Hermetic cereal storage in the Bronze Age: evidence from the Gáva culture settlement at Rotbav, Transylvania

Laura Dietrich[1], Oliver Dietrich[2], and Julia Meister[3]
1 Deutsches Archäologisches Institut, Berlin, DE; laura.dietrich@dainst.de; corresponding author
2 Freie Universität Berlin, Berlin, DE; o.dietrich@fu-berlin.de
3 Julius-Maximilians-Universität Würzburg, Würzburg, DE; julia.meister@uni-wuerzburg.de

ABSTRACT – *The present paper explores the possibility to better understand the function of pits through phytolith and starch analysis. A case study from the Late Bronze Age/Early Iron Age settlement phase of Rotbav in southeastern Transylvania is discussed in detail. It appears that a large storage vessel originally sealed with a bowl was kept in a pit filled with chaff or straw to preserve its contents.*

KEY WORDS – *Bronze Age; Transylvania; food storage; phytoliths*

Hermetično skladiščenje žit v bronasti dobi: dokazi iz najdišča kulture Gáva v Rotbavu v Transilvaniji

IZVLEČEK – *V članku raziskujemo možnost za boljše razumevanje namembnosti jam na podlagi analiz fitolitov in škroba. Obravnavamo študijski primer iz pozno bronasto- in starejše železnodobne faze naselbine Rotbav v severovzhodni Transilvaniji. Gre za večjo shrambeno posodo, ki je bila pokrita s skledo in bila postavljena v jamo, zapolnjeno s plevami ali slamo, z namenom konserviranja vsebine.*

KLJUČNE BESEDE – *bronasta doba; Transilvanija; shranjevanje hrane; fitoliti*

Introduction

Several methods have traditionally been employed to keep humidity, oxygen, and insects away from field crops in order to preserve them, with airtight sealed containers, along with pits lined with straw or chaff, being among the most common (*Reynolds 1974; Sigaut 1980; 1988; Fairbairn, Omura 2005, Villers* et al. *2006; Diffey* et al. *2017; Urem-Kotsou 2017*). However, it is difficult to find evidence for such techniques in the archaeological record, particularly regarding regions with earthen architecture and in the absence of carbonized cereals (*Monah 2002; Marinova, Valamoti 2014; Hrisrova* et al. *2017; Valamoti* et al. *2019* for an overview of such evidence from southeastern Europe). So far, the identification of grain storage has mostly been based on the identification of characteristic archaeological features (*Sigaut 1988; Fairbairn, Omura 2005* with references). This approach may to some degree be hindered by the frequent and complex reuse of storage pit features (*Ivanova* et al. *2020*). This pilot study sets out to highlight a pit type that with a high probability is connected to a specific cereal storage technique and a methodology that allows its identification by phytolith and starch analysis. Our case study comes from the Bronze Age/Early Iron Age settlement of Rotbav in Transylvania, a region and time for which so far only scarce macrobotanical evidence exists (*Cârciumaru 1996; Ciută 2012; Ciută, Bejinariu 2012; 2019; Ciută, Molnár 2014* with references).

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The Gáva culture settlement of Rotbav

The archaeological site of Rotbav-La Pârâuţ is situated upon a high terrace formation above the River Olt in southeastern Transylvania at 498 m.a.s.l (Fig. 1; 45°83'N/25°56'E). The plateau is delimited by the Valea Cetăţii stream to the north and a steep hill to the west (Fig. 2); to the east, the Josephinian survey shows a swampy area with an arm of the River Olt. This landscape was heavily transformed by the creation of two lakes to the north of the site in the 1970s, and today the Olt flows at a distance of roughly 500m to the east of the site. The form of the plateau was not affected, but the site has been and still is used for cultivation, the plough horizon reaching a thickness of approximately 40cm.

The settlement has a size of around 4ha, of which 1800m² were excavated, and the site was additionally investigated by archaeological and geophysical surveys. Rotbav-La Pârâuţ is thus the most extensively researched site of this period in the region so far, and has been comprehensively published (*Dietrich 2014a*). Its importance lies in a long stratigraphy comprising the timespan from the Middle Bronze Age (in Romanian terminology) to the Bronze Age/Iron Age transition, being inhabited roughly between 1900/1800 BC and 1200/ 1100 BC, following radiocarbon data (*Dietrich 2014b*). The stratigraphic sequence covers six distinct building phases. The first three belong to the early Middle Bronze Age Wietenberg culture, followed by two of the Late Bronze Age Noua culture. The last building phase belongs to the Gáva culture, which marks the Bronze Age/Iron Age transition (*Dietrich 2012*). The pottery from Rotbav (*Dietrich 2012; 2014a. 211–214*) places the Gáva settlement into a developed phase of the culture, described by Marian Gumă as horizon Mahala IV-Somotor II-Mediaş I-II-Teleac II and dated to Ha B (*Gumă 1993.190; cf. Ciugudean 2009; 2011*).

