

A Stone Oil Lamp with Seven Nozzles Carved with Jewish Symbols from the Late Second Temple Period.

A circular oil lamp 22 cm in diameter with seven nozzles was archaeometrically studied to verify its authenticity. Traditional Jewish decorations are carved in the upper part of the lamp: a seven-branched Menorah (candelabrum), wheat ear, a basket with figs, pomegranates, date palm tree, grape leaf and grapes, olive branches and barley ear. Most of the symbols are similar to those found on Jewish coins of the period. It is made of silica-enriched chalk of the Early Senonian sequence exposed in the Jerusalem area. This oil lamp is the product of the Jewish limestone industry that flourished during the late Second Temple period in Jerusalem (first century CE), related to religious purity laws. The prevalence of malleable silicified chalk in the Jerusalem environs and sophisticated processing techniques such as use of a lathe facilitated the production of this stone oil lamp. The distribution of the chemical elements of the patina is identical to those elements found in the stone. Soot was found embedded within the multi-layered patina which is attached firmly to the lamp's outer and inner surface. Microcolonial fungi structures and minerals are indicative of natural long-term development in a subsurface burial setting. All of these factors reinforce its authenticity.

By Amnon Rosenfeld

Geological Survey of Israel,
Jerusalem, Israel

Shimon Ilani

Geological Survey of Israel,
Jerusalem, Israel

W.E.K. Krumbein

Department of Geomicrobiology, ICBM,
Carl von Ossietzky Universitaet, Oldenburg,
Germany

H. R. Feldman

The Anna Ruth and Mark Hasten School,

Touro College, Division of Paleontology, N.Y.
American Museum of Natural History,
New York

Steve Daren

Daren Laboratories and Scientific Consultants,
Nes Ziona, Israel
July 2011

INTRODUCTION

An ancient chalk oil lamp was archaeometrically studied to verify its authenticity. The rock was originally a soft, fine-grained chalk rich in marine microfossils but intense recrystallization processes destroyed the calcitic microfossils and the rock has hardened and became a silicified chalk (limestone). The stone lamp is circular, beige in color has seven nozzles and a round handle arranged in perfect octagonal symmetry (Fig. 1). It is 22 cm in diameter, 6.7 cm in height, about 800 cm³ in volume and it weighs 1640 g. The upper part of the lamp is carved in relief with traditional Jewish decorations (clockwise): a seven-branched Menorah (candelabrum; Fig. 2), wheat ear, a basket with figs, three pomegranates (Figs. 1, 3) date palm tree (Fig.4) and grape leaf with grapes, two olive branches and barley ear (Fig.5). The exterior surface of the lamp is smooth. The fact that the oil lamp is carved from a limestone (hard chalk) suggests that it is a product of the Jerusalem material culture of the local inhabitants that was widely produced and used during the Second Temple Period (first century CE; Magen 2002). The oil lamp was probably used in rituals that necessitated that laws of purity be followed.

The oil lamp was bought in the year 2000 on the antiquity art market of Jerusalem and lacks an archaeological provenance. It was said to be discovered near a village, northeast of Jerusalem. It is now stored at the Israel Antiquities Authority in Jerusalem. The purpose of this article is to prove whether this decorated stone oil lamp is authentic or a modern forgery.

For the analytical methods and the sampling of the patina and the rock of the stone oil lamp, please refer to Rosenfeld et al., (2010).

THE TYPOLOGY OF THE LAMP

The base of the lamp is smooth and flat. The wall of the lower part is somewhat slanted, widening toward its upper part. The lamp is octagonal and radially symmetrical with the outer circle divided to seven nozzles and a handle (Fig. 1). The upper part of the lamp consists of three concentric circular zones. A small inner one comprises the filling hole, 5.7 cm in diameter, and lacks a rim. Around it, in a 3.6 cm circular zone bordered by a ridge are carved eight decorations. The thickness of this zone is between 3 and 5 mm. The third circle comprises the radiating nozzles and longer handle. Each nozzle has a depression tangent to the ridge (probably for a better grip). The nozzles become narrower toward their edge. In plan view, the upper parts of the nozzles are elongated rectangles. The wick holes, or nozzles are 1.1 cm in diameter and were carved by a drilling technique, leaving spirally concentric marks (Fig. 6). The inside bottom of the oil reservoir has a step-like series of separate, circular grooves. The undulating calcitic patina deposited on the step-like drilling marks in the internal reservoir and the inside oblique outlet of a nozzle (wick hole) into the reservoir of the stone oil lamp can be seen in Figure 7. The handle is doubled looped, perpendicular to its wall, and longer than the nozzles (Fig. 1).

