

Earliest floral grave lining from 13,700–11,700-y-old Natufian burials at Raqefet Cave, Mt. Carmel, Israel

Dani Nadel^{a,1}, Avinoam Danin^b, Robert C. Power^c, Arlene M. Rosen^d, Fanny Bocquentin^e, Alexander Tsatskin^a, Danny Rosenberg^a, Reuven Yeshurun^{a,f}, Lior Weissbrod^a, Noemi R. Rebollo^g, Omry Barzilai^g, and Elisabetta Boaretto^g

^aThe Zinman Institute of Archaeology, University of Haifa, Israel, 91905; ^bThe Hebrew University of Jerusalem, Jerusalem, Israel, 91904; ^cPlant Foods and Hominin Dietary Ecology Research Group, Max Planck Institute for Evolutionary Anthropology, 04103 Leipzig, Germany; ^dDepartment of Anthropology, University of Texas, Austin, TX 78712; ^eCentre de Recherche Français à Jérusalem USR 3132, Centre National de la Recherche Scientifique, 75794 Paris, France; ^fProgram in Human Ecology and Archaeobiology, National Museum of Natural History, Smithsonian Institution, Washington, DC; and ^gWeizmann Institute–Max Planck Center for Integrative Archaeology, Dangoor Research Accelerator Mass Spectrometer Radiocarbon Laboratory, Weizmann Institute of Science, Rehovot, Israel, 76100

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Flowering plants possess mechanisms that stimulate positive emotional and social responses in humans. It is difficult to establish when people started to use flowers in public and ceremonial events because of the scarcity of relevant evidence in the archaeological record. We report on uniquely preserved 13,700–11,700-y-old grave linings made of flowers, suggesting that such use began much earlier than previously thought. The only potentially older instance is the questionable use of flowers in the Shanidar IV Neanderthal grave. The earliest cemeteries (ca. 15,000–11,500 y ago) in the Levant are known from Natufian sites in northern Israel, where dozens of burials reflect a wide range of inhumation practices. The newly discovered flower linings were found in four Natufian graves at the burial site of Raqefet Cave, Mt. Carmel, Israel. Large identified plant impressions in the graves include stems of sage and other *Lamiaceae* (*Labiatae*; mint family) or *Scrophulariaceae* (figwort family) species; accompanied by a plethora of phytoliths, they provide the earliest direct evidence now known for such preparation and decoration of graves. Some of the plant species attest to spring burials with a strong emphasis on colorful and aromatic flowers. Cave floor chiseling to accommodate the desired grave location and depth is also evident at the site. Thus, grave preparation was a sophisticated planned process, embedded with social and spiritual meanings reflecting a complex preagricultural society undergoing profound changes at the end of the Pleistocene.

burial customs | preburial preparation | radiocarbon dates

In the Mediterranean Levant, the earliest known burials involved disposal of the dead in sporadic and isolated pits dug in caves and their terraces. Such burial sites are known at the caves of Qafzeh, Skhul, Tabun, Amud, and Kebara, all dated to the latter half of the Middle Paleolithic, ca. 120,000–55,000 y ago (1–5). The bodies were usually interred in flexed positions, sometimes with selected animal parts placed on them. In all instances only a few individuals were buried at each site, likely reflecting intermittent burials. These sites were not cemeteries in the modern sense, where frequent, repetitive interment and memorial events take place at a specifically dedicated location, usually for generations.

Natufian [ca. 15,000–11,500 calibrated years (Cal.) B.P.] sites used for burial reflect a different pattern. To date, more than 450 skeletons have been unearthed in sites such as el-Wad Cave and Terrace, Eynan, Hayonim Cave and Terrace, Hilazon Tachtit Cave, Nahal Oren, and Raqefet Cave; these sites have several characteristics conceptually similar to modern cemeteries (6–18). At each, at least several dozen burials were found in a delineated and densely used area. The unprecedented density of graves and the great variety of inhumation practices in these sites represent some elaboration of earlier traditions and a wide variety of innovations. The new forms of burial include the combination of individual and multiple graves, flexed and

full-length postures, patterned orientations, head and body decoration with beads, removal of the skull after body decomposition, use of ochre-based pigments, provisioning with grave goods and offerings, and possibly an association with funeral feasts (13, 19).