The remains of the Gáva settlement phase were not present in all sections excavated at Rotbav, likely due to erosion and ploughing, but they could be excavated on an area of 1372m² (*Dietrich 2014a. 214–217*). This allowed us insights into the settlement structure, which is characterized by large, regularly dispersed, partly subterranean constructions (Fig. 2). Fireplaces and pit features are located between these buildings. The cultural layer was situated immediately below the plough horizon and had a thickness of approximately 15cm, although likely it was originally much thicker. A total of four semi-subterranean houses could be partially excavated in the main area of the settlement, situated at distances of four to 15m from each other. Postholes and burnt loam with impressions of wickerwork hint at the superstructures, although the entrances or inner divisions of houses could not be identified. Near the houses, concentrations of pottery and other artefacts suggest that activity areas and pits were regularly associated with the dwellings. Most pits were filled with domestic refuse or settlement debris (*Dietrich 2014a* for an extensive presentation of the features), and thus their original functions could not be determined with security. However, one, labelled feature 4/2008, stood out because of its contents – two nearly complete vessels, making an in situ use context highly likely.

Pit feature 4/2008

Feature 4/2008 was located approximately 5m to the south of one of the houses (structure 10, Figs. 2–3) and next to the remains of a fireplace (feature 2/2008, Fig. 2) destroyed by ploughing. It first showed as an oval-rounded yellowish spot of *c.* 110cm maximal diameter. The pit filling proved to be very homogenous loamy fine sand. Pottery fragments and burnt loam were observed only in its uppermost part, roughly within the first 10cm. The maxi-

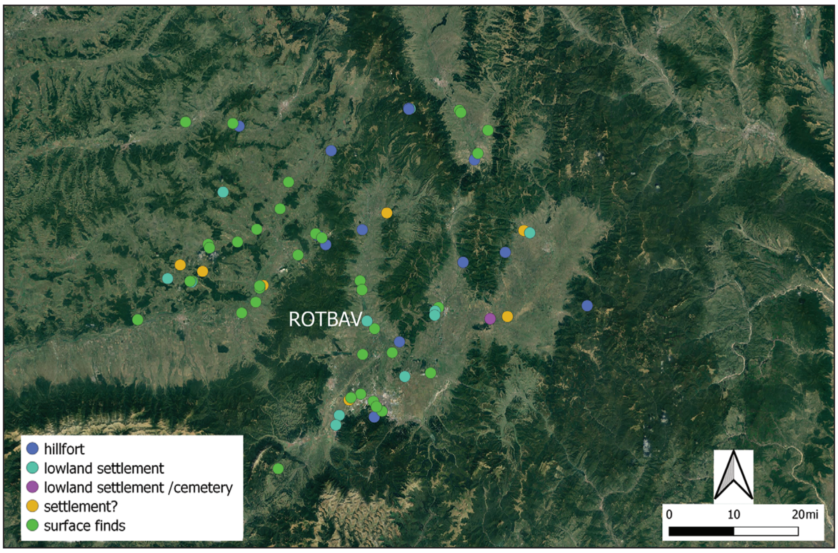
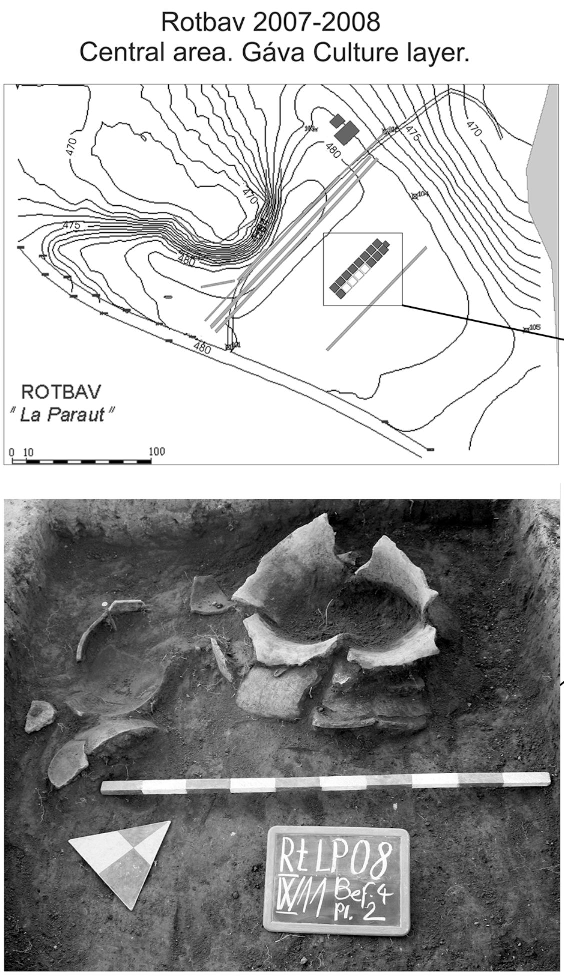


Fig. 1. Gáva finds in southeastern Transylvania and location of the settlement of Rotbav (findspots after* Dietrich 2014a.322–332*; base map Gogle Satellite, https://mt1.google.com/vt/lyrs=s&x={x}&y={y}&z={z}).

mum depth of the feature was 54cm, a part of the pit likely being destroyed by the plough. After removal of 10cm of sediment, finds became scarce, but the rims of two large vessels became visible. One was a large, bag-shaped vessel decorated with four knobs at the shoulder and a rim drawn towards the exterior (Fig. 3a). The vessel, of which all fragments could be recovered, has a height of 42.7cm, a maximal diameter of 47.6cm and a rim diameter of 35cm. The measurements and formal characteristics – a wide stable bottom and large mouth to enable users to reach the contents – speak in favour of a storage vessel. The second vessel is a so-called 'Zipfelschüssel', a bowl that originally had four pronounced lobes, fluted in the interior (Fig. 3b). This vessel was found broken in several fragments, but unlike the first one not all fragments were present in the pit. The preserved smallest width of the vessel is 41.8cm, and thus it could have served well as a lid for the larger vessel even in a damaged condition.

