body	Medium Ware	Wheelmade	High Fired	Organic and Mineral	2.8cm	2.3cm	0.5cm	5.1YR 8.1/3.4	4.2YR 7.1/4.8	6.9YR 7.6/2.2
36	309	Body	Medium Ware	Handmade	High Fired	Organic and Mineral	5.5cm	3cm	1cm	5.1YR 8.1/3.4	5.1YR 8.1/3.4	5.1YR 8.1/3.4
37	161	Rim	fine ware	Handmade	High Fired	Organic and Mineral	4cm	2.8cm	0.5cm	5.8YR 7.3/4.0	5.8YR 7.3/4.0	5.8YR 7.3/4.0
38	306	Body	Medium Ware	Handmade	Medium Fired	Organic and Mineral	3.5cm	3cm	1.2cm	5.1YR 8.1/3.4	7.5YR 5.3/2.5	7.5YR 5.3/2.5
39	Surface	Body	Medium Ware	Wheelmade	High Fired	Organic and Mineral	8.3cm	7.1cm	1cm	5.6YR 8.5/4.0	5.6YR 8.5/4.0	5.6YR 8.5/4.0
40	Surface	Body	Medium Ware	Handmade	High Fired	Organic and Mineral	4.9cm	4.5cm	0.5cm	4.2YR 7.1/4.8	3.9YR 7.2/3.3	7.5YR 5.3/2.5
41	Surface	Body	Medium Ware	Handmade	High Fired	Organic and Mineral	5cm	5.8cm	0.5cm	2.1YR 6.1/8.2	2.1YR 6.1/8.2	7.1YR 7.0/3.3
42	Surface	Body	Coarse Ware	Handmade	High Fired	Organic and Mineral	9.7cm	6cm	3cm	4.2YR 7.1/4.8	4.2YR 7.1/4.8	7.5YR 5.3/2.5
43	292	Handle	Coarse Ware	Handmade	High Fired	Organic and Mineral	10cm	4cm	2cm	4.2YR 7.1/4.8	4.2YR 7.1/4.8	7.5YR 5.3/2.5
44	292	Handle	Medium Ware	Wheelmade	High Fired	Mineral	8.2cm	4.5cm	1.5cm	5.1YR 8.1/3.4	5.1YR 8.1/3.4	5.1YR 8.1/3.4
45	292	Rim	Medium Ware	Handmade	Medium Fired	Organic and Mineral	22cm	8cm	5cm	5.1YR 8.1/3.4	0.7YR 6.9/4.6	7.5YR 5.3/2.5
46	292	Body	Medium Ware	Wheelmade	High Fired	Mineral	11.5cm	9.5cm	1cm	6.6YR 8.0/5.1	6.6YR 8.0/5.1	6.6YR 8.0/5.1
47	292	Body	fine ware	Handmade	High Fired	Mineral	2cm	1.5cm	0.3cm	5.8YR 7.3/4.0	1.7YR 5.9/5.3	5.6YR 8.5/4.0
48	292	Body	Medium Ware	Handmade	High Fired	Organic and Mineral	8cm	3cm	1.7cm	6.6YR 8.0/5.1	6.6YR 8.0/5.1	7.5YR 5.3/2.5
49	292	Body	Medium Ware	Handmade	High Fired	Organic and Mineral	11.5cm	6cm	1.5cm	5.1YR 8.1/3.4	5.1YR 8.1/3.4	7.5YR 5.3/2.5
50	292	Body	Medium Ware	Handmade	High Fired	Organic and Mineral	8.5cm	6cm	1cm	0.7YR 6.9/4.6	0.7YR 6.9/4.6	7.5YR 5.3/2.5
51	446	Body	Medium Ware	Nested pottery	Medium Fired	Mineral	4.5cm	3cm	0.8cm	4.2YR 6.6/6.5	1.7YR 5.9/5.3	1.7YR 5.9/5.3
52	292	Body	Medium Ware	Handmade	High Fired	Organic and Mineral	22cm	12cm	1.5cm	6.0YR 8.3/2.9	6.0YR 8.3/2.9	5.1YR 8.1/3.4
53	292	Body	Medium Ware	Handmade	High Fired	Organic and Mineral	9.5cm	8cm	3cm	3.3YR 5.9/9.2	3.3YR 5.9/9.2	7.5YR 5.3/2.5
54	292	Body	Medium Ware	Handmade	High Fired	Mineral	12cm	8cm	2cm	5.6YR 8.5/4.0	4.2YR 7.1/4.8	7.1YR 7.0/3.3
55	435	Body	Medium Ware	Handmade	High Fired	Organic and Mineral	10.5cm	6.3cm	1cm	3.9YR 7.2/3.3	6.6YR 8.0/5.1	7.5YR 5.3/2.5

56	435	Body	Medium Ware	Handmade	High Fired	Organic and Mineral	10cm	8.5cm	0.7cm	6.6YR 8.0/5.1	6.6YR 8.0/5.1	6.6YR 8.0/5.1
57	435	Body	Medium Ware	Handmade	High Fired	Organic and Mineral	9cm	7cm	0.7cm	6.6YR 8.0/5.1	6.6YR 8.0/5.1	6.6YR 8.0/5.1
58	435	Body	Medium Ware	Handmade	High Fired	Organic and Mineral	4cm	3.2cm	0.8cm	6.0YR 8.3/2.9	6.6YR 8.0/5.1	6.6YR 8.0/5.1
59	435	Body	Medium Ware	Handmade	High Fired	Organic and Mineral	7cm	4.1cm	0.8cm	6.6YR 8.0/5.1	6.6YR 8.0/5.1	6.6YR 8.0/5.1
60	435	Body	Medium Ware	Handmade	High Fired	Organic and Mineral	7cm	6cm	2cm	5.6YR 8.5/4.0	0.7YR 6.9/4.6	7.5YR 5.3/2.5
61	147	Rim	fine ware	Handmade	High Fired	Organic and Mineral	3.6cm	3.2cm	0.4cm	6.6YR 8.0/5.1	5.6YR 8.5/4.0	6.6YR 8.0/5.1
62	147	Handle	Coarse Ware	Handmade	High Fired	Organic and Mineral	4cm	2cm	3cm	4.2YR 6.6/6.5	4.2YR 6.6/6.5	4.2YR 6.6/6.5
63	188	Rim	Medium Ware	Wheelmade	High Fired	Organic and Mineral	13cm	5cm	1cm	4.2YR 6.6/6.5	4.2YR 6.6/6.5	7.5YR 5.3/2.5
64	188	Handle	Medium Ware	Handmade	High Fired	Organic and Mineral	6cm	5cm	2cm	2.2YR 6.0/1.8	2.2YR 6.0/1.8	7.5YR 5.3/2.5
65	188	Body	Medium Ware	Wheelmade	High Fired	Organic and Mineral	8.5cm	7.2cm	0.7cm	0.7YR 6.9/4.6	5.8YR 7.3/4.0	6.6YR 8.0/5.1
66	188	Handle	Medium Ware	Handmade	High Fired	Mineral	8.5cm	1.5cm	1.3cm	6.2YR 7.4/5.8	6.2YR 7.4/5.8	6.2YR 7.4/5.8
67	63	Rim	White ware	Handmade	High Fired	Mineral	4.5cm	3cm	0.4cm	8.3YR 8.9/2.8	8.3YR 8.9/2.8	8.3YR 8.9/2.8
68	451	Rim	Medium Ware	Handmade	High Fired	Organic and Mineral	8.5cm	5.8cm	0.8cm	5.8YR 7.3/4.0	0.7YR 6.9/4.6	7.5YR 5.3/2.5
69	292	Body	Medium Ware	Handmade	High Fired	Organic and Mineral	3.5cm	2.3cm	0.5cm	5.1YR 8.1/3.4	6.9YR 7.6/2.2	5.1YR 8.1/3.4
70	453	Rim	Medium Ware	Wheelmade	High Fired	Organic and Mineral	4.7cm	3.4cm	0.7cm	5.8YR 7.3/4.0	4.2YR 6.6/6.5	7.1YR 7.0/3.3
71	453	Body	Medium Ware	Handmade	low-fired	Mineral	3.2cm	2.4cm	0.4cm	0.7YR 6.9/4.6	0.7YR 6.9/4.6	0.7YR 6.9/4.6
72	453	Rim	Medium Ware	Handmade	Medium Fired	Organic and Mineral	3.3cm	1.2cm	0.9cm	4.2YR 7.1/4.8	4.2YR 7.1/4.8	7.5YR 5.3/2.5
73	453	Body	Medium Ware	Handmade	High Fired	Mineral	2.5cm	2cm	0.4cm	5.8YR 7.3/4.0	5.8YR 7.3/4.0	6.6YR 8.0/5.1