The decorations on the lamp consist of the Menorah (candelabrum; Fig.2) of the Temple with its seven branches and the “Shiv’at Haminim,” the seven plant species (Figs.1, 3, 4 and 5) symbolizing the Land of Israel (Deuteronomy, 8:8). These eight symbols are carved in relief in a circled pattern around the filling hole of the lamp. The lamp's axis of symmetry runs along the handle through the palm tree and toward the Menorah.

The seven-branched Menorah (Fig. 2), which is 2.6 cm in height and width, is built of three half concentric slightly asymmetrical circular branches arranged on both sides of a vertical stem composed of articulated astragal-like beads with a triangular (pyramidal) base. There seems to be a weathered single nozzle oil lamp carved at the top of each branch of the Menorah. Thus, the Menorah was probably the stand for holding seven single oil lamps. A similar, nozzle oil

lamp with a jutting wick that lies at the end of each Menorah's branch can be seen in the mosaic from the Samaritan synagogue at El-Khirbe (now at the Good Samaritan Inn museum in Ma'ale Adumim, east of Jerusalem). The height to length ratio of the Menorah is 1, (equal) similar to the proportion mentioned in the Talmud (Menakhot, 28b). The closest Menorah comparable to this is the one incised upon the wall of the Priests' House in Jerusalem (Avigad, 1980, fig. 154) with its tripod base, and the Menorah depicted on the Arch of Titus in Rome (except the base). This Menorah is similar in shape and proportion to the lamp depicted on the Mattathias Antigonus coin (37 BCE) (Avigad, 1980, fig. 155; Meshorer, 1967, pl. 5, fig. 36, 36A; 2000, p. 45) except the tripod base.

On the right side of the Menorah there are curved ear of wheat whereas on the left side there are curved ear of barley (Figs. 1, 3 and 5). Both sets incline toward the Menorah. The shapes of the wheat and barley resemble those found on Jewish coins from the times of the Procurator Ambibolus, under Augustus (9-12 CE) (Meshorer, 1997, pl. 73, figs. 313-315; 2000, p. 15). A similar curved ear of barley is depicted on a Jewish coin from the time of the Procurators Coponius (6-9 CE) and Marcus Ambibolus (9-12 CE) under Augustus (Hendin, 1996, figs. 635-638; Meshorer, 1997, pl. 73, figs 311-315). To the left of the barley are two olive branches, diverging from one stem at a 60° angle. The olive branches depicted on the Jewish coins of the Procurator Pontius Pilatus under Tiberius (26-36 CE; Meshorer, 1997, pl. 74, fig. 333, 333a-333e) could be the inspiration to this decoration of the oil lamp. To the left and slightly below the olive branch is a grape leaf, associated with a bunch of grapes and a small twig (Fig. 5). Resembling the leaves found on the Jewish coins from the time of Tiberius and the Procurator Valerius Gratus, (15-26 CE; Hendin, 1996, fig. 643; Meshorer, 1967, pl. 29, fig. 224; 1997, pl. 74, fig. 326, 326a). A similar leaf and bunch of grapes are painted on a wall of a Jewish cemetery of the late Second Temple Period in Jericho (Hachlili and Killebrew, 1999). To the right of the wheat is badly preserved a braided basket carved in cross section, with what appear to be figs (pigeon?), similar to fig baskets (but without the handle) on the Darom (South) lamps (Sussman 1972, figs, 14 - 15, p. 66). To the right and slightly below the fig basket are three pomegranates, branching from a single stem, that symbolize plenty. These are found on Jewish coins from the first Jewish rebellion in 66-70 CE (Avigad, 1980, figs. 238-239; Meshorer, 1967, pl.19, figs. 148 – 152, pl. 20, figs. 158-159, 164; 2000, p. 35). Below the Menorah are a palm