The sediments from the pit and the inside of the vessel were separated, sieved through a 1mm mesh and flotated. This produced a number of small bone fragments and <1g of charred wood from the pit fill-



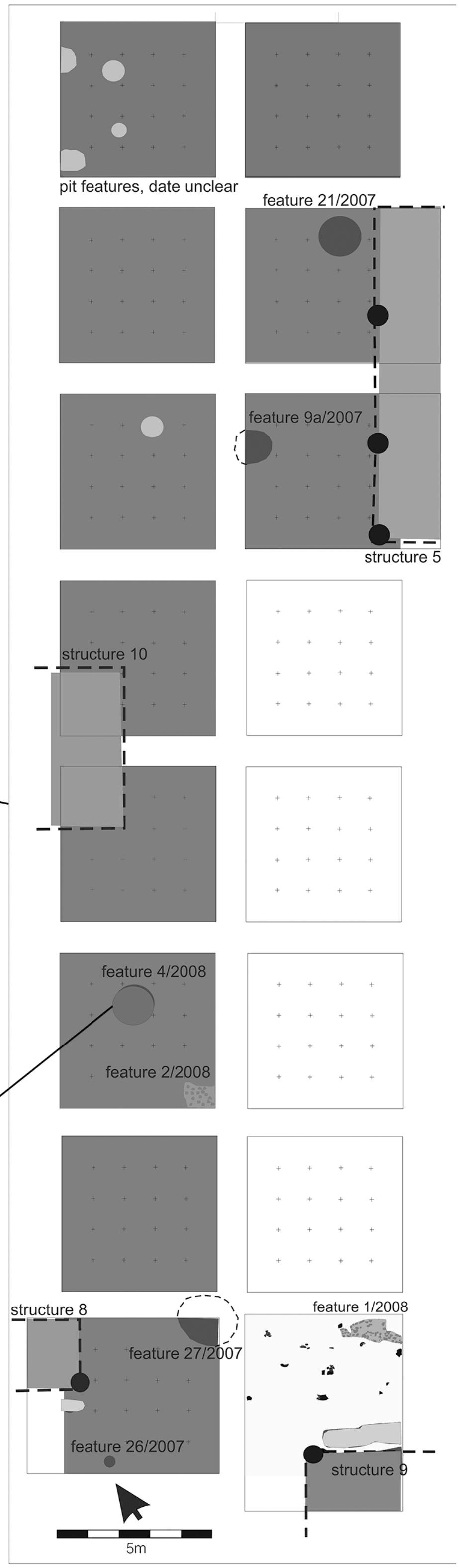


Fig. 2. The Gáva settlement phase of Rotbav and the location of the pit feature 4/2008 (graphics by L. Dietrich).

ing, but no other charred plant macroremains. As charred grains and plant remains were recovered from other contexts at Rotbav (*cf. Dietrich 2014a. Anhang 6*), this is not due to preservation conditions. The vessel contents were completely decayed, or the vessel had been emptied (which could be indicated by the position of the lid besides the large vessel). No food crusts were observed on either vessels' inner surface. However, neither of the two vessels had been placed on the bottom of the pit, indicating that the latter had been filled with some kind of material that held the vessels in place (Figs. 4–5). We suspected that the vessels could have been originally placed in chaff or straw. Accordingly, four sediment samples were taken to check this hypothesis.

Phytolith evidence

Phytolith analyses were conducted on the four soil samples (Tabs. 1–2). RT08-1 is from the upper part of the pit, RT08-2 from inside the pit next to the vessels, RT08-4 is from inside the vessel and RT08-3 from the cultural layer outside the pit (sample locations are marked in Fig. 4).

Phytolith extraction of the samples followed the procedures outlined by Rosa Maria Albert *et al.* (*1999*). To remove carbonates, phosphates, and organic material, approximately 1g of the air-dried sediment was treated with 3 N HCl, 3 N HNO_3, and H_2O_2. The mineral components of the samples were separated according to their densities using 2.4g/ml sodium polytungstate solution [Na_6 ($H_2W_{12}O_{40}$) H_2O]. Slides were prepared by weighing out about 1mg of sediment onto a microscope slide, mounting with Entellan New (Merck). The counting of about 1300 phytoliths per sample was performed using a KERN OBE-114 microscope at 400x magnification. Unidentifiable phytoliths were counted and recorded as weathered morphotypes. To allow quantitative comparisons between the samples, phytolith numbers per gram of sediment were estimated by relating phytolith amounts and weights of the processed sample material to the initial sample weights. Morphological identification of phytoliths was based on standard literature (*e.g., Twiss* et al. *1969; Brown 1984; Mulholland, Rapp Jr. 1992; Piperno 2006*), as well as on modern plant reference collections (*Albert 2000; Albert, Weiner 2001; Tsartsidou* et al. *2007; Albert* et al. *2011; Portillo* et al. *2014*). The International Code for Phytolith Nomenclature was followed where possible (*Madella* et al. *2005*).