4-1-1. Group One: Rims

Rims are among the most distinctive parts of pottery vessels used in daily life. 18 rims were retrieved from Tell Aswad, categorized into three forms:

1. Flared rim: Four rims of this form were identified, with thicknesses ranging from 1 to 2 cm (Fig. 2a-b, Sketches 1a-b, Table 3).

2. Rounded rim: Eight rims of this form were found, with thicknesses between 1–2 cm (Fig. 3a-b, Sketches 2a-b, Table 3).

3. Simple rim: Six rims of this form were obtained, with thicknesses also between 1–2 cm (Fig. 4, Sketch 3, Table 3).

4-1-2. Group Two: Handles

11 handles were obtained from Tell Aswad, divided into two types based on form:

1. Simple handle: Three handles of this type were found (Fig. 5, Sketch 4, Table 4). These were made using the handmade wicking method and were attached to the neck of the vessel from the rim.

2. Thick and medium semi-circular handle: Eight handles of this type were found (Fig. 6, Sketch 5, Table 4). These were also made using the handmade wicking method and were attached to the body of the vessel from the neck.

Table 3: Rim Forms of Tell Aswad (fig: 2a-2b-3a-3b-4), (Authors, 2024).

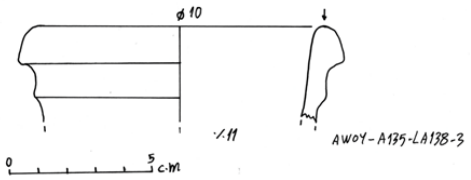
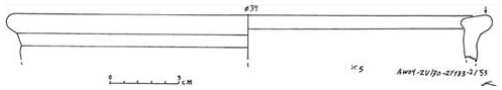
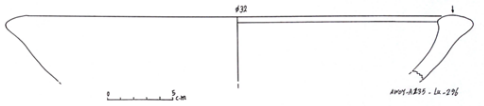
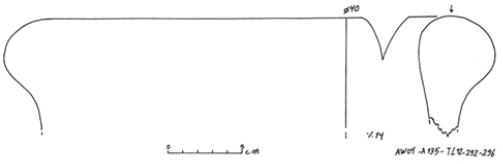
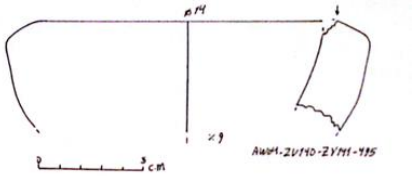
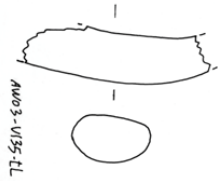
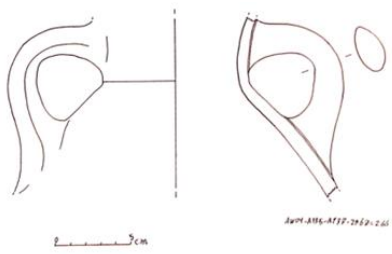
Form	Fig/ Sketch Number	Figure	Sketch
Flared	Fig. 2a Sketch. 1a		
	Fig. 2b Sketch. 1b		
Rounded	Fig. 3a Sketch. 2a		
	Fig. 3b Sketch. 2b		
Simple	Fig. 4 Sketch. 3		

Table 4: Handle Forms of Tell Aswad (fig: 5-6), (Authors, 2024).

Form	Fig/Sketch Number	Figure	Sketch
Simple	Fig. 5 Sketch. 4		
Thick and Medium Semi-circular	Fig. 6 Sketch. 5		

4-2. pottery vessels

Due to the absence of complete pottery vessels at Tell Aswad, the pottery forms were reconstructed based on the designs of pottery sherds related to the rim and handle. As a result, the pottery forms have been categorized into four groups:

1. Bowls
2. Jars
3. Pots
4. Large earthen jars

4-2-1. Bowls

Ten bowl rims were found at Tell Aswad. The characteristic shapes of Tell Aswad bowls include:

- Bowls with a flared rim and a hemispherical body
- Bowls with a rounded rim and a flat body

The bowl group is further divided into two subgroups: deep bowls and shallow bowls.

- Shallow bowls: Four rims were identified. These are defined as bowls with a rounded rim and a hemispherical body. They can also be described as bowls with a flared rim and a hemispherical body (see: Sketch 6a-b and Table 5).
- Deep bowls: Six rims were identified. These include a variety of shapes, such as bowls with rounded rims and hemispherical bodies, bowls with flared rims and hemispherical bodies, and bowls with flared rims and flat bodies (see: Sketch 7 and Table 5).

4-2-2. Jars

Two groups of pottery jars were found at Tell Aswad, divided based on their form:

1. Necked jars: Characterized by a rounded flared rim (see: Sketch 8a and Table 5).
2. Neckless jars: Defined by the absence of a neck, with the rim attached directly to the body. A characteristic shape is the jar with a flared rim (see: Sketch 8b and Table 5).