Materials and Methods

Here we report on the discovery of grave linings made of flowering plants in four radiocarbon-dated (13,700–11,700 Cal. B.P.) Natufian burials excavated at Raqefet Cave, Mt. Carmel, Israel (Figs. 1 A and B, 2, and 3; Figs. S1 S2, S3 and S4; and Table S1). Excavations at the site exposed 29 skeletons, all but one clustered in a small area (ca. 15 m²) (Fig. 1C). Although not suitable for all Natufian contexts, the term “cemetery” seems justified here, because frequent, repetitive interments took place at a specifically dedicated location, probably for at least several generations. The retrieved skeletons include infants, children, and adults (14, 15). Most of the burials were single interments, although four were double, in which two bodies were interred together in the same pit. In the double burials, deaths were certainly contemporaneous or almost so, because the burials are simultaneous. However, the cause of death (epidemic, accident, violence) is unknown, and in most such cases is never identified (10).

The current study focuses on the analyses of plant impressions in four graves (Table S1). To document the complex formation processes in the Natufian graveyard, to refine the microstratigraphy, and to assess depositional and postdepositional processes, we collected sediment samples from all contexts in and around the graveyard for micromorphological studies (SI Text, section S1). We also sampled a wide array of deposits across the site for phytolith analysis (SI Text, section S2). These samples include 16 samples from eight burials, 12 samples from four bedrock mortars, and seven samples from other contexts and from naturally accumulating soils located away from the cave’s entrance (Table S2).

Results

The graveyard deposits vary in thickness from ~0.8 m in the concentration between Homo 9 and Homo 15 (Locus 1) to ~0.6 m in the concentration of Homo 31 to Homo 28 (Fig. 1C and Fig. S3). In thin sections the grave fills appear as heterogenic calcareous ash deposits mixed with comminuted charcoal, bones, local soil, gravel, and snail shells (SI Text, section S1 and Fig. S5 A and B). The uppermost part of the anthropogenic deposits was strongly affected by bioturbation, manifested as a loose consistency, high porosity and crumbly structure (Fig. S5 C and D). Significantly, bioturbation acted mainly on a millimetric scale and decreased considerably with depth.

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¹To whom correspondence should be addressed. E-mail: dnadel@research.haifa.ac.il.

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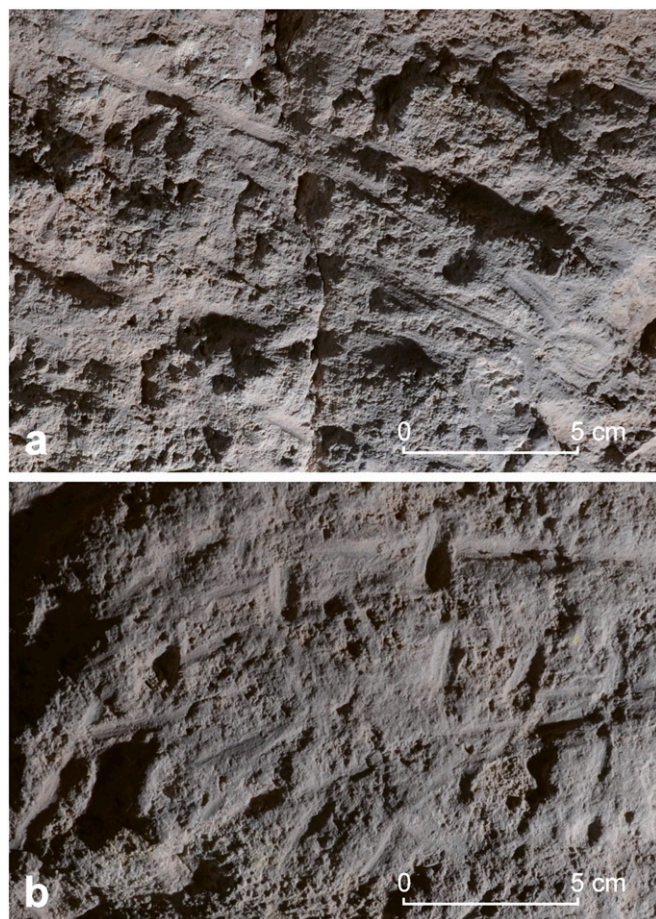