Phytoliths were abundant in all four soil samples examined, ranging from 1.1 to 4.0 million phytoliths per gram of sediment (Fig. 6a; Tab. 1). The highest concentrations were observed in samples RT08-2 and RT08-4, while the lowest concentration was observed for sample RT08-3. Phytolith preservation is generally poor, as evidenced by high proportions of weathered phytoliths (mean=21.4%, σ=1.5%, n=4; Tab.1) and the absence of multicellular phytoliths, likely in association with a varied range of depositional and post-depositional processes (*Alexandre* et al. *1997; Cabanes* et al. *2011; Madella, Lancelotti 2012*).

The morphological analyses show that all samples are similar in their morphotype assemblages (Tab. 1). Grass phytoliths, occurring at a rate of about 56.5% (σ=0.6%, n=4), were the most common group identified. According to their short cell morphologies, grasses belong mostly to the C3 *Pooideae* subfamily that include common cereals, such as wheat and barley. However, the absence of multicellular phytoliths in the samples did not allow for identifying the type of grasses and cereals. Grass short cells, commonly produced in leafs, stems and inflorescences, were abundant in all samples, averaging 40.4% (σ=1.8%, n=4). Epidermal cells from grass leaves and stems, including, for instance, prickles and bulliform cells, show similar values with an average amount of *c.* 40.3% (σ=2.1%, n=4). Additio-

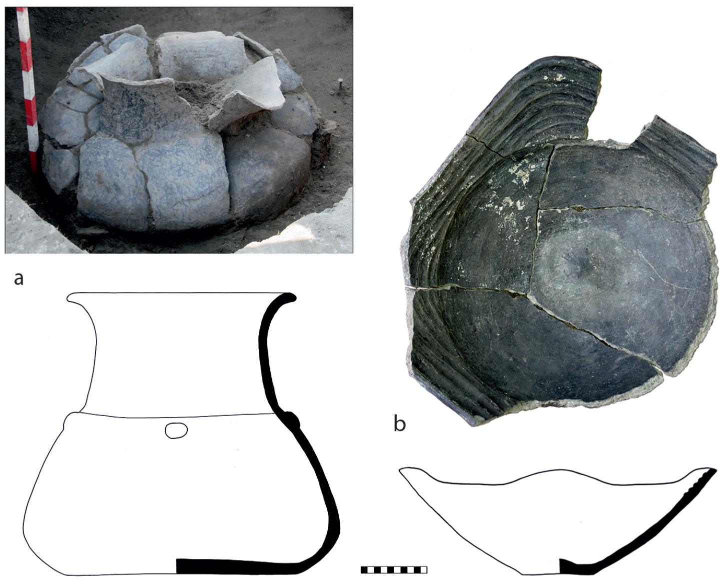


Fig. 3. The two vessels from pit feature 4/2008 (photos/drawings by O. Dietrich).

Sample ID, description of sample location and phytolith amounts			Relative abundances of phytoliths					Anatomical origin of grass phytoliths		
Sample ID	Number of phyt. per 1g of sediment	Layer/areal/ description	Grass phyt. (%)	Dicotyledonous leaves (%)	Dicotyledonous wood/bark (%)	Other phyt. (%)	Weathered morpho types (%)	Leaves and stems (%)	Short Cells (%)	Inflorescence phyt. (%)
RT08-1/MD 5309	2 675 000	inside pit, upper part	56.80	4.18	15.23	0.85	22.95	37.24	42.78	19.98
RT08-2/MD 5310	3 972 000	inside pit next to vessels	56.47	6.38	16.90	0.58	19.66	41.06	38.69	20.25
RT08-3/MD 5311	1 138 000	cultural layer outside pit	55.72	6.97	16.18	0.53	20.60	40.92	39.34	19.75
RT08-4/MD vessel	3 617 500	inside large vessel	57.08	6.27	14.03	0.20	22.42	42.07	40.82	17.11

Tab. 1. Description of samples, phytolith amounts, relative abundances of phytoliths and anatomical origin of grass phytoliths obtained from all sediment samples.

nally, grass phytoliths derived from their floral parts (*e.g.*, decorated elongate dendritic and elongate echinate cells) account for 19.3% on average (σ=1.5%, n=4).

Dicotyledonous phytoliths occur at an average rate of 21.5% (σ=2.0, n=4; Tab. 1). Parallelepipedal blocky phytoliths, for instance, one of the most common wood/bark morphotypes, account for 12.5% (σ= 1.7%, n=4) on average. Other diagnostic dicotyledonous morphotypes such as globulars, polyhedrals or jigsaw-shaped phytoliths were not observed.

