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Wooden coffins in the Avar-period cemetery in Frohsdorf, Lower Austria

Abstract: The Avar period cemetery in Frohsdorf is located in eastern Austria in the area of the former western periphery of the Avar Khaganate. In a non-literate culture like that of the Avars, it is only possible to reconstruct everyday culture, including funerary rituals, through archaeological sources. Through archaeological field seasons from 2001 to 2011, we have been able to document numerous coffins and grave fixtures made of wood in inhumation graves. Burials in coffins seemed to be common practice. The coffins are preserved in different states, including wood residues and charred wood residues. In Frohsdorf, in contrast to many other investigated Avar cemeteries, we subjected these coffins and their wooden remains to a detailed analysis. Wood species analyses show a preference for a certain type of wood, namely oak. Based on the preservation status of the wooden remains the authors have developed a hypothesis concerning part of the funeral ritual at this cemetery.

Keywords: Avar period, Burial ground, Coffin, Early medieval archaeology, Funerary rituals, Wood species analysis

DOI 10.1515/opar-2015-0001
Received August 25, 2014; accepted November 26, 2014

1 Introduction

The Avar cemetery in Frohsdorf is situated in Eastern Austria on a gravel terrace in the southern Vienna Basin, the so-called Steinfeld, west of the river Leitha close to the Rosalie Mountains. The area associated with the burial ground and its surroundings had been intersected by old branches of the river and were in the middle of its floodplains. The graves were dug into the fluvial deposits, which consist of coarse gravel and sand layers conglomerate.

The site was discovered by aerial archaeological prospection in May 2000. Aerial photographs showed the burial ground covering approximately 100 meters from the northeast to the southwest and measuring at its widest part around 60 meters. In this area, we identified almost 280 graves during aerial archaeological interpretation [1].

Research on the cemetery was undertaken through two small-scale excavations during 2001 and 2002. From 2004 to 2006 and from 2009 to 2011 with the help of two FWF grants (P16593, P21181) we conducted large-scale research excavation at this site. In these campaigns, we investigated a total area of 4200 m² and excavated, documented and retrieved 501 burials.

In contrast to many other excavated and already analyzed Avar burial grounds, we paid special attention to coffins and wooden fixtures in order to better understand what role they played within Avar funerary rituals.

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2 Preliminary results of the archaeological excavations

The graves are arranged in rows, at times very close to each other, and were elaborately built and well equipped. Graves were identified through above-ground markings indicated by wooden columns (e.g. graves 4, 41, 44, 327, 600). In some cases, we assumed these might have been superstructures (e.g. graves 140, 293, 301). The mostly long rectangular grave pits were up to 3.40 m (average 1.26 m) deep. Generally, the burials were oriented in a NW-SE orientation. Usually the dead were deposited in the dorsal position. In some cases, there is evidence for deviant burials (e.g. reopening of the grave and manipulation of the corpse, turned corpse, ventral position).

Above the burial level, we detected animal bones – mostly skulls or parts of skulls from cattle, though also from sheep or goat [2] – in many cases in a standardized zone of the grave filling. The rule-like appearance of these findings suggests that they are associated with funeral rites.

In numerous graves, we unearthed wooden coffins and wooden fixtures. The grave furnishings consisted of dress decoration and grave goods typical of the cultural Avar milieu. Women's graves contained jewelry such as earrings (e.g. with s-shaped loops, *Kettchenohrgehänge*, etc.), glass bead necklaces and (mostly spiral) finger rings. Next to pelvis or legs, iron knifes were deposited. In many women's graves, ceramic vessels [3], which had most likely served as a repository for food or drink offerings, were deposited near the feet-or lower-leg-area. Moreover, we frequently found ceramic vessels in children's graves – in many cases the only grave good. On the other hand, ceramic vessels in men's graves were rare. Men's graves were usually equipped with knives and a steel tool for making fire. As well as in women's graves (spiral) finger rings were also found. In addition, men's graves contained weapons such as arrowheads, more rarely reflexive composite bows, axes, swords and sabers. A total of 39 well-equipped men's graves contained cast belt fittings or belt fittings made of bronze sheets. In most graves animal bones were found near the feet, which have been interpreted as remnants of food offerings.