4-2-3. Pots

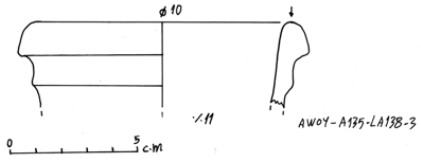
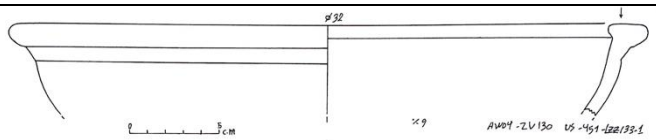
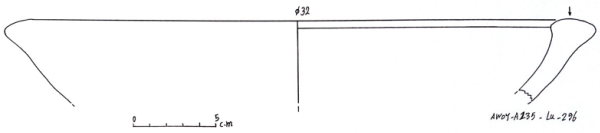
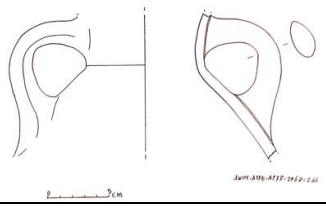
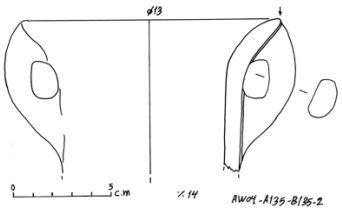
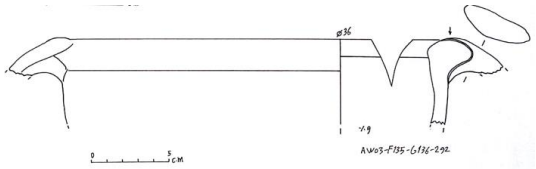
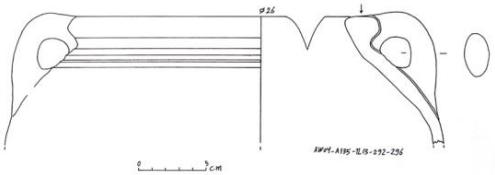
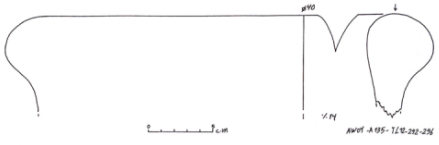
Five handles and rims related to pots were found at Tell Aswad, divided into two subgroups:

1. Open-mouth pots: Characterized by a flared rim and a spherical or hemispherical body (see: Sketch 9a and Table 5).
2. Closed-mouth pots: Characterized by rounded rims and spherical bodies (see: Sketch 9b and Table 5).

4-2-4. Large Earthen Jars

Two large earthen jars with rounded thick rims were unearthed at Tell Aswad. Their characteristic forms include a rounded flared rim, a neck, and a spherical body (see: Sketch 10 and Table 5).

Table 5: Pottery vessel forms from Tell Aswad (Authors, 2024).

Form	Sketch Number	Type	Sketch
Bowls	Sketch. 7	Deep Bowls	
	Sketch. 6a	Shallow Bowls	
	Sketch. 6b		
Jars	Sketch. 8a	Necked Jar	
	Sketch. 8b	Neckless Jar	
Pots	Sketch. 9a	Open-mouth Pot	
	Sketch. 9b	Closed-mouth Pot	
Large Earthen Jar	Sketch. 10		

5. Typology based on manufacturing technique

5-1. Pottery Type

The pottery sherds from Tell Aswad are classified into three groups:

1. Coarse ware: 7 sherds (10% of the total).
2. Medium ware: 62 sherds (85% of the total).
3. Fine ware: 3 sherds (4% of the total).

Additionally, one sherd of white ware was recovered, accounting for 1% of the total pottery (see: Chart 2).

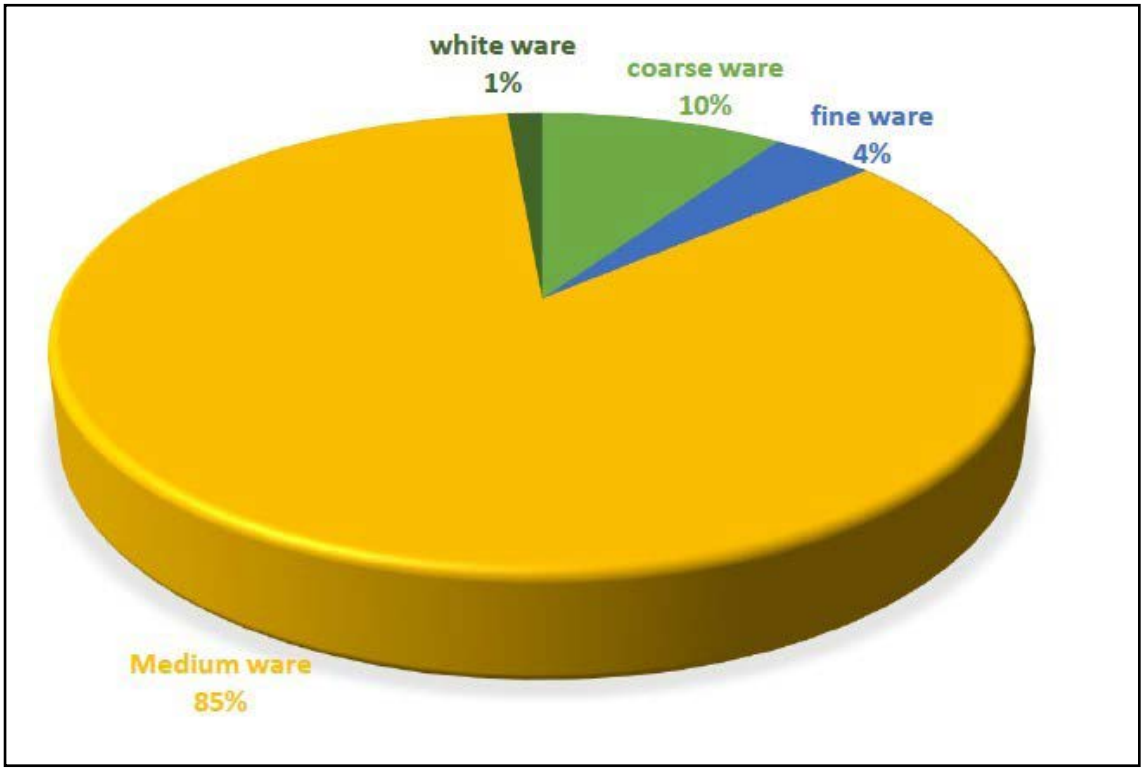


Chart 2: Types of pottery discovered at Tell Aswad (Authors, 2024).

5-2. Pottery fabrication technique

The pottery sherds from Tell Aswad were made using both handmade and wheel-made techniques:

• Handmade techniques:

- The "shaping in the thumb method" was used for deep and shallow bowls.
- The "shaping in the wick or tube method" was used for large earthen jars, jars, and vessel handles.
- Two sherds were made using the nested method, consisting of two layers of paste with distinct textures in terms of temper and paste.
- Two sherds were made using the finger method.
- In total, 62 pieces of handmade pottery were identified.

• Wheel-made techniques:

- Both fast and slow pottery wheels were used to manufacture shallow bowls (see: Fig. 7).

Fig. 7: Shallow bowls discovered at Tell Aswad were made using a potter's wheel (Authors, 2024).

5-3. Color of Pottery Core

The pottery cores from Tell Aswad are categorized based on Munsell's table (see: Table 6):

- Red core: 2 sherds
- Black core: 19 sherds
- Pea core: 17 sherds
- Brown core: 11 sherds
- Orange core: 24 sherds

Table 6: The color of the potsherds of Tell Aswad (Authors, 2024).