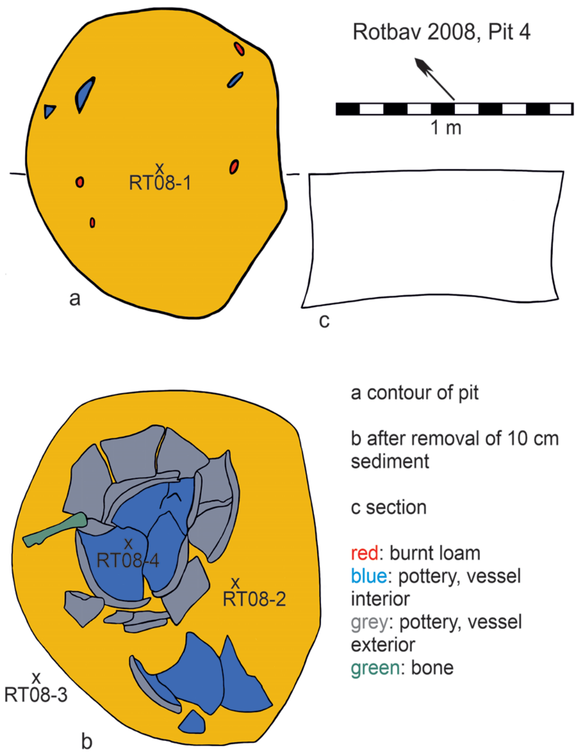


Fig. 4. Pit feature 4/2008.* a *planum view,* b *after removal of 10cm of sediment,* c *section of the pit (drawings made by O. Dietrich).

Starch analysis

To confirm the original presence of cereals within the large vessel, five subsamples from sample RT08-4 (inside of the vessel) and the control sample RT08-3 (cultural layer outside of the pit) were subjected to microscopic analysis in order to identify possibly preserved starch granules. Sample preparation/microfossil extraction followed the protocol established by Li Liu *et al.* (*2018*) with a few modifications. The sediment was mechanically crushed and homogenized. One mg of sediment was put into 1.5ml test tubes, dispersed in distilled water and centrifuged for 5 minutes. Microfossil extraction then followed two procedures: (a) EDTA dispersion; after centrifuge the supernatant was decanted, 0.4ml of EDTA solution was added to each tube. The tubes were left for 2 hours and vortexed each 10 minutes for 30 seconds to disperse the sediment, then filled with distilled water and centrifuged for 5 minutes at 3000 rpm, and the supernatant was decanted. (b) Heavy liquid separation; 0.4ml of SPT at a specific gravity of 2.35 was added to each tube. The tubes were then centrifuged for 15 minutes at 3000rpm. The top layer of organics was removed from each tube by a new pipette and then transferred into a new tube. Distilled water was added, and the samples centrifuged for 5 minutes at 3000 rpm to concentrate the starch at the bottom of the tube, and the supernatant was decanted. The process was repeated two more times.

The samples were mounted in 50% glycerol and 50% distilled water on glass slides and analysed with polarizing filters at x400 for starch with a Bresser Polarisation microscope. Photos were taken with a Bresser Microcam of 12 MP for each slide. The reference collection for starch granule types established by Gismondi *et al.* (*2019*) was used for com-

Phytolith morphotype	RT08-1/ MD 5309 inside pit, upper part	RT08-2/ MD 5310 inside pit next to vessel	RT08-3/ MD 5311 cultural layer outside pit	RT08-4/ MD Vessel inside large vessel
Bulliform	3	7	4	2
Cillindroid psilate	84	121	85	112
Cillindroid scabrate	33	51	45	49
Hair cell	33	65	60	70
Papillae cell	21	22	17	19
Hair cell (prickle)	22	29	32	21
Elongate dendritic	15	20	23	20
Elongate echinate	45	53	44	55
Elongate polylobate	20	24	14	15
Elongate wavy	16	16	15	16
Elongate verrucate	6	8	4	9
Elongate crenate	5	4	2	2
Elongate ruminate	3	5	1	2
Elongate granulate	0	2	3	4
Elongate spilate	3	0	0	3
Elongate corniculate	0	3	2	0
Parallelepipedal blocky psilate square ends	60	86	60	72
Parallelepipedal blocky psilate rounded ends	28	44	29	16
Parallelepipedal blocky scabrate square ends	30	47	31	30
Parallelepipedal blocky scabrate rounded ends	20	11	10	19
Parallelepipedal blocky psilate irregular	11	9	9	8
Parallelepipedal blocky scabrate irregular	3	0	6	6
Parallelepipedal elongate psilate	12	8	17	22
Parallelepipedal elongate scabrate	7	8	13	9
Parallelepipedal elongate facetated	0	0	0	0
Parallelepipedal thin psilate rounded ends	6	11	10	16
Parallelepipedal thin psilate square ends	73	79	55	131
Parallelepipedal thin scabrate rounded ends	0	2	5	4
Parallelepipedal thin scabrate square ends	17	18	21	38
Short cell rondel	187	213	171	226
Short cell tall rondel	2	0	3	5
Short cell trapeziform	68	67	56	95
Short cell saddle	10	8	6	3
Short cell bilobate	19	18	15	15
Short cell cross	11	2	4	5
Trapeziform sinuate	21	25	13	22
Trapeziform polylobate	8	14	13	6
Cylindric sulcate tracheid	8	3	4	5
Weathered morphotype	271	270	234	333
Total number of counted morphotypes per sample	**1181**	**1373**	**1136**	**1485**

Tab. 2. List of phytolith morphotypes identified and their frequencies (counts) in soil samples and a pottery vessel from Rotbav, giving the stratigraphic location and sample information.

parison. Starch preservation was overall bad, and well preserved granules were only observed in three subsamples of RT08-4. These allow a tentative determination as *Triticum aestivum* (common wheat, *cf.* Fig. 6b and *Gismondi* et al. *2019.nr. 30a-b*). *Triticum aestivum* is not among the species identified for the Wietenberg culture layers at Rotbav, from which macrorests of *Triticum monococcum*, *Triticum* sp. and *Hordeum* sp. have been recovered (*Dietrich 2014a.Anhang 6*). For the Noua culture, evidence is lacking so far.