tree with six wide, full palm branches and two small clusters of dates hanging on both sides (Figs. 1 and 4). The palm tree symbolizes the Land of Judea as well as honey made from dates. The closest similarity to this illustration is found on Jewish coins from the times of Procurators Coponius (6-9 CE), Marcus Ambibulus (9-12 CE) under Augustus; (Hendin, 1996, figs. 635-638; Meshorer, 1997, pl. 73, fig. 313), and Antonius Felix, under Claudius (52-59 CE); (Hendin, 1996, fig. 652). Most of the Jewish decorations of this stone oil lamp is similar to the coinage folklore of the first century CE, before 70 CE.

THE COMPOSITION OF THE STONE

The oil lamp composed of hard chalk (limestone) from the Cretaceous Period and composed of calcium carbonate (calcite). Geologically, all chalks to the east of Jerusalem belong to the Senonian Menuha Formation and consist of abundant marine microorganisms (Mount Scopus Group, Flexer *et al.* 1990). The lower part of the chalk sequence (Early Senonian) is well cemented rock named “Ka’akule” member, that is up to 10 m in thickness. This unit in the Jerusalem area contains up to 15% silica. In the stone sample there is no evidence of microfossils indicating intense recrystallization. These processes involved influx of siliceous solutions that formed a relatively homogeneous, hard type of rock, attaining isomorphic physical properties (Arkin *et al.* 1993). Thus, it is an excellent rock for carving and drilling, almost free of lines of weakness or unexpected fractures that may appear during the production of the artifact. An examination of the stone from which the lamp is made (Tab.1) indicates that the rock consists of calcium carbonate crystals, 2-40 microns in size. The average concentration of elements by weight percentage (Table 1 by SEM-EDS) of the stone is as follows: carbon 16.8 - 20.3%, oxygen 34.5-40.9%, fluorine 0.6-1.8%, sodium 0.2-1.2%, magnesium 0.2-0.4%, aluminum 1.0-2.8%, silicon 0.4-10.7%, potassium 0.2-0.7%, calcium 27.7–36.9 % and iron 0.3-0.8%.

THE COMPOSITION OF THE PATINA

The extraction of minerals from the stone, the sedimentation of airborne dust particles and/or the interaction with the burial environment and the micro-organisms living on the stone

surface, all contribute to changes in the morphological and mineralogical surface of the stone, (including color changes). Changes of the stone's surface are known as patination, a thin outer layer of patina produced on the surface of a rock by weathering after long exposure (Neuendorf et al., 2005).

The patina of the lamp is multi-layered (Fig. 8), indicating slow development over an extended period of time and that the burial conditions changed or fluctuated with time. Some soot can be seen within each of the seven nozzles embedded in, and covered by white patina. The traces of soot indicate that this decorated lamp was in use and was not for aesthetic purposes only. The oil lamp might not have been used often because calcareous material deteriorates while subjected to intense and prolonged heat. The silica content within the carbonate of this lamp contributes physical strength to that chalk as well as the ability to sustain heat. On the patina tiny iridescent fragments of glass (of the environment) can be seen. The concentration of elements in the patina by weight percentage (Table 1), observed range is as follows: carbon 10.9-24.8%, oxygen 19.2-32.6%, fluorine 1.1-7.5%, sodium 1.9-6.0%, magnesium 0.2-1.1%, aluminum 2.3 - 5.6%, silicon 18.6-38.5%, sulfur 0.1-0.8%, chlorine 0.1-1.2%, potassium 0.4-1.5%, calcium 8.1-19.6% and iron 1.3-3.1%.