Pottery Core Color	Quantity	Color code
Red	2	1.7YR 5.9/5.3
Black	19	7.5YR 5.3/2.5
Pea	17	9.0YR 7.9/5.9 ، 5.8YR 7.3/4.0 ،6.2YR 7.4/5.8 , 5.6YR 8.5/4.0 , 0.1Y 8.8/3.0, 9.5YR 7.5/2.1 ،5.1YR 8.1/3.4
Brown	11	7.1YR 7.0/3.3 , 2.2YR 6.0/1.8
Orange	24	5.5YR 7.5/6.7 ،6.6YR 8.0/5.1 ،3.3YR 5.9/9.2 ،0.7YR 6.9/4.6 , 0.3YR 7.3/6.3 , 4.2YR 7.1/4.8

5-4. Pottery Temper

Pottery temper can be divided into two major categories: organic (such as straw and chaff) and mineral (such as sand, etc.). Identifying the type of temper is undeniably linked to the strength of the pottery after firing and is particularly significant in pottery studies. The pottery excavated at Tell Aswad contains two types of temper: organic (including straw and chaff) and mineral (including stone powder, sand, and lime powder). Notably, 82% of the pottery sherds from Tell Aswad contain both types of temper, while 18% contain only the mineral temper (see: Chart 3). Workshop studies indicate that no pottery sherds with only organic temper have been found

at this site. To analyze the Tell Aswad pottery in greater detail, four samples (1, 4, 7, 11) were selected from different layers and examined using a Tescan Vega II XMU microscope at the Syrian Atomic Energy Commission laboratory (see: Fig. 8 and Table 7). The SEM (Scanning Electron Microscope) results of the Tell Aswad pottery samples at a 50 µm scale reveal that these samples contain mineral temper. Mineral crystals, such as sand and silica, are observed, and salt crystals are present in pottery sample 11. Additionally, it is worth noting that pottery samples 1, 4, and 11 contain organic temper (straw), which burned during firing, leaving cavities in its place.

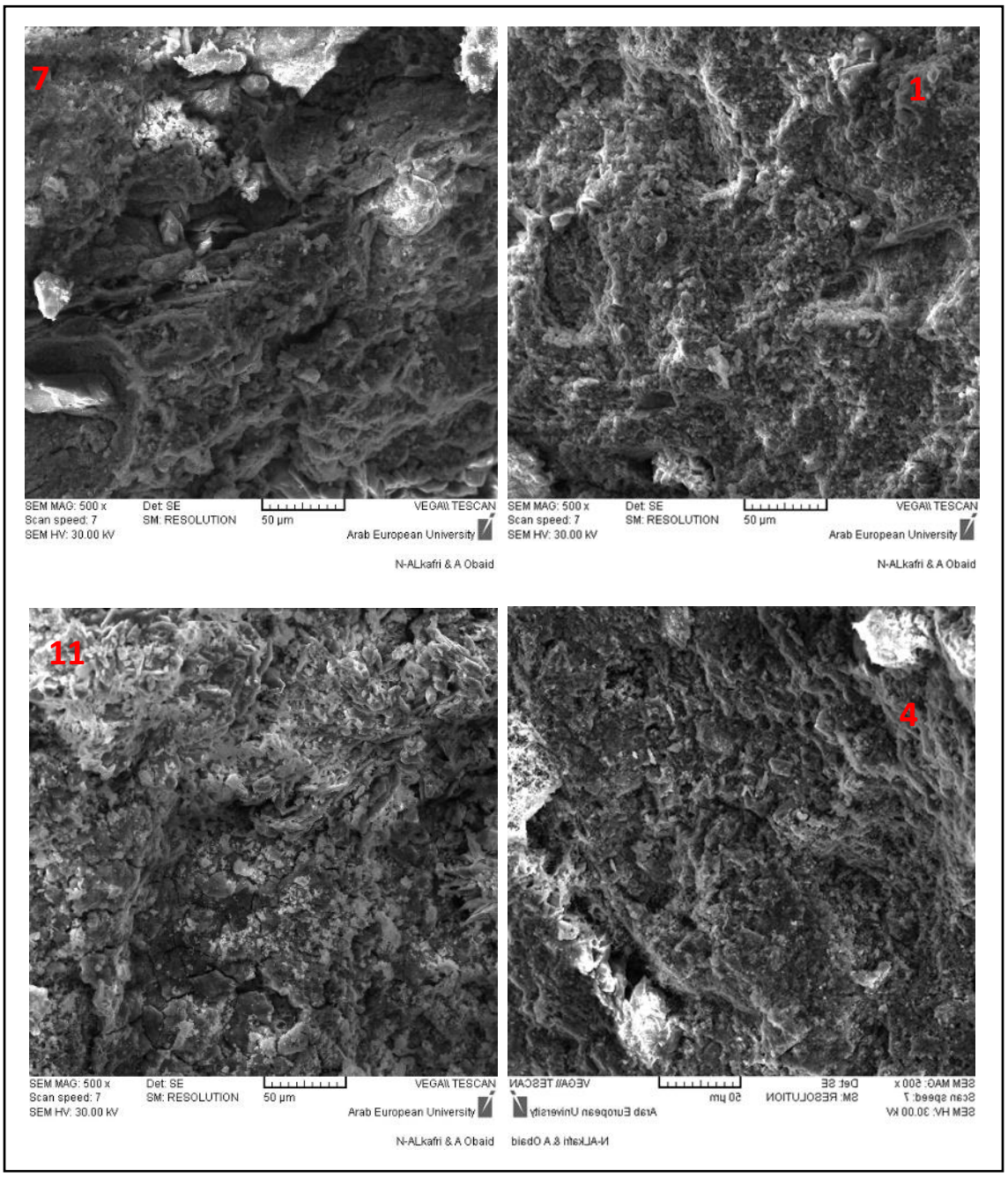


Fig. 8: SEM results of samples 4, 15, 19, and 23 from Tal Aswad at 50 µm (Authors, 2024).

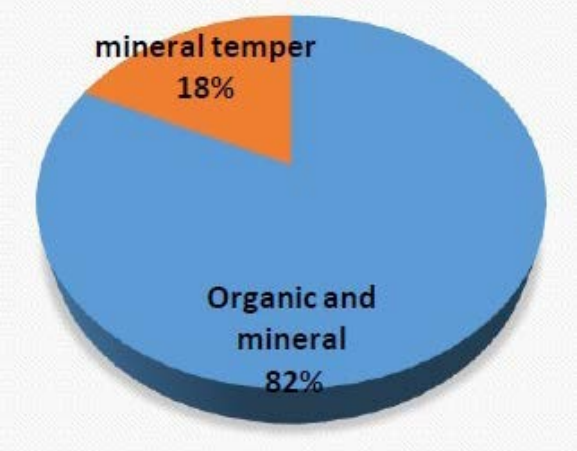


Chart 3: Temper of pottery sherds discovered from Tell Aswad (Authors, 2024).

5-5. Pottery Firing Rate

Pottery is fired at one of five rates: very low fired (up to 400°C), low fired (400–700°C), medium fired (700°C and above), high fired (900°C and above), and very high fired (1,100–1,200°C). The workshop study of Tell Aswad pottery, conducted by the authors, yielded the following conclusions: 78% of the pottery sherds from this site are high fired, 19% are medium fired, 1% are low fired, and 2% are very high fired (see: Chart 4). Furthermore, the SEM results indicate the presence of fused silica in the pottery samples. The presence of fused silica suggests that the pottery sherds were subjected to high temperatures, resulting in complete firing and high strength.