Discussion

Phytolith analysis reveals that two samples have particularly high phytolith concentrations. Sample RT08-2 was taken inside the pit, next to the two pottery vessels, RT08-4 is from the inside of the large bag-shaped vessel. Another sample, RT08-1, was taken inside the pit filling, but in a stratigraphical position above the two vessels. Here, the phytolith concentration is considerably lower. The lowest value comes from sample RT08-3 which represents a control sample from the cultural layer next to the pit. The phytoliths stem mostly from the C3 Pooid subfamily and come largely from stems and leaves. Both concentrations and origin of the phytoliths fit the hypothesis of a pit filled with chaff or straw to protect the contents of the vessel. Starch analyses indicate that the vessel contained cereals, likely *Triticum aestivum*.

In addition to being covered with the bowl (fragment), the vessel could have been sealed airtight with clay. As the upper part of the pit was absent, the possibility that also the pit was sealed in that way cannot be excluded. Sealing in an airtight container would have reduced moisture and kept insects or mice away, conserving the grains for several years (*Diffey* et al. *2017.1–3*). The capacity of the vessel at Rotbav may indicate that it was used to store a part of the provisions for the winter or seed grains. The find context with the bowl next to the large vessel and the vessel itself filled with straw (phytoliths do not form in grains, starch being scarce) makes it highly possible that the vessel was emptied and then left there (damaged during retrieval?) while the straw/chaff decayed and the pit in its upper part was slowly refilled with sediments. Originally there could have been more such vessels stored in the pit.

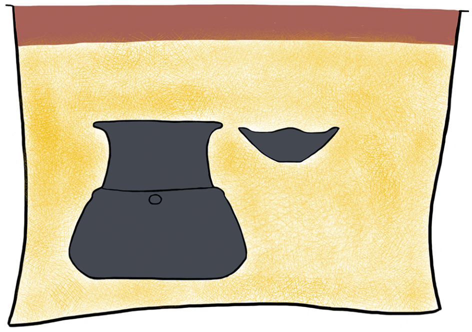


Fig. 5. Tentative reconstruction of the pit feature with two vessels embedded in straw and the pit sealed by clay (drawing by O. Dietrich).

Phytolith or starch analyses have so far not been published for Gáva sites. Organic remains have only sparsely been reported from contexts of the Gáva culture or the Early Iron Age in general. From Şimleu Silvaniei – 'Observator' foxtail millet (*Setaria italica*), and two wheat species (*Triticum monococcum* and *Triticum dicoccum*) are mentioned (*Ciută, Bejinariu 2019*). Beatrice Ciută and Ioan Bejinariu recently collected the evidence published to date of other finds of cereals from Early Iron Age contexts, and their list contains three more sites (Teleac: *Triticum durum* and *Hordeum vulgare* from a grave; Bernadea: millet; Tăşad: mostly *Triticum aestivum*, but also *Triticum monococcum, Triticum dicoccum, Triticum spelta,* and *Panicum miliaceum; Ciută, Bejinariu 2019.47*). Rotbav now adds to this list, although any sensible discussion of Early Iron Age cereal use still needs much more data.

Summing up, our case study proves that combined phytolith and starch analysis are an interesting (and not overly costly) approach to determine the probable use of prehistoric pits in the absence of preserved macrorests.