Based on common chronological schemes the Frohsdorf graves mainly belong to the 8th century [4, p. 159; 5, pp. 115–116]. Subject to a precise, fine chronological analysis, the entire period of the Frohsdorf cemetery extends from the mid-7th century to the time after 800.

3 Wooden coffins and wooden fixtures

In Frohsdorf, 298 graves from a total of 501 (60%), we can clearly prove wooden coffins or wooden fixtures were used. This mostly concerns graves of adult, mature, senile and juvenile individuals. Even though this has been observed, the determination and evaluation of anthropological data was a problem because of the very poor state of preservation of the skeletal material, due to soil conditions. It has been found that 91 (approximately 68 %) of 134 women's graves and 69 (approximately 64 %) of 107 men's graves definitively contained wooden coffins. This high percentage of coffins allows the conclusion that in the Avar period cemetery at Frohsdorf, the burial of the deceased in wooden coffins, regardless of sex / gender and / or age of death was common.

Out of 80 from the 298 graves, we extracted 132 samples of wood, respectively as charcoal. From these samples, 97 (approximately 73 %) species or genus were determined. From 23 samples, we differentiated conifers and hardwood. Some samples contained more than one wood species. In total, coffins' woods of 48 graves are identified as being hardwood or conifer or belonging to a certain genus (tab. 3).

3.1 Preservation

The preservation conditions of the wooden coffins and fixtures were very different. We proved differences in coffins and fixtures through colorations, differences in soil consistency, wood residues or charcoal residues. These common forms occurred individually and combined. In the cases of consistency, coffins' fillings usually were less compact than the graves' fillings. This is because the coffins' cavities were probably preserved quite long and the surrounding material solidified. After a breakdown of the coffin the

surrounding material trickled slowly in, which caused the filling of the lower portions of the coffins. In addition, the dislocations of bones, such as the roll off of skulls, as it was observed in Frohsdorf in many cases (e.g. graves 43, 98 (fig. 1), 155, 187, 201, 213, 242, 279 (fig. 1a), 291, 350, 417, 484, 569 and 648), is probably evidence for hollow spaces existing longer during the decomposition process. Thus, we evaluated that as a hint towards an existence of a coffin, even if no coffin material was preserved [for similar considerations see 6; 4, p. 84].

In Frohsdorf wooden residues were mostly charred, although in a few cases (graves 10, 20, 34, 50, 85, 103, 350, 384, 580 and 605) uncarbonized. According to present knowledge, this charring is due to anthropogenic influences respectively heat effects of fire (see paragraph 3.6).

Figure 1: Grave 279 with rolled off skull (photo: Johann Rudorfer)

Figure 1a: Grave 98 with rolled off skull (photo: Bendeguz Tobias)

3.2 Construction and dimensions

According to the preservation and soil conditions (fine sand or coarse gravel), we can verify only a few parts of coffin constructions. However, in total we have determined the following prospect:

In Frohsdorf, we verified box-shaped plank coffins. An impressive example was found in grave 310 (fig. 2), demonstrating the coffin's consistence of several longitudinal planks. In the case of the coffin's lids, two internal cross planks connected the longitudinal planks. In grave 256 a cross plank was detected above the lower leg bones, in graves 35, 42, 103, 142, 187 (fig. 3) and 256 longitudinal planks of the coffins' lids. In Frohsdorf, we could not detect any tree-coffins as known from other Avar period cemeteries [7, p. 67; 8, pp. 41–42; 9, p. 35]. In some cases (e.g. graves 1, 10) we observed extensions of the longitudinal planks of the coffins' side walls towards the head and foot ends. It is possible that these extensions were used as handles.

Iron coffin nails or coffin clamps, as they were detected at other places [7, p. 67; 8, pp. 41–42; 10, p. 101; 11, p. 165; 4, p. 84; 12], were not identified in Frohsdorf. We therefore expect coffin here to be constructed with timber connections.