To accurately determine the firing temperature of Tell Aswad pottery, TGA (Thermogravimetric Analysis) tests were performed on samples 1, 4, 7, and 11 at the Syrian Atomic Energy Laboratory (see: Table 7). The results show that the firing temperature of Tell Aswad pottery ranged from 1,000 to 1,100°C (see: Charts 5, 6, 7, and 8). This indicates that the pottery underwent sufficient and complete firing. It should be noted that during the TGA tests, the temperature was increased to 4,000°C until the clay in the pottery sherds was completely decomposed, as seen in Charts 5, 6, 7, and 8. However, the maximum firing temperature of the pottery itself was 1,000–1,100°C.

Chart 4: Firing rate of pottery sherds discovered from Tell Aswad (Authors, 2024).

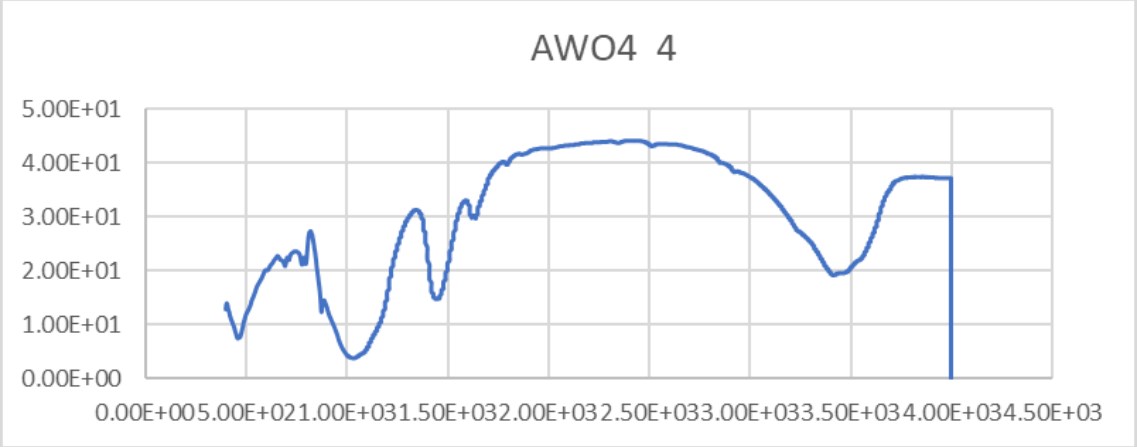


Chart 5: TGA test result for pottery sample 1 from Tell Aswad (Authors, 2024).

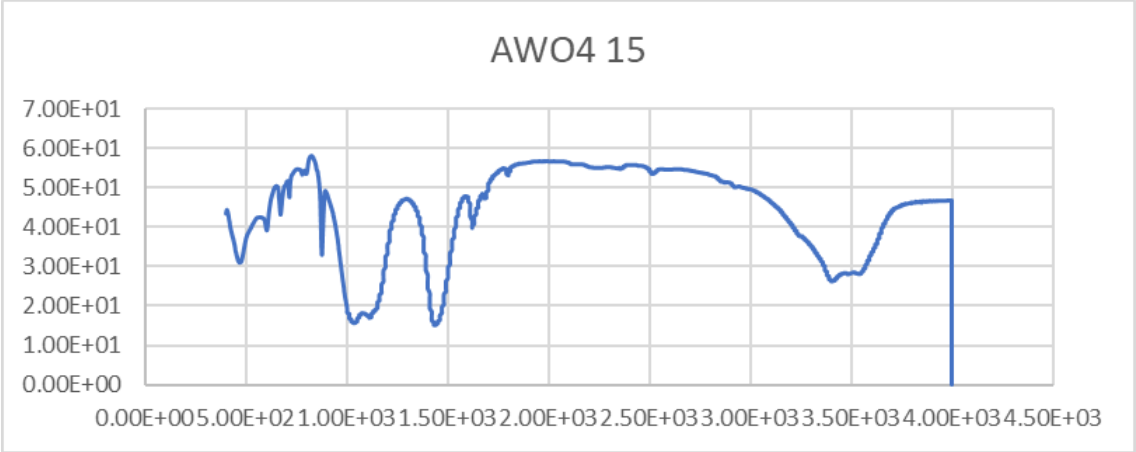


Chart 6: TGA test result for pottery sample 7 from Tell Aswad (Authors, 2024).

Chart 7: TGA test result for pottery sample 4 from Tell Aswad (Authors, 2024).

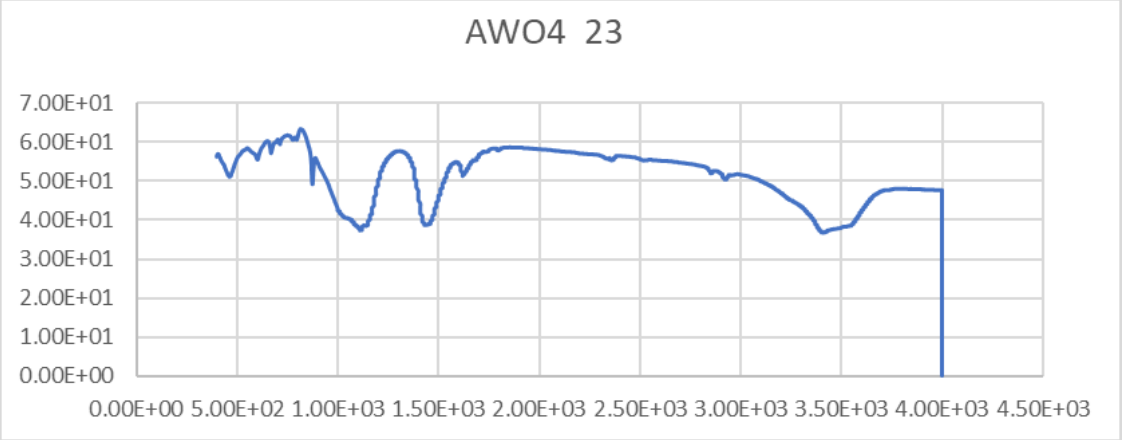


Chart 8: TGA test result for pottery sample 11 from Tell Aswad (Authors, 2024).

5-6. Pottery polishing

Pottery can be polished using various methods to create a uniform surface. In Tell Aswad pottery, wet hand polishing and coating methods are applied to different types of pottery (see: Fig. 9).

Fig. 9: Pottery sherds unearthed at Tell Aswad reveal wet-hand polishing methods (Authors, 2024).

6. Typology based on Pottery Decoration

90% of the pottery sherds unearthed at Tell Aswad feature slip decoration, while 18% display carved, embossed, or colored decoration.

6-1. Slip decoration

In this method, after the vessel dries, it is dipped into a mixture of clay and water. Colored slurry is used to alter the color of the vessel body. This type of decoration is observed in 90% of the pottery sherds from Tell Aswad (see: Figs. 10a and 10b).

Fig. 10a-b: Slip decoration on pottery sherds from Tell Aswad (Authors, 2024).

The study aimed to investigate the composition of the slip (colored coating) on pottery sherds discovered at Tell Aswad. Four samples (1, 4, 7, and 11; see Table 7) were selected from different layers of the site for analysis. Fourier Transform Infrared (FTIR) spectroscopy experiments were conducted at the Syrian Atomic Energy Commission laboratory using a Thermo Scientific Nicolet 6700 FT-IR Spectrometer.

The FTIR analysis revealed several key findings:

1. Absence of Kaolinite: The characteristic absorption bands of kaolinite (typically observed at 3698 cm^{-1}, 3660 cm^{-1}, 3620 cm^{-1}, and 3670 cm^{-1}) were not detected in any of the Tell Aswad pottery samples. This indicates that kaolinite was not present in the slip of these pottery pieces.