The white layered patina from the upper part of the lamp that also covers the decorations is composed of the same material (calcite and silica) as the rock itself but is less crystallized and less compact. Based on mineralogical analysis, the oil lamp patina contains calcite associated with quartz grains and only traces of small aggregates of fluorite, small amounts of whewellite (calcium oxalate) and apatite (calcium phosphate). The brown material coating the sides of the oil lamp is composed of clay minerals rich in calcium carbonate, with almost equal amounts of silica and calcite. This soil is typically developed on chalky terrains, occurs in or adjacent to Jerusalem and is most probably represents the environmental soil that was in contact with the oil lamp.

Examination of the elemental composition of the patina (Table 1) reveals rather variable concentrations. This chemical heterogeneity in the concentrations of the elements is natural and

characteristic of differential biological activity of the micro-organisms in different locations related to many micro environmental factors. The color and thickness of the patina on the vessel's surface is not uniform. It is brownish-yellow to dark brown and white on the vessel's upper surface whereas inside the nozzles it is white to grayish-brown. The thickness of the patina ranges from 0.1 mm to 1 mm. The patina indicates normal carbonate deposition with microcrystalline carbonate and oxalate-type of deposition (whewellite), (Rosenfeld et al., 2010, figs. 9-10). The interior of the lamp is coated with the same carbonate patina as is found on the exterior of the lamp. The patina and the deposits on the vessel's surface were developed during burial. Chemical analyses of the patina found no trace of any modern elements, adhesive or bonding substance. In addition, we found no indication that the lamp had been significantly treated, cleaned or enhanced.

MICROCOLONIAL FUNGI

Biodeterioration of stone can be caused by microorganisms, such as bacteria, fungi and lichens, or plants such as mosses. The biodeterioration of the stone by fungi is caused by etching the surfaces due to acid excretion, as well as by physical penetration of the surface itself. Microcolonial fungi (MCF), known to concentrate and deposit manganese and iron, play a key role in the alteration and biological weathering of rocks and minerals (Staley *et al.* 1982; Gorbushina 2003; Ilani *et al.* 2008). They are microorganisms of high survivability, inhabiting rocks in extreme conditions, and are also known to survive in subsurface and subaerial environments (Krumbein 2003; Krumbein and Jens 1981; Sterflinger and Krumbein 1997). Long-living black yeast-like fungi were found inside the patina of the wheat decoration forming pitted embedded circular structures of 1-5 microns in size (Rosenfeld et al., 2010, figs, 9-10). The fungi were identified as *Coniosporium* sp. and related species belonging to a group of dematiaceous black yeasts that grow in colonies very slowly over dozens to hundreds of years. We found traces of phosphates and oxalic acid products, such as apatite (calcium phosphate) and whewellite (hydrated calcium Oxalate) in the patina of the stone oil lamp. These minerals are the products of the microorganism living on the stone surface over a prolonged period, leaving these mineralogical traces on the stone, changing its surface and building the patina.

DISCUSSION

The oil lamp is carved with Jewish symbols of the “Menorah” and “Shiv’at Ha’Minim.” These most important Jewish symbols are found together on this lamp for the first time. Multi-nozzle oil lamps, some with seven nozzles arranged in a circle, are known from the Hellenistic, Roman and Byzantine periods. These lamps were mainly ceramic, produced on a potter’s wheel and molded. Oil lamps made of stone (limestone) were found broken and fragmented in the excavations in the City of David of the early Hellenistic Period (Kahil 1992), in the Burnt House in the Jewish Quarter of the early Roman Period (first century CE), and at Masada of the same period (Barag and HersHKovitz 1994). Stone workshops were located in Jerusalem and its immediate surroundings during the early Roman Period where the Jewish stone vessel industry flourished (Magen 1984, 1988, 1994, 2002). The type and the shape of the lamp, its composition and the configuration of these symbols relate its production to the first two thirds of the 1st century CE, before the destruction of the Second Temple (70 CE; Varda Sussman, personal communication). The isomorphic physical properties of this limestone, due to its relative high silica content, facilitated the drilling and the carving work. The spiral drill marks in the nozzles (and in the reservoir of the stone oil lamp (step-like pattern; Figs. 6, 7) suggest the use of a slow speed lathe and/or a bow drill that was very common during the Roman period (Ogden, 1982; Rosenfeld et al., 2003).