Figure 2: Grave 310 with coffin made of wooden planks (photo: Döme Jankovich)

Figure 3: Grave 187 with longitudinal planks of the coffin lid (photo: Nicole Pieper)

It has to be considered that the coffins have succumbed to the pressures surrounding them have been partly broken. Therefore, sometimes the coffin dimensions documented may differ slightly from the original proportions. However, overall, the dimensions show clear tendencies regarding lengths and widths that also correlate broadly with the calculated body heights. The dimensions of the coffins of all deceased, adult and non-adult individuals, have lengths from 37 to 242 cm (average 167.57 cm) and rather tight-calculated widths from 18 to 82 cm (average 42.96 cm) (tab. 1). Due to poor preservation of the bones, it was possible to calculate the body heights only for a few individuals (tab. 1). The body heights were determined from the lengths of the long bone with the obtained regression formula of Sjøvold [13] (tab. 1). Therefore, only insufficient samples for comparing coffins' lengths and body heights are existent. Regardless, between those lengths available for both coffins' lengths and body heights, we could observe differences of between 30 to 80 cm.

Table 1: Tabular presentation of the coffins' dimensions, gender, age at death and body heights (~: coffin length or width cannot be reconstructed)

grave	coffin length	coffin width	sex / gender	age of death group	body height
1	~	43	female?	adult	
2	~	~	male	mature-senile	
4	~	~	male	mature	
5	~	~	female?	mature-senile	
6	177	41	female	adult-mature	
7	181	46	indiff.	infant II	
8	~	~	skeleton not preserved		
10	~	56	indiff.	infant II	
11	~	~	indiff.	juvenile	
12	~	~	male	mature-senile	163
13	182	49	female	senile	
15	~	~	skeleton not preserved	presumably infant	
16	117	25	female?	infant II	
17	160	31	indiff.	infant II	
18	186	45	female	adult	
19	132	35	skeleton not preserved		
20	~	41	indiff.	juvenile	
31	~	~	male	adult-mature	171
32	~	~	male	mature	
33	~	49	female	juvenile-adult	
34	~	~	male	juvenile	
35	~	36	indiff.	infant II	
39	~	~	indiff.	infant I	
40	176	40	male	adult	
41	222	54	male	juvenile-adult	180
42	~	~	indiff. / female	infant I / early adult	
43	~	~	indiff.	adult	156
44	169	37	female	adult	
45	~	~	indiff.	juvenile	
46	125	36	indiff.	infant I	
48	~	39	indiff.	mature-senile	
49	~	~	female?	juvenile	
50	~	~	indiff.	adult	

continued **Table 1:** Tabular presentation of the coffins' dimensions, gender, age at death and body heights (~: coffin length or width cannot be reconstructed)

grave	coffin length	coffin width	sex / gender	age of death group	body height
51	202	45	male	mature-senile	171
54	173	47	female	mature	
57	~	37	female	mature-senile	
59	187	44	female / indiff.	adult / neonatus-infant Ia	
60	~	~	male	adult	
61	198	50	male	adult	
63	~	33	female?	infant II	
67	131	46	indiff.	infant II	
69	160	36	female	infant II	
70	~	~	skeleton not preserved		
74	199	41	male	adult	
76	~	~	indiff.	infant I	
77	152	28	female	mature-senile	
79	~	~	indiff.	infant I	
85	~	~	female	early adult	
98	240	52	female	adult	157
101	~	~	skeleton not preserved		
102	~	39	female	early adult	
103	186	41	female	juvenile	
104	~	~	female?	infant I	
105	~	~	male	adult-mature	
106	~	~	indiff.	infant I	
108	~	~	skeleton not preserved		
109	~	32	female	mature-senile	
110	123	42	female?	infant II	
113	187	50	female/male	juvenile	
114	~	~	female?	infant I	
117	~	~	female	adult	
118	~	~	male	mature-senile	
122	126	38	female?	infant I	
130	149	47	female	mature	
132	~	42	female?	infant I-II	
140	~	~	female / male	adult/mature-senile	171 (ind.2)
142	~	~	female?	infant I	
146	~	43	female	adult-mature	
148	~	~	female?	infant I	
150	~	28	female?	infant I-II	
153	~	~	skeleton not preserved		
155	180	39	female	adult	
158	120	34	indiff.	infant I	
163	~	~	male	early adult	
167	136	41	skeleton not preserved		
169	~	38	female	early adult	
170	~	~	female	juvenile	
172	~	~	skeleton not preserved	presumably infant	