2. Presence of Illite/Muscovite: Absorption bands at 463 cm^{-1}, which are indicative of illite/muscovite, were observed in the Tell Aswad samples. This suggests the presence of illite and muscovite structures in the pottery.

3. Albite: An absorption band at 1600 cm^{-1}, associated with albite, was detected in the Tell Aswad samples but was notably absent in Sample 1.

4. Calcite: Absorption bands at 1874 cm^{-1}, 1713 cm^{-1}, and 1436 cm^{-1}, consistent with calcite, were identified in the Tell Aswad pottery samples.

5. Quartz: An absorption band at 1778 cm^{-1}, accompanied by a doublet band at 1801 cm^{-1}, indicative of quartz, was observed in these samples.

6. Feldspar/Orthoclase: Absorption bands in the range of 900–1200 cm^{-1} correspond to feldspar/orthoclase mineral structures. Specifically, bands at 1113 cm^{-1} and 1143 cm^{-1} in the clay samples are diagnostic of plagioclase feldspar. The band at 1070 cm^{-1}, associated with Si-O stretching vibrations, further supports the presence of silicate minerals. The bands at 1113 cm^{-1} and 1143 cm^{-1} also exhibit a comb-like spectral pattern characteristic of silicon bonding environments.

7. Organic Material: An absorption band at 1621 cm^{-1}, characteristic of carbonyl (C=O) stretching vibrations, suggests the presence of organic material in the Tell Aswad pottery samples. However, this feature is absent in Sample 1. Additionally, two distinct bands at 1292 cm^{-1} and 1285 cm^{-1}, attributable to C-H bending vibrations, further indicate organic components. These organic signatures are also absent in Sample 1.

In summary, the FTIR analysis of the Tell Aswad pottery samples revealed the presence of illite/muscovite, albite, calcite, quartz, feldspar/orthoclase, and organic materials, while confirming the absence of kaolinite. These findings provide insights into the mineralogical and organic composition of the pottery slip at Tell Aswad.

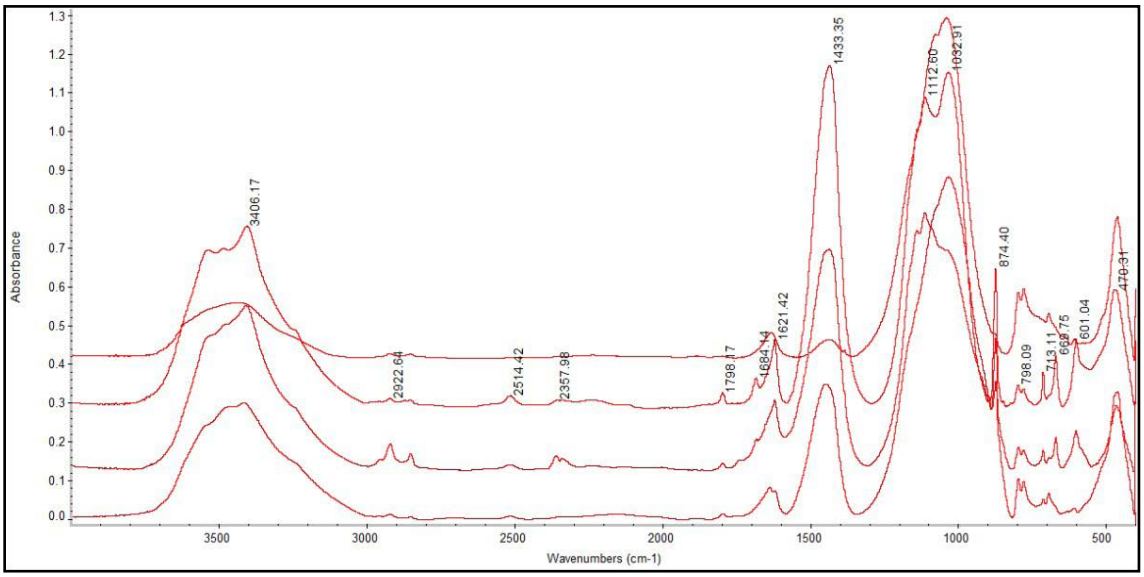


Chart 9: FTIR test results for pottery samples 4, 7, 11, 1 discovered from Tell Aswad (Authors, 2024).

Using the Munsell Soil Color Chart, the Tell Aswad pottery sherds were classified into four distinct slip color categories: orange ware, pea ware, brown ware, and two-colored ware.

Orange Ware: The orange ware pottery from Tell Aswad (with Munsell color codes 5.5YR 7.5/6.7, 4.2YR 7.1/4.8, 6.6YR 8.0/5.1, 3.3YR 5.9/9.2, 0.7YR 6.9/4.6, and 0.3YR 7.3/6.3) represents the most abundant pottery type at the site. It can be categorized into three distinct groups:

1. Medium Orange Ware: This group consists of handmade pottery with thin orange slips applied to both surfaces. It contains organic temper and medium to coarse mineral particles, exhibits well to high firing ranges, and has wall thicknesses of 1-2 cm.

2. Coarse Orange Ware: Also handmade, this type features interior and exterior slips, organic temper with coarser mineral particles, and medium firing (though some high-fired examples exist). The walls are thicker, measuring 1.5-3 cm.

3. Medium Wheel-Made Orange Ware: This group is characterized by thinner walls (0.7-1.5 cm), similar slip applications, and organic temper with medium-coarse mineral particles.

Pea Ware: The pea ware from Tell Aswad, with Munsell color codes 9.0YR 7.9/5.9 and 5.1YR 8.1/3.4, has been categorized into three groups:

1. Medium Pea Ware: This handmade pottery features pea-colored slips on both surfaces, contains organic temper with medium-to-coarse mineral particles, was fired at medium to high temperatures, and has wall thicknesses of 1-2 cm.

2. Fine Pea Ware: Also handmade, this type has thin slips that match the clay paste color. It is distinguished by fine mineral temper, high firing temperatures, and thin walls (0.4-0.5 cm).

3. Medium Wheel-Made Pea Ware: This group features pea-colored slips on both surfaces, contains organic temper with medium mineral particles, was high-fired, and has intermediate wall thicknesses of 1-1.5 cm.

Brown Ware: The brown ware from Tell Aswad displays Munsell color codes of 7.1YR 7.0/3.3 (light brown) and 2.2YR 6.0/1.8 (dark brown/blackish brown). This handmade pottery has a monochromatic surface, with both interior and exterior coated in thin brown to blackish-brown slips. The fabric contains organic temper with either medium-sized or fine mineral particles. Most examples were high-fired, though a minority show medium-fired characteristics. The ware has wall thicknesses ranging from 0.5-2 cm, with thinner examples typically containing finer mineral particles.

Two-Colored Ware: Eight sherds of two-colored pottery were obtained from Tell Aswad. This type is medium ware and handmade, though some sherds are wheel-made. It features an outer slip of thin clay in cream, pea green, and red or brown colors, and an inner slip of thin clay in red, orange, and cream colors. This pottery contains both organic and mineral temper and is highly fired.

6-2. Decoration with Color

Traces of colored pigments in red, cream, and brown have been observed on 8% of the pottery sherds (six sherds) discovered at Tell Aswad (see: Figs. 11a and 11b).