The patina is attached firmly on and inside the lamp’s walls. The patina on the stone oil lamp is multi-layered (Fig. 8) indicating naturally slow development over an extended period of time. The soot within the nozzles is embedded in and covered by the white patina layers. Morphological analysis of the patina on the stone lamp indicates that it is continuous and uninterrupted with some traces found on all sides, its underside, on the ornamentation as well as on the outer rim and inside the lamp itself, including inaccessible sites such as inside the nozzles. The occurrence of multi-colonial fungi structures and calcium-oxalate mineralization indicates the natural development of the patina in a ground or cave environment. The patina developed simultaneously over the entire oil

lamp, including the carvings.

There is no indication that the surface of the stone lamp was cut, scratched or etched in recent times. No modern substances or bonding material were found in the patina. Microscopic examination of the surface of the oil lamp and its patina layering, indicate that the stone oil lamp and the ornamentation were produced during the same time period and that no changes were made to the lamp's surface other than limited treatment or cleaning if any.

The distribution of the same chemical elements were found both in the stone as well as in the patina (Table 1). The enrichment of the silica, aluminum and potassium in the patina (compared to the stone) is due to the contribution of quartz grains and clay minerals from the environment-the soil and the airborne dust particles (Ganor et al., 2009). The presence of similar elements both in the stone and the patina in variable concentrations and the additional environmental materials (quartz grains clay minerals and micro-organism extracts like oxalates), indicates that the patina is most probably authentic (*cf.* Ilani *et al.* 2008). The occurrence of sodium chlorine indicates contact with water and soil, a well-known phenomenon with archaeological artifacts in this area. The occurrence of the fluorine both in the stone and in the patina originates probably from the fluorite micro-crystals found in the stone.

The oxalic acids and other traces of minerals of the micro-organism occurring in the patina and on the stone surface provide a direct indication of the duration of these biogeochemical lifecycles reactions on the stone. According to the identified micro-organism (MCF) and its mineral traces, we can suggest with certainty that at least a period of 50-100 years, up to a period of hundreds of years was necessary for the formation of the multiple carbonate bio-organic layered patina.

CONCLUSIONS

The lamp was produced during the Second Temple Period (First century CE)

in Jerusalem and represents a Jewish tradition related to religious purity laws.

Traditional Jewish decorations are carved in the upper part of the lamp: a seven-branched Menorah, a date palm tree, a grape leaf and grapes, olive branches, wheat ear, barley ear, a basket with figs and pomegranates. Similar motives are found also from the coinage assemblage known from around the turn of the first century CE and before 70 CE (the destruction of the second Temple). The religious Jewish restrictions, the prevalence of malleable siliceous chalk in the Jerusalem environs and the sophisticated processing techniques such as use of a lathe facilitated the mass production of stone vessels including the manufacturing of this stone oil lamp. The chemical elements of the stone and patina are similar and were extracted from the stone. MCF structures representative of fungal colonies that grow very slowly were found within the patina. The patina was found to be multi-layered and was also identified in concealed, inaccessible crevices. The MCF structures attached to the lamp's surfaces are indicative of natural long-term development of the patina of the stone oil lamp in a burial setting. The embedding of soot within the multi-layered patina of the stone oil lamp is another supportive evidence of its authenticity. We can say with a high level of probability that the oil lamp, including its ornamentations, was produced many centuries ago, probably just before 70 CE.

ACKNOWLEDGEMENTS

We thank Prof. Z. Safrai, Bar-Ilan University, Faculty of Jewish Studies, Ramat-Gan, Israel and Dr. Z. Lewy, Geological survey of Israel, Jerusalem for their comments. Thank are due to Dr. V. Sussman for her remarks regarding the typology of the decorations on the oil lamp. Thanks to Prof. J. Harrell Toledo University, Ohio for his constructive geological remarks.