continued **Table 1:** Tabular presentation of the coffins' dimensions, gender, age at death and body heights (~: coffin length or width cannot be reconstructed)

grave	coffin length	coffin width	sex / gender	age of death group	body height
173	~	~	female?	infant I	
176	~	~	female	mature-senile	
179	~	~	male	adult-mature	
187	215	37	female/male	adult-mature	
189	~	~	female	juvenile-senile	
192	~	~	indiff.	infant I	
195	~	37	female	adult	
196	~	~	skeleton not preserved		
197	206	46	male	adult-mature	
199	~	~	indiff.	infant II	
200	~	~	indiff.	infant II	
201	163	35	female	adult	165
206	~	51	female	adult	
208	~	48	female	grown-up	
209	~	31	skeleton not preserved	presumably infant	
210	~	~	skeleton not preserved	presumably infant	
211	~	~	male	juvenile	
213	150	40	female?	adult-mature	
216	~	~	skeleton not preserved		
217	~	~	indiff.	infant II	
220	204	42	male	adult	
222	~	~	female?	infant II	
223	~	~	female?	infant II	
224	~	~	indiff.	infant II	
236	~	~	male	adult	
237	~	~	female	adult	
238	~	~	male	adult	
240	~	~	indiff./indiff.	infant II/infant I	
242	~	~	female	adult	
243	134	36	indiff.	infant I	
244	222	52	male	adult	
245	166	45	female	juvenile	
252	118	54	skeleton not preserved	presumably infant	
253	~	~	male	mature	
256	~	~	female	mature-senile	
257	~	~	skeleton not preserved	presumably infant	
258	~	45	indiff./male ?	infant I/mature	
260	~	~	female	adult	
261	~	62	female	adult	
262	~	~	indiff.	infant I	
263	202	45	female	adult	
265	183	53	male	mature	
270	~	~	female?	infant II	
272	~	~	skeleton not preserved	presumably infant	
275	~	~	skeleton not preserved	presumably infant	

continued **Table 1:** Tabular presentation of the coffins' dimensions, gender, age at death and body heights (~: coffin length or width cannot be reconstructed)

grave	coffin length	coffin width	sex / gender	age of death group	body height
282	~	~	female	adult	
283	116	48	indiff.	infant I	
287	130	36	indiff.	infant I	
288	~	~	female	adult	
289	188	44	male?	adult-mature	
290	~	38	female	mature	
297	~	~	indiff.	infant II	
298	~	47	male	adult	
299	~	~	indiff.	infant I	
300	182	60	female	mature	
301	~	~	female	adult	
310	200	75	female	adult	
312	145	37	female?	mature-senile	
315	121	26	indiff.	infant II	
316	184	47	male	infant II-juvenile	
319	~	46	male?	juvenile	
320	~	~	indiff.	juvenile	
321	212	76	male	adult-mature	165
323	175	48	female	mature-senile	
324	184	44	indiff.	juvenile	
326	197	47	male	adult	
327	159	41	female	adult-mature	
336	~	28	indiff.	infant I	
339	~	~	female?	infant II	
341	~	~	indiff.	infant I	
342	99	29	skeleton not preserved	presumably infant	
343	~	48	female	juvenile	
344	~	~	male	juvenile	
346	168	52	skeleton not preserved		
347	184	50	female	adult	
348	~	40	female?	mature-senile	
349	112	~	indiff.	infant I	
350	203	52	male	mature-senile	
351	161	31	female?	infant II	
352	113	30	indiff.	infant I	
353	~	38	skeleton not preserved		
354	104	38	indiff.	infant I	
356	110	31	indiff.	infant I	
357	189	43	male	adult	
360	176	49	indiff./indiff.	infant I/senile	
361	193	50	female	adult	
362	117	34	indiff.	infant I	
364	192	41	male / indiff.	mature-senile/ juvenile	
375	~	47	male	infant II	
378	~	~	skeleton not preserved	presumably infant	

continued **Table 1:** Tabular presentation of the coffins' dimensions, gender, age at death and body heights (~: coffin length or width cannot be reconstructed)