Fig. 11a-b: Tell Aswad's pottery sherds are decorated with color (Authors, 2024).

6-3. Carved Decorations

These decorations are created by carving into semi-dry pottery using sharp, pointed tools. This type of decoration was found on 6% of the pottery sherds from Tell Aswad. Examples include geometric circular designs (one sherd, see Fig. 13 and sketch 13) and horizontal band decorations on the upper half of the pottery vessel (two sherds, see Figs. 12a and 12b). Additionally, comb-shaped decorations are also present in the pottery from this site.

Fig. 12a-b: Horizontal band-type carved decorations from Tell Aswad pottery (Authors, 2024).

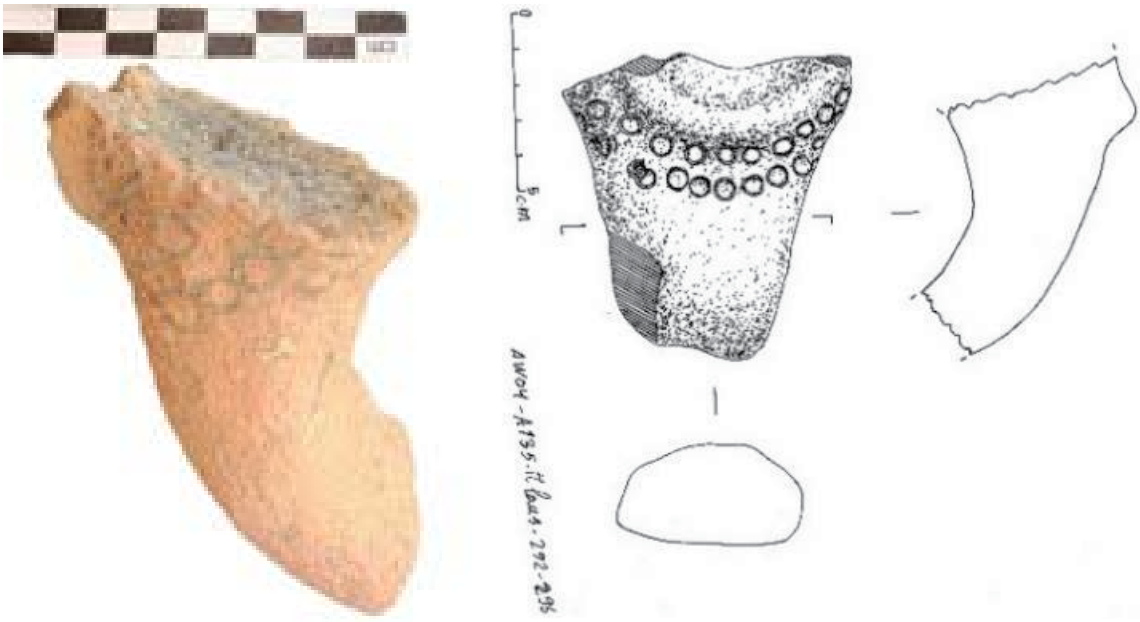


Fig. 13 & Sketch 11: Handle with geometric decorations carved in a circular shape (Authors, 2024).

6-4. Embossed Decorations

Small pieces of clay added to the body of a vessel in various forms are referred to as "added patterns." In some cases, these additions or raised elements serve purely decorative purposes. In other instances, they are intended to enhance the strength or usability of the object. Embossed decorations are found in 4% (3 sherds) of the pottery sherds from Tell Aswad. These decorative elements appear as broad horizontal bands, meticulously crafted using the added pattern technique and applied horizontally along the upper section of the pottery sherd (Fig. 14 a-b).

Fig. 14 a-b: embossed decorations including horizontal bands created with the added-pattern technique on Tell Aswad pottery (Authors, 2024).

7. Dating the Tell Aswad Pottery Using the Thermoluminescence Method (TLOSL)

The thermoluminescence (TL-OSL) dating method is a significant tool in archaeological research, as it allows for direct and accurate dating of ceramics, pottery, and burnt bricks. Its advantages include rapid analysis, minimal sample requirements (only milligrams), and an error margin of 5–10%. This study utilized TL-OSL to determine the age of pottery sherds from Tell Aswad, thereby establishing a precise chronology for the site. Twelve pottery samples were selected from various trenches and layers at Tell Aswad and analyzed using a RISO TL/OSL DA-20 device at the laboratory of the Syrian Atomic Energy Commission. Each sample consisted of 300 mg. It is important to note that the thermoluminescence dating results have a margin of error of ±120–250 years. The analysis revealed that the pottery from Tell Aswad spans multiple chronological periods: the Neolithic period (c. 6000 BC), the Chalcolithic period (c. 3400 BC), the Bronze Age (1800–1200 BC), the Iron Age (c. 800 BC), and the Roman period (571 CE), (Table 7).

8. Analysis and Decision

In this study, a total of 73 pottery sherds from the Neolithic site of Tell Aswad were analyzed and examined. The classification of the sherds was based on their form, manufacturing techniques, and decorative features.

Table 7: Results of the thermoluminescence dating test "TLOSL" (Authors, 2024).

No	Catalog number	Trench	Layer	Context	Locus	Sample Age (years BP)
1	60	A130	-	435	D132	3266 (1266 BCE)
2	21	F135	-	315	G315	2200 (200 BCE)
3	5	Zv135	296	292	TL	3600 (1600 BCE)
4	53	A135	296	292	TL	5400 (3400 BCE)
5	11	A135	296	292	C137	1571 (571 CE)
6	63	A125	Fosse82	188	B127	2542 (542 BCE)
7	7	Zv142	526	472	Cuvette	8000 (6000 BCE)
8	49	A135	296	292	A137	3200 (1200 BCE)
9	50	A135	296	292	TL	2874 (874 BCE)
10	16	A135	296	292	TL	3700 (1700 BCE)
11	15	A135	296	292	TL	3800 (1800 BCE)
12	70	Zv130	-	453	Zy133	3400 (1400 BCE)

Form: The pottery from Tell Aswad includes bowls (both deep and shallow), jars, large earthen jars, and pots (open-mouth and closed-mouth varieties).

Manufacturing Technique: The pottery was categorized into three groups based on thickness:

• Coarse ware: 10% of the samples, with a thickness greater than 1.4 cm.

• Medium ware: 85% of the samples, with a thickness ranging from 0.7 to 1.4 cm.

• Fine ware: 4% of the samples, with a thickness less than 0.7 cm (Chart 2).

This indicates that medium-sized sherds are the most prevalent at Tell Aswad.

Manufacturing Method: The pottery was either handmade (62 sherds) or wheel-made (11 sherds), (Chart 3).

Pottery Temper:

• 82% of the pottery had both organic and mineral temper.

• 18% had only mineral temper (Chart 4).

Firing Temperature:

• 78% of the pottery was fired at a high temperature.

• 19% at a medium temperature.

• 2% at a very high temperature.

• 1% at a low temperature (Chart 5).

Decoration:

• 90% of the pottery had slip-type decorations in colors such as orange, brown, and pea-green, covering both the interior and exterior surfaces.

• 18% featured carved, embossed, and colored decorations.

Scientific Analysis:

• Thermogravimetric Analysis (TGA) indicates that the pottery was fired at approximately 1000°C.