Fig. 3. Photographs of plant impressions found at the bottom of graves. (A) Impressions under the skeletons of Homo 25 and Homo 28. The long impressions are of square stems. (B) Impressions under the skeleton of Homo 1. Note the short, parallel impressions of square stems crossing long stems (at the top center) and the Y-like branching stems (at the left). Photographs reproduced with permission from E. Gernstein.

At the base of the grave we recorded more than 30 impressions; we identified 13 stem impressions, 3–15 cm long and 0.5–2 cm wide, with rectangular cross-sections and visible longitudinal veins preserving stem vascular bundles (Fig. 3A and Figs. S1 B–D, S2, and S3). One set of impressions was identified as the flowering stems of *Salvia judaica* Boiss. (Judean sage) (Fig. 4A) based on the size and angles between the branching stems (Fig. 4B). Other rectangular stems belong to sage and closely related species of the mint family (*Labiatae*) or to the figwort family (*Scrophulariaceae*). Species of these families currently grow on the terrace and slopes below the cave. Local plants of these families flower in spring; most have a strong, aromatic fragrance, and some possess medicinal properties. The stems become stiff in April–May and begin to deteriorate after desiccation during the summer. Thus, the impressions on the veneer were formed before midsummer. Additional impressions in this grave include stems with a round cross-section; three wide leaves, 5 cm in length, likely of trees; a row of five small impressions with a close morphological affinity to seeds of *Cercis siliquastrum* L. (Judas tree) and small (<3 mm), round impressions of unidentified seeds.

The double grave of Homo 18 and Homo 19 is unique because it preserves data regarding a preparation phase preceding the floral lining. Here, a bedrock bulge on the cave floor was chiseled to serve as an inner wall of the grave. The chiseled surface is ca. 40 × 40 cm in area, creating an almost vertical plane, whereas the

rest of the bedrock in the cave is usually undulating and has a different color (Fig. S4 A and B). Only after the modification of the rock were the veneer and plant lining set inside, as indicated by the impressions of reeds (*Phragmites?*) and other species found on the thin vertical veneer (Fig. S4C).

We identified another dense set of impressions at the base of the Homo 1 grave; it was exposed 40 y ago, although at the time the impressions were not observed (14). Here, there are several examples of square stems crossing each other at right angles and in regular intervals, seemingly in a loose net-like arrangement of the lining (Fig. 3B). Impressions of stems with round cross-sections were exposed immediately under the skeleton of a child (Homo 31) (Fig. 1C and Figs. S1A and S3). Apparently, the practice of lining graves with flowers was not age-related, according to the Raqefet burials. This finding is not surprising; when children were not excluded from the rest of the dead community (usually they were), their treatment did not substantially differ from that of the adults (10).

The plant impressions were restricted to the burial area. No similar remains were observed elsewhere on the cave floor or cave walls. Furthermore, no flint, stone, or bone impressions were found in the graves despite the presence of thousands of these hard and durable artifacts within the grave fills. This finding suggests that the green lining was thick and continuous, covering the entire grave floor and sides, preventing other objects from leaving impressions on the mud veneer.