REFERENCES

Arkin, Y., Michaeli, L., and Wolfson, N. 1993. University road approaches to Har Ha'Zofim tunnel borehole investigation, *Geological Survey of Israel Report* GSI/19/93, Jerusalem, 39 p.

- Avigad, N., 1980. The upper City of Jerusalem. *Shikmona Press LTD, Jerusalem*, (in Hebrew), 265 p.
- Barag, D., and Hershkovitz, M. 1994. Lamps from Masada, in Masada IV. The Yigael Yadin Excavations 1963-1965, *Final Reports*. Jerusalem, 147 p.
- Flexer, A., Honigstein, A. Rosenfeld, A., and Polishook, B. 1990. Geology, geo-technical properties and exploitation of chalk in Israel – an overview, in *Chalk. Chalk symposium in Brighton Polytechnic*, 1989. Thomas Telford, London, 63-70.
- Ganor E., Kronfeld J., Feldman H.R., Rosenfeld A., Ilani S. 2009. Environmental dust: A tool to study the patina of ancient artifacts *Journal of Arid Environments* **73**, 1170–1176
- Gurbushina, A., 2003. Microcolonial fungi: survival potential of terrestrial vegetative structures, *Astrobiology*, 3, 543-554.
- Hachlili, R., Killebrew, A.E. 1999. Jericho. The Jewish Cemetery of the Second Temple Period. Israel Antiquities Authority, Rep. No 7, 202 p.
- Hendin, D. 1996. Guide to Biblical Coins. Nyack, N.Y. Amphora, 315 p.
- Ilani, S., Rosenfeld, A., Feldman, H. R., Krumbein, and W. E. K., Kronfeld, J. 2008. Archaeometric analysis of the Jehoash Inscription tablet, *Journal of Archaeological Science*, 35, 2966-2972.
- Kahil, J.M. 1992. Chalk Vessels assemblages of Persian/Hellenistic and Early Roman periods, in *Exploration of the City of David*, (eds. A. De Groot, and D.T. Ariel), Qedem, 33, 190-274.
- Krumbein, W.E. 2003. Proceedings of the EC Conference Cultural heritage

Research: A Pan-European Challenge, 5, 39-47.

Krumbein, W.E., and Jens, K. 1981. Biogenic rock varnishes of the Negev Desert (Israel): an ecological study of iron and manganese transformation by cyanobacteria fungi, *Oecologia*, 50, 25-38.

Magen, Y. 1984. Jerusalem as the center for stone-ware production during Herodian times, *Qadmoniot*, 17, 124-127.

Magen Y. 1988. The Stone Ware Industry in Jerusalem of the Second Temple Period, *Society of Nature Conservation*, (in Hebrew), 161 p.

Magen, Y. 1994. The stone vessel industry during the Second Temple Period, in *Purity Broke Out in Israel*.(ed. O. Rimon), 7-27, The Reuven and Edith Hecht Museum, University of Haifa, Israel, 7-27.

Magen, Y. 2002. *the Stone Vessel Industry in the Second Temple Period – Excavations at Hizma and the Jerusalem Temple Mount*, Israel Exploration Society and Staff Officer of archaeology, Jerusalem, 186 p.

Meshorer, Y. 1967. *Jewish Coins of the Second Temple Period*. Am Hasefer Pub. Ltd. Tel-Aviv. 184 p.

Meshorer, Y. 1997. *A Treasury of Jewish Coins*. Yad Izhak Ben-Zvi Press. Jerusalem. 332 p.

Meshorer, Y. 2000. *Testimony. The Israel Museum, Jerusalem*. 63 p.

Neuedorf, K.K.E., Mehl, J.P.Jr., and Jackson, J. 2005. *Glossary of Geology* (5th ed.). American Geological institute, Alexandria, Virginia, 779 p.

Ogden, J. 1982. *Jewellery of the Ancient world*. New York; Rizzoli, 185 p.

Rosenfeld, A., Dvoracheck, M. and Amorai-Stark, S. 2003.

Roman Wheel-cut Engraving, Dyeing and painting Microquartz Gemstones.

Journal of Archaeological Science, 30, 227-238.