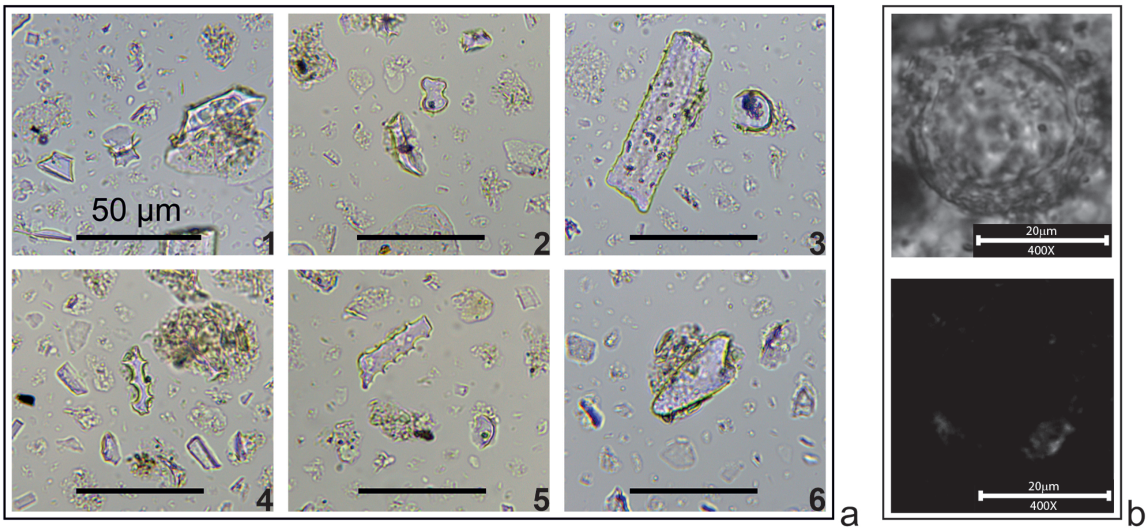


Fig. 6.* a *photomicrographs of selected phytolith morphotypes identified in the Rotbav samples. The photographs were taken at 400x magnification:* 1 *short cell rondel;* 2 *short cell trapeziform (left), short cell bilobate (right);* 3 *elongate entire (left), short cell rondel (top view, right);* 4 *elongate dentritic;* 5 *elongate echinate;* 6 *prickle (photos made by C. Binder).* b *photomicrograph of a starch granule (*Triticum aestivum*), taken at 400x magnification.

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References

Albert R. M. 2000. *Study of ash Layers through phytolith analyses from the Middle Paleolithic Levels of Kebara and Tabun Caves*. Unpublished PhD thesis. Universitat de Barcelona. Barcelona.

Albert R. M., Esteve X., Portillo M., +3 authors, and Hernandez F. 2011. *Phytolith CoRe, Phytolith Reference Collection*. http://phytcore.org/phytolith/index

Albert R. M., Lavi O., Estroff L., +3 authors, and Lev-Yadun S. 1999. Mode of occupation of Tabun Cave, Mt Carmel, Israel during the Mousterian Period: a study of the sediments and phytoliths. *Journal of Archaeological Science 26: 1249–1260*. http://dx.doi.org/10.1006/jasc.1999.0355

Albert R. M., Weiner S. 2001. Study of phytoliths in prehistoric ash layers using a quantitative approach. In J. D. Meunier, F. Colin (eds.), *Phytoliths, applications in earth sciences and human history*. A. A. Balkema Publishers. Lisse: 251–266.

Alexandre A., Meunier J.-D., Colin F., and Koud J.-M. 1997. Plant impact on the biogeochemical cycle of silicon and related weathering processes. *Geochimica et Cosmochimica Acta 61: 677–682*.
http://dx.doi.org/10.1016/S0016-7037(97)00001-X

Brown D. A. 1984. Prospects and limits of a phytolith key for grasses in the central United States. *Journal of Archaeological Science 11: 345–368*.
http://dx.doi.org/10.1016/0305-4403(84)90016-5

Cabanes D., Weiner S., and Shahack-Gross R. 2011. Stability of phytoliths in the archaeological record: a dissolution study of modern and fossil phytoliths. *Journal of Archaeological Science 38: 2480–2490*.
http://dx.doi.org/10.1016/j.jas.2011.05.020

Cârciumaru M. 1996. *Paleoetnobotanica*. Editura Glasul Bucovinei. Iaşi.

Ciugudean H. 2009. Bemerkungen zur Chronologie der befestigten Siedlung von Teleac. *Analele Banatului 17: 67–87*.

2011. Periodizarea culturii Gáva în Transilvania în lumina noilor cercetări. *Apulum XLVIII: 69–102*.

Ciută B. 2012. *Plant species within the diet of Prehistoric communities from Transylvania*. Editura Mega. Cluj-Napoca.

Ciută B., Bejinariu I. 2012. Date arheobotanice privind conţinutul unei gropi rituale aparţinând grupului cultural Cehăluţ – Hajdúbagos. *Terra Sebus 4: 155–167*.

2019. Archaeobotanical analyses on charred macroremains from Şimleu Silvaniei "Observator" site (2015 archaeological campaign). *Acta Musei Porolissensis XLI: 43–52*.

Ciută B., Molnár Z. 2014. Contribuţii la dieta comunităţilor Otomani din situl Carei-Bobald. Terra Sebus. *Acta Musei Sabesiensis 6: 87–99*.

Dietrich L. 2012. Die Gáva-Siedlung von Rotbav, Südostsiebenbürgen. Ein kurzer Vorbericht. Satu Mare. *Studii şi Comunicări XXVIII(I): 101–108*.

2014a. *Die mittlere und späte Bronzezeit und die ältere Eisenzeit in Südostsiebenbürgen aufgrund der Siedlung von Rotbav*. Habelt. Bonn.

2014b. Datele radiocarbon din asezarea apartinand epocii bronzului de la Rotbav (jud. Brasov, Romania). *Studii şi Cercetări de Istorie Veche şi Arheologie 65: 59–70*.

Diffey C., Neef R., and Bogaard A. 2017. The archaeobotany of large-scale hermetic cereal storage at the Hittite capital of Hattusha. In A. Schachner (ed.), *Innovation versus Beharrung: Was macht den Unterschied des hethiotischen Reich sim Anatolien des 2. Jt. v. Chr.?* Internationaler Workshop zu Ehren Jürgen Seeher. Ege Yayınları. Istanbul: 185–201.

Fairbairn A., Omura S. 2005. Archaeological identification and significance of ÉSAG (agricultural storage pits) at Kaman-Kalahöyük, Central Anatolia. *Anatolian Studies 55: 15–23*.