• Scanning Electron Microscopy (SEM) reveals that the temper in the pottery includes mineral

crystals, silica, and organic materials. The presence of fused silica suggests that the sherds were fired at very high temperatures, contributing to their high strength.

• Fourier Transform Infrared Spectroscopy (FTIR) analysis of the slip on the sherds shows that it contains minerals such as albite, muscovite, calcite, and orthoclase, as well as organic components.

Dating: Some of the pottery sherds at Tell Aswad are wheel-made, indicating that they belong to both prehistoric and historical periods. This is further confirmed by thermoluminescence dating conducted on 12 pottery samples. The results are as follows:

• One sherd (sample number 7) dates to the Neolithic period, around 6000 BCE.

• One sherd (sample number 4) dates to the Chalcolithic period, around 3400 BCE.

• Six sherds (sample numbers 1, 3, 7, 10, 11, and 12) date to the Bronze Age.

• Three sherds (sample numbers 2, 6, and 9) date to the Iron Age.

• One sherd (sample number 5) dates to 500 CE.

These findings provide a comprehensive understanding of the pottery from Tell Aswad, its production techniques, and its chronological context.

9. Conclusion

Tell Aswad, a Neolithic site located in the Damascus Basin, has yielded 73 pottery sherds to date. Through the examination of these sherds analyzing their typology and employing thermoluminescence dating the following findings have been established:

Typology of Pottery Findings: The pottery from Tell Aswad was classified based on its form and manufacturing techniques, including vessel type, production methods, and decorative styles.

1. Typology Based on Vessel Form: The pottery at Tell Aswad includes bowls, jars, pots, and large earthen jars. This indicates a limited variety in vessel forms.

2. Typology Based on Manufacturing Technique:

• Medium Pottery Type: This category constitutes 85% of the pottery found at Tell Aswad.

• Manufacturing Method: Most of the pottery sherds were handmade.

• Tempering: Two types of tempering were observed—mineral and organic-mineral. Organic-mineral tempering is predominant, accounting for 82% of the pottery.

• Firing: 78% of the pottery was fired at high temperatures.

• Decoration: 90% of the pottery features a slip coating, while only 18% exhibits carved, embossed, or colored decorations.

From these findings, it can be concluded that the potters of Tell Aswad were skilled in pottery production, particularly in selecting temper materials, controlling firing temperatures, and employing various handmade techniques, such as nesting. However, the pottery decoration was relatively simple and limited, with only 18% of the sherds showing decorative elements.

Dating of Tell Aswad Pottery: The typology of Tell Aswad pottery (including its forms and manufacturing techniques) and the presence of wheel-made pottery suggest that the site dates to multiple periods, spanning both prehistoric and historical eras.Thermoluminescence dating

of twelve pottery samples further supports this, indicating that the pottery dates to the sixth, fourth, second, and first millennia BCE. Tell Aswad is not merely a Neolithic site. Instead, it was continuously inhabited from the Pre-Pottery Neolithic (PPN) period through the Pottery Neolithic (PN), Chalcolithic, Bronze Age, and into historical periods.

Endnotes

1. A layer of soil in this site has been removed due to military operations conducted therein.
2. It is imperative to acknowledge that the primary objective of the excavation at Tell Aswad was to investigate the beginnings of agriculture and animal domestication, and to study the plastered skulls. Consequently, the pottery sherds identified in this site have not been the focus of attention.
3. Riso TL/OSL DA-20: Technical Specifications: Irradiation sources: Beta radiation (90Sr/90Y). Optical stimulation: either blue LEDs (470 nm, 80 mW/cm2) or IR LEDs (870 nm, >135 mW/cm2). Thermal stimulation: up to 700 oC at heating rates from0.1 to 10 K/s. OSL and TL signals detection: with a blue/UV sensitive photo electron multiplier tube (PMT), with maximum detection efficiency between 200 and 400 nm. detection filters: Hoya U-340 (7.5 mm thick, ø = 45 mm), Schott BG 39 (2 mm thick, ø = 45 mm), Corning 7-59 (4 mm thick, ø = 45 mm). Sample positions: 48 individual sample positions. Operating environment: darkroom (red light).
4. The presence of Jebeil point arrowheads and ornaments, which date back to the same period, in these same layers has been discovered.
5. The whiteware is made from lime powder. It has a polished outer and inner surface and is fired at a medium to high temperature.
6. Scanning Electron Microscope (SEM) XL Chamber With CCD Motorized. stage SED BSED.
7. Features: ETC EverGlo source for long life. Dynamic Alignment ensuring exceptional high-resolution line shapes. USB 2.0 interface, Full integration with the OMNIC software. allowing the user to focus on their studies. Configurable for multiple spectral ranges (far-IR to UV-Vis). Five external beam options. Wide selection of detectors.

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Authors' Contribution

A.B. and C. conceived of the presented idea. A.B. developed the theory and performed the computations. D carried out the experiment A.B. and C.D. verified the analytical methods. All authors discussed the results and contributed to the final manuscript.

Conflict of Interest

Authors declared no conflict of interest.

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چکیده

یکی از مهم‌ترین محوطه‌های دورهٔ نوسنگی در جنوب‌غرب سوریه محوطهٔ تل اسود می‌باشد. این محوطه توسط «دوکنتنسن و استوردر» کاوش شده و تعداد محدودی قطعات سفال به‌دست آمده است. کاوشگران قطعات سفال شناسایی شده در تل اسود را به دورهٔ نوسنگی باسفال نسبت داده‌اند، در صورتی که در بررسی‌های کارگاهی انجام‌یافته توسط نگارندگان، مشخص گردید که این قطعات سفالی به دوره‌های نوسنگی، مس‌وسنگ، مفرغ و دوران تاریخی قابل انتصاب هستند. مسأله اصلی این پژوهش، گونه‌شناسی سفال تل اسود براساس فرم و تکنیک ساخت، و مشخص کردن تاریخ‌گذاری دقیق محوطه تل اسود براساس یافته‌های سفالی با استفاده از روش آزمایش سالیابی ترمولومینسانس می‌باشد؛ از این‌رو، تلاش خواهد شد به پرسش‌های طرح شده پاسخ داده شود؛ ۱. یافته‌های سفالی تل اسود ازلحاظ گونه‌شناسی و مطالعهٔ ساختاری به چه شکل قابل معرفی است؟ ۲. تاریخ‌گذاری مطلق با استفاده از آزمایش سالیابی ترمولومینسانس تل اسود به چه شکل قابل تعیین می‌باشد؟ در این پژوهش، گونه‌شناسی براساس فرم و تکنیک ساخت به‌همراه آزمایش ترمولومینسانس انجام خواهد شد. سفال‌های این محوطه ازلحاظ فرم و تکنیک تزئین تنوع زیادی ندارند، ولی ازلحاظ تکنیک ساخت به‌نظر می‌رسد که سفالگران تل اسود در زمینهٔ ساخت سفال تجربهٔ کافی داشته‌اند. براساس نتایج تاریخ‌گذاری یافته‌های سفالی با استفاده از روش ترمولومینسانس می‌توان گفت که با توجه به این‌که استقرار در تل اسود از دورهٔ نوسنگی بدون سفال آغاز شده است، ولی سفال‌های به‌دست آمده نشان‌دهندهٔ دورهٔ نوسنگی تا دوران تاریخی هستند.

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