Rosenfeld, A., Ilani, S., Krumbein, W.E., Daren, S. and Feldman, H.R. 2010.

A Stone Oil Lamp with Seven Nozzles from the Late Second Temple Period –
First Century CE. *Liber Annuus*, 60, 377-391.

Staley, J.T., Palmer, F.E., and Adams, J.B. 1982, Microcolonial fungi common
inhabitants on desert rocks, *Science*, 215, 1093-1095.

Sterflinger, K., and Krumbein, W.E. 1997, Dematiaceous fungi as the main agent of
biopitting on Mediterranean marbles and limestones, *Geomicrobiology*
Journal, 14, 219-231.

Sussman, V., 1972, *Ornamented Jewish Oil Lamps from the Destruction of the*
Second Temple through the Bar Kokhba Revolt, The Bialik Institute and the
Israel Exploration Society, Jerusalem. (in Hebrew), 149 p.

Sample	C %	O %	F %	Na %	Mg %	Al %	Si %	S %	Cl %	K %	Ca %	Fe %
HU-1 P	10.9	28.0	4.6	6.0	1.1	5.0	24.9	0.8	0.5	1.0	15.7	1.7
S.D.	3.7	4.0	3.4	3.6	0.1	1.2	3.7	1.2	0.5	0.8	8.6	2.0
HU-2 P	12.9	27.8	3.2	1.9	0.3	5.4	38.5	0.1	0.1	0.5	8.1	1.3

S.D.	5.9	7.0	3.5	1.6	0.2	8.2	14.2	0.1	0.5	0.3	8.3	2.0
HU-3 P	24.8	19.2	1.6	3.1	0.7	5.6	23.8	0.2	1.2	1.5	15.3	3.1
HU-4 P	17.5	24.5	7.5	4.7	0.6	3.9	18.6	0.8	0.1	0.8	19.6	1.7
S.D.	9.6	7.5	6.3	3.5	0.3	4.4	12.8	1.0	0.2	0.8	11.6	2.2
HU-5 Sa	18.9	34.9	1.8	1.2	0.3	2.8	10.7	n.d	0.1	0.7	27.7	0.8
HU-5 Sc	20.3	40.9	0.8	0.2	0.2	n.d	0.4	n.d	n.d	n.d	36.9	0.3
GSI-1 S	16.8	34.5	0.6	-	0.4	1.0	10.2	-	-	0.2	34.6	0.4
GSI-2 P	21.4	32.6	1.1	-	0.3	2.3	24.2	-	-	0.6	14.6	1.5
GSI-4 P	22.9	31.2	2.3	-	0.2	5.2	18.7	-	-	0.4	17.8	0.6

Table 1. Distribution of elements on the patina and stone in weight percent (P = patina; S= stone; Sa = stone "aggregate" coarse fraction; Sc =stone cryptocrystalline fine fraction; S.D. = standard deviation; - = not measured; n.d = not detected). Note that the concentration of elements on the patina and the stone is similar; however, it is noteworthy that the patina contains elements derived from the rock. The samples designated with HU were analyzed by SEM-EDS in the Hebrew University, Jerusalem and represent an average of four measurements (sample HU-3 represent 2 measurements). The GSI Samples were analyzed by SEM-EDS in the Geological Survey of Israel, and represent an average of two measurements.



Figure 1. A plan view of the stone oil lamp with seven nozzles. The seven branched Menorah and the seven plant species are encrusted with white and brownish patina. The diameter of the lamp is 22 cm.



Figure 2. The carved Menorah is the main decorative element on the oil lamp. Three half concentric circular branches arranged on both sides of a vertical stem, are built of astragal-like beads. The Menorah stands on a tripod-shaped base. There appears to be an oil lamp with a flame at the top of each branch. The height and width of the Menorah is 2.6 cm.



Figure 3. The carved Menorah (part), the wheat ear, the figs and the pomegranate ornamentation (part) showing the brown to white layering of the patina on and around the symbols (decoration circular zone = 3.6 cm).