The abundance of phytoliths recovered from eight graves provides additional evidence for the habitual use of plants in the

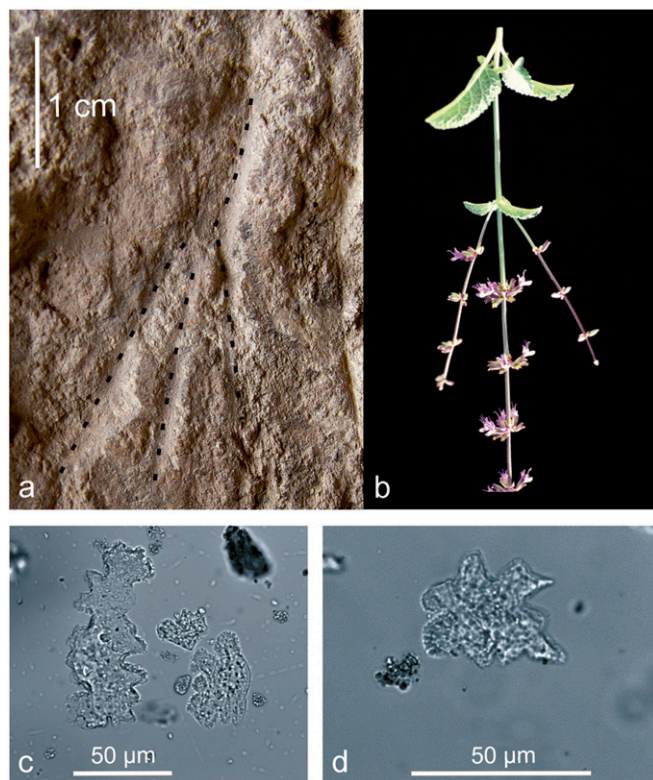


Fig. 4. (A) Impressions of flowering stems in the grave of Homo 25 and Homo 28, marked by dashed lines. Photograph reproduced with permission from E. Gernstein. (B) Flowering stems of *Salvia judaica*, presented in the same scale and orientation as the impressions in the grave. Photograph reproduced with permission from A. Danin. (C and D) Jigsaw-puzzle phytoliths indicating tissue of a dicot plant. These phytoliths are associated with the graves and are also found in *Salvia* species growing near the cave today. Photographs reproduced with permission from R. Power.

Raqefet Cave burials (Fig. 4 C and D). Phytoliths were identified in 35 contexts in the cave and on its terrace, including control samples. They consist of morphotypes from grasses, dicotyledon leaves, reeds, and sedges. The average density of samples from the eight graves is 61,199 phytoliths per gram of sediment, whereas the average for the off-site control samples is only 27,231 per gram. The eight grave samples produced 91% of all jigsaw dicotyledon phytoliths even though these contexts produced only 38% of all phytoliths (*SI Text*, section S1, Tables S2–S4, and Fig. S7). The density of dicot phytoliths found in graves at Raqefet Cave is unique for phytolith concentrations at Natufian sites and supports the suggested use of large quantities of shrubs in the burials. Our recent study (summer 2012) revealed that phytoliths of local Lamiaceae species (including *Salvia fruticosa*) fall morphologically within the group of dicotyledonous phytolith morphotypes and thus may be one of the taxa used as grave lining at the Raqefet Cave burials (Fig. 4 C and D).

Direct ^{14}C dates of bone collagen (extracted from three human skeletons) are now available for two double graves. The Homo 18 and Homo 19 skeletons produced a range of 13,700–13,000 Cal. B.P. The Homo 28 skeleton was dated to 12,550–11,720 Cal. B.P. (Fig. S7). The dates indicate that the site was used for burial, repeatedly, in the same confined area and with the same customs and grave preparation, likely for as long as about 2,000 y. The characteristics of the burial customs (6, 14), the flint assemblage (15), and the bedrock mortars accord with these dates. Indeed, the site was used as a graveyard for many generations, during which inhumation practices that included plant lining did not change.

The burial pits contained abundant material remains. In many burials worked and natural stone objects were set on edge, perhaps as markers or symbols. Flints and butchered animal bones were very common. The low frequency of trampling, burning, and carnivore gnawing marks on the animal bones suggest instant burial of food remains during interment, as would be expected in funerary feasting. Abundant bedrock mortars and cup marks were hewn in the cave floor adjacent to the graves (15), and one human skeleton was found resting on the rim of a large bedrock mortar. This finding suggests that at least some mortars functioned in conjunction with the burials.