Gismondi, A., D'Agostino, A., Canuti, L., Di Marco, G., Basoli, F., Canini, A. 2019. Starch granules: a data collection of 40 food species. *Plant Biosystems 153(2): 273–279*. https://doi.org/10.1080/11263504.2018.1473523

Gumă M. 1993. *Civilizaţia primei epoci a fierului în sud-vestul României*. Melior Trading S.R.L. Bucharest.

Hrisrova I., Atanassova J., and Marinova E. 2017. Plant economy and vegetation of the Iron Age in Bulgaria: archaeobotanical evidence from pit deposits. *Archaeological and Anthropological Sciences 9: 1481–1494*. https://doi.org/10.1007/s12520-016-0328-x

Ivanova M., Schlütz F., and Benecke N. 2020. Subteranean silos at Vráble, southwestern Slovakia. A case study of geochemistry and distribution of finds in fill deposits. In A. Kozubová, E. Makarová, and M. Neumann (eds.), *Ultra velum temporis. venované Jozefovi Bátorovi k 70. narodeninám*. Slovenská archeológia. Supplementum 1. Nitra: 257–271. https://doi.org/10.31577/slovarch.2020.suppl.1.21

Liu L., Wang J., Rosenberg D., Zhao H., Lengyel G., and Nadel D. 2018. Fermented beverage and food storage in 13,000 y-old stone mortars at Raqefet Cave, Israel: Investigating Natufian ritual feasting. *Journal of Archaeological Science. Reports 21: 783–793*. https://doi.org/10.1016/j.jasrep.2018.08.008

Madella M., Alexandre A., and Ball T. 2005. International code for phytolith nomenclature 1.0. *Annals of Botany 96: 253–260*. http://dx.doi.org/10.1093/aob/mci172

Madella M., Lancelotti C. 2012. Taphonomy and phytoliths: a user manual. *Quaternary International 275: 76–83*. http://dx.doi.org/10.1016/j.quaint.2011.09.008

Marinova E., Valamoti S. M. 2014. Crop diversity and choices in the prehistory of SE Europe: the archaeobotanical evidence from Greece and Bulgaria. In A. Chevalier, E. Marinova, and L. Pena-Cocharro (eds.), *Plants and people: choices and diversity through time*. Oxbow Books. Oxford: 64–74.

Monah D. 2002. Découvertes de pains et de restes d'aliments céréaliers en Europe de l'Est et Centrale. *Civilisations 49: 67–76*.

Mulholland S. C., Rapp Jr. G. 1992. A morphological classification of grass silica-bodies. In S. C. Mulholland, G. Rapp Jr. (eds.), *Phytolith systematics – emerging issues, advances in archaeological and museum science*. Springer Science & Business Media. New York: 65–89.

Piperno D. R. 2006. *Phytoliths: A comprehensive guide for archaeologists and paleoecologists*. Altamira Press. Lanham.

Portillo M., Kadowaki S., Nishiaki Y., and Albert R. M. 2014. Early Neolithic household behavior at Tell Seker al-Aheimar (Upper Khabur, Syria): A comparison to ethnoarchaeological study of phytoliths and dung spherulites. *Journal of Archaeological Science 42: 107–118*. http://dx.doi.org/10.1016/j.jas.2013.10.038

Reynolds P. J. 1974. Experimental Iron Age storage pits: An interim report. *Proceedings of the Prehistoric Society 40: 118–131*. https://doi.org/10.1017/S0079497X00011348

Sigaut F. 1980. Significance of underground storage in traditional systems of grain production. In J. Shejbal (ed.), *Controlled atmosphere storage of grains*. Elsevier. Amsterdam: 3–13.

1988. A method for identifying grain storage techniques and its application for European agricultural history. *Tools and Tillage VI(1): 3–46*.

Tsartsidou G., Lev-Yadun S., Albert R.-M., Miller-Rosen A., Efstratiou N., and Weiner S. 2007. The phytolith archaeological record: strengths and weaknesses evaluated based on a quantitative modern reference collection from Greece. *Journal of Archaeological Science 34: 1262–1275*. http://dx.doi.org/10.1016/j.jas.2006.10.017

Twiss P. C., Suess E., and Smith R. M. 1969. Morphological classification of grass phytoliths. *Soil Science Society of America Journal 33: 109–115*. http://dx.doi.org/10.2136/sssaj1969.03615995003300010030x

Urem-Kotsou D. 2017. Storage of food in the Neolithic communities of northern Greece. *World Archaeology 49(1): 73–89*. https://doi.org/10.1080/00438243.2016.1276853

Valamoti S. M., Marinovac E., Heiss A. G., +21 authors, and Kanceva Ruseva T. 2019. Prehistoric cereal foods of southeastern Europe: An archaeobotanical exploration. *Journal of Archaeological Science 104: 97–113*. https://doi.org/10.1016/j.jas.2018.11.004

Villers P., de Bruin T., and Navarro S. 2006. Development and applications of the hermetic storage technology. In I. Lorini, B. Bacaltchuk, H. Beckel, + 11 editors, and V. M. Scussel (eds.), *Proceedings of the 9th International Working Conference on Stored-Product Protection*. Brazilian Post-harvest Association. Passo Fundo. Sao Paulo: 719–729. http://spiru.cgahr.ksu.edu/proj/iwcspp/pdf2/9/6119.pdf