grave	coffin length	coffin width	sex / gender	age of death group	body height
379	196	53	female	mature	
384	~	64	male	adult	
387	~	38	female	adult	
390	193	60	female	senile	
391	~	51	male	juvenile-adult	152
392	188	61	female?	adult-mature	
394	~	~	female	mature	
398	106	35	indiff.	infant I	
411	131	40	female?	infant II	
415	192	43	male	adult	
416	210	58	male	mature-senile	
417	173	41	female	adult	
418	104	37	indiff.	infant I	
419	160	53	female?	adult	
420	~	38	female	juvenile	
432	~	40	indiff.	infant II	
433	200	59	female	mature-senile	
434	231	58	female	adult	159
435	181	51	male	adult-mature	
436	213	64	male	adult-mature	
437	215	58	male?	adult/mature/senile	
438	186	34	male	mature	
440	121	34	skeleton not preserved		
444	193	37	female	senile	
448	~	~	male	adult	165
451	~	~	indiff./female	infant I/adult	
452	~	~	indiff.	infant I	
453	175	~	female	juvenile-adult	
456	200	49	female	mature	
458	~	31	female	adult	
459	~	~	indiff.	infant I	
460	102	39	indiff.	infant I	
461	~	18	indiff.	neonatus-infant Ia	
462	109	28	skeleton not preserved		
468	~	~	female	mature	
469	106	44	female?	infant I	
470	242	82	male	adult	161
472	187	53	female	adult	
473	~	~	indiff.	infant I	
486	~	~	female	senile	
489	~	35	indiff.	infant II	
490	~	~	male?	juvenile	
492	183	41	female	mature	
493	214	40	male	adult	
495	150	38	male?	infant II	

continued **Table 1:** Tabular presentation of the coffins' dimensions, gender, age at death and body heights (~: coffin length or width cannot be reconstructed)

grave	coffin length	coffin width	sex / gender	age of death group	body height
498	192	40	male	adult	
501	201	36	male	adult-mature	
506	~	~	female	adult	
512	126	42	indiff.	infant I	
513	~	41	indiff.	juvenile	
514	198	45	male	mature	
515	167	31	female	mature-senile	
519	~	39	male?	infant II	
520	~	28	male	adult	
523	~	~	male	juvenile	
527	105	38	indiff.	infant I	
529	215	55	female	adult	
530	181	40	female	juvenile	
531	~	~	indiff.	infant II	
533	91	30	indiff.	infant I	
534	~	~	indiff.	grown-up	
537	190	49	female	adult	
539	196	55	female	adult	
541	178	53	female	juvenile-adult	
543	123	33	skeleton not preserved		
544	197	50	male	adult-mature	
545	164	34	female	juvenile	
546	152	36	female?	infant I	
548	~	~	skeleton not preserved	presumably infant	
549	74	26	skeleton not preserved	presumably infant	
552	~	49	female	adult	
553	171	37	male	adult-mature	
554	~	34	male	adult	
557	153	35	female	senile	
558	166	34	male	adult	
559	144	~	indiff.	infant II	
560	146	42	indiff.	infant II	
562	110	33	indiff.	infant I	
563	195	46	male	mature-senile	
564	~	38	female?	juvenile	
565	~	41	indiff.	mature	
566	165	31	indiff.	infant II	
567	137	35	indiff.	infant II	
569	~	50	female	senile	
571	205	53	male	adult-mature	
572	173	60	indiff.	infant II - juvenile	
573	158	49	female?	infant II	
575	181	39	female	adult	
577	~	~	female	mature	
578	~	40	female	adult	

continued **Table 1:** Tabular presentation of the coffins' dimensions, gender, age at death and body heights (~: coffin length or width cannot be reconstructed)