Discussion

The Raqefet Cave plant impressions and phytoliths provide evidence for the earliest known use of plant lining in grave preparation. Earlier examples of plant lining are limited to utilitarian grass beddings found at Middle Stone Age/Middle Paleolithic Sibudu Cave (20), Misliya Cave (21), and Tor Faraj rockshelter (22), where the lining was identified as thin laminar layers containing abundant phytoliths and other microscopic plant remains. The oldest macroscopic lining remains yet identified were found on brush hut floors at Ohalo II (23,000 y ago), where grass bedding composed of large bundles of *Puccinellia convoluta* was exposed and analyzed (23). The finds from Raqefet Cave indicate that 13,700–11,700 y ago the Natufians lined graves with a soft mud veneer and then placed on the veneer a thick cover of fresh flowering plants, thereby providing color and aromatic fragrance. Claims for earlier use of flowers in the Shanidar IV Neanderthal burial (Iraq) were based on concentrations of microscopic pollen grains found adjacent to the skeleton (24, 25). However, the presence of rodent burrows, the abundant remains of jird (*Meriones crassus*) bones in the same layer, and this rodent's habit of storing seeds and flower heads in its burrows cast serious doubts on this interpretation (26).

Natufian grave preparation at Raqefet Cave included three basic patterns. The first was the creation of a pit in either Middle Paleolithic or Natufian deposits. In several cases Natufian pits were dug successively in the same location, with the later ones

disturbing earlier ones (Fig. 1C and Fig. S3). These pits were dug in loose deposits and then were filled with sediments from the immediate surroundings (Fig. S5 A–D). This pre-Natufian tradition was practiced for millennia and was very common at Raqefet Cave and many other Natufian burial sites (1, 2, 6, 9, 10, 16, 17).

The second pattern was the chiseling of bedrock to accommodate the desired grave. The Natufian skills of high-quality rock and stone carving are well demonstrated by bedrock and stone mortars (27–29) and by aesthetic and symbolic objects such as figurines and decorative designs (16, 30, 31). At Raqefet Cave there is direct evidence for bedrock chiseling in the graveyard as part of grave preparation. In one case the result was a vertical surface against which the foot of Homo 19 rested (Fig. S4). Rather than simply being a part of the physical setting of the grave pit, this chiseled surface may have had a symbolic meaning. Stones set vertically are very common in burials (e.g., Homo 25; see also Fig. S3) and even occur in bedrock mortars at Raqefet Cave (27).

The third pattern was the lining of the pit with a thick layer of green plants, including flowering species renowned for their aromatic fragrance and bright colors. This lining may have been the practice for all burials at the site, although remains were preserved only in some of the graves resting directly on bedrock. The lining practice appears to have taken place regardless of age and sex, in single and double burials. It may have been common in other Natufian sites, although such remains could be preserved for millennia only in particular conditions. Naturally, all three patterns of grave preparation could have been combined, as was the case for the Homo 18–Homo 19 grave.

Experimental studies have demonstrated flowers' significant role as external sources of emotional stimuli, with measurable positive impacts on human social function (32). Flowers can be used to express sympathy, pride, and joy (33). They also are used to express religious feelings; in some religions flowers are considered the direct route for spiritual communication (34). These relationships may benefit fitness in both humans and flowers and have been linked to the domestication of certain species of flowering plants more than 5,000 y ago (32, 35). At a significantly earlier period, the use of flowers in social events (funerals) may have served as yet another means for enhancing group identity and solidarity. The Natufian development of group-specific burials and related practices likely reduced social tensions and improved group cohesion in a period of fluctuating environmental conditions, increasing population density, and growing social conflicts (6–11, 36, 37). The emergence of Natufian cemeteries, such as those at Raqefet Cave and Hilazon Tachtit Cave, also may represent new and complex social organizations which could have included the establishment or strengthening of special interest groups, inheritance of corporate property, territorial ownerships, and aspects of social organization (6–11, 12, 13, 19).

The careful preparation of the graves and the common use of flowers add yet another perspective to Natufian funerary rites and their impact on the participants in a way that is familiar among many modern cultures.

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