Figure 4. The palm tree with six wide, full palm branches and two small clusters of dates hanging on both sides. The palm tree represents both the honey made of the dates as well as the Land of Judea. (decoration circular zone = 3.6 cm).



Figure 5. The carved barley ear, the two olive branches the grape leaf, associated with a bunch of grapes and part of the palm tree. (decoration circular zone = 3.6 cm).

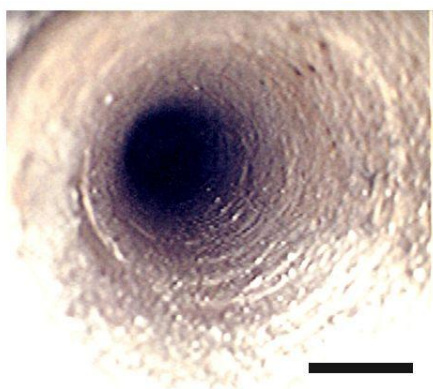


Figure 6. A spirally concentric drilling marks (with calcitic patina) within a nozzle

(scale bar = 1 cm).

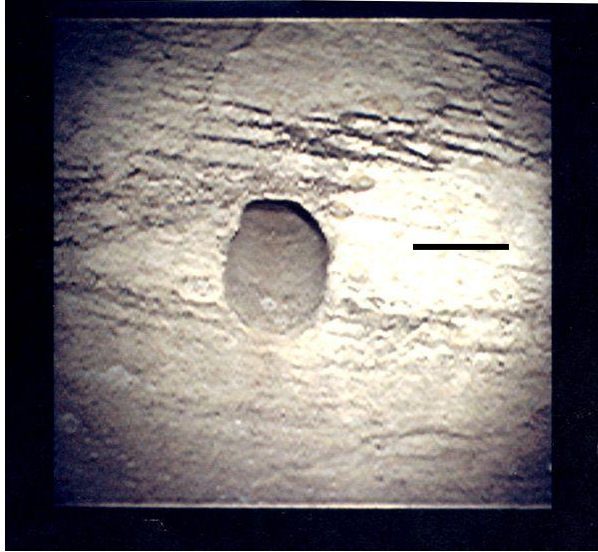


Figure 7. The inside outlet of a nozzle into the internal reservoir of the stone oil lamp. Notice the undulating calcitic patina deposition on the step-like drilling marks (scale bar = 1 cm).

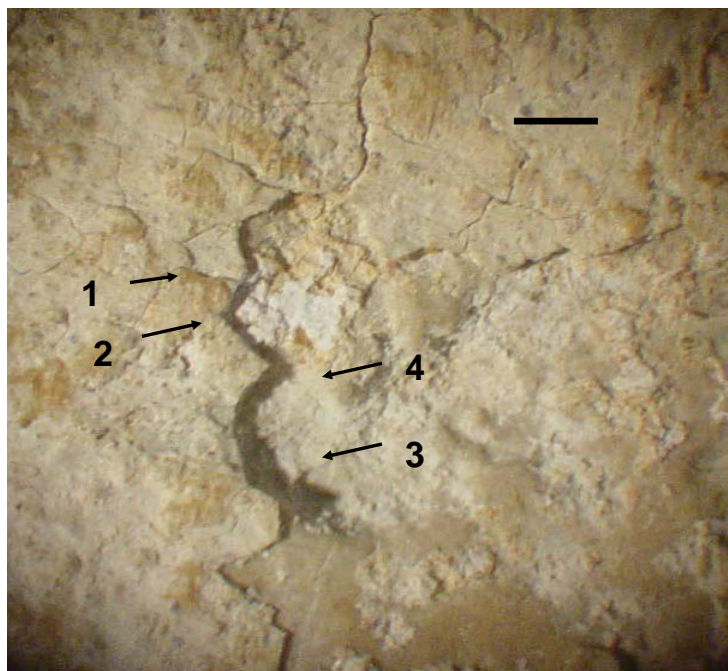


Figure 8. Four carbonate layers of the patina (arrows) adjacent to the ear of wheat, the topmost of which is continuous with the uppermost patina covering the wheat (scale bar = 1 cm)..