grave	coffin length	coffin width	sex / gender	age of death group	body height
579	188	46	indiff.	mature	
580	184	51	male	adult	
582	~	42	female?	infant II	
585	116	36	skeleton not preserved	presumably infant	
586	~	34	indiff.	juvenile	
589	~	27	skeleton not preserved	presumably infant	
590	218	42	male	mature-senile	
591	188	45	female??/male	adult-mature	
592	~	48	male	juvenile	
593	168	39	female	adult	
594	198	40	male	juvenile	
599	127	36	indiff.	infant II	
601	195	60	female	mature	
603	133	32	female?	infant I	
604	87	35	indiff.	infant I	
605	203	53	male	adult	
609	175	~	female	adult	
612	~	~	female	juvenile	
613	143	~	female	grown-up	
614	197	44	male	senile	
615	~	~	indiff.	infant I	
616	~	~	female?/male?	adult	
617	161	45	female	juvenile	
618	146	35	female	mature-senile	
619	192	51	male	mature	
620	192	50	male	mature-senile	
621	189	43	female	adult	
624	~	~	male	mature	
625	133	38	female?	infant II	
626	198	54	male	adult	
628	~	40	indiff.	infant II	
629	221	72	male	adult-mature	
632	204	57	male	adult	
633	171	43	male	mature	
636	129	32	female?	infant I	
641	~	~	female	mature	
644	123	30	indiff.	infant I	
645	212	55	male	mature	
649	111	25	indiff.	infant I	
652	~	~	female	adult-mature	
657	199	48	male	adult	
659	~	46	female	adult-mature	157

The coffins' sizes were probably well adapted to the body sizes of the dead and the intended furnishings. Grave 51, for example, differentiated in the proportion of coffin length to body height, is rather small with a 31 cm difference. The preserved grave equipment (an iron awl with wooden handle, fire steel with flints, ceramic pot, an iron knife, as well as remnants of meat offerings bones of poultry, cattle and sheep/goat [2]) seems rather modest. In contrast, the lavishly furnished graves 98 and 470 have in the proportion of coffin length to body height larger differences of 83 and 81 cm. The men's grave 470 contained a cast bronze belt fitting, a bronze decorative plate with a chain, textile and leather remnants of clothes, an iron knife and animal bones. Grave 98 was a woman's burial with bronze bobble earrings, other earring types, a necklace made of bronze and silver sheet, rod beads, on each hand three spiral finger rings, an iron knife and a bag decorated with bronze sheets that was attached by a chain to a belt and animal bones. The correlation of coffins' lengths with the age at death, which we determined by methods summarized by Szilvássy [14], and sex supports the individual adaptation of the coffins (fig. 4). Thus, in each age group despite a relatively large range of variation, the average length of the coffins increased from toddlers (*Infans* I) with 116 cm, children (*Infans* II) with 147 cm, juvenile (*Juvenil*) with 182 cm to grown-ups with 190 cm. Since adult females in a population are usually smaller than men, we have separated adults in this evaluation even after assigned gender, in which determination we included both archaeological and anthropological evidence. The average coffin length of female deceased was 181 cm, with that of male 199 cm.

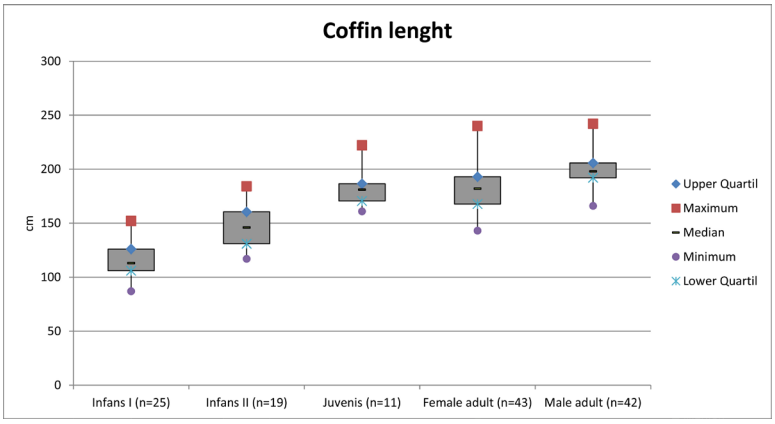

Figure 4: Box plots of coffin lengths and their variation within an age group / gender group (graphic arts: Karin Wiltschke-Schrotta)

Multiple coffin planks were found slanted and/or bent. This suggests the collapse of the coffins during the decomposition process. Similar observations are known for example from Sommerein (A) [15, p. 32].

Frequently at the head and foot ends of the grave bases we observed hollows. In addition, in the grave bases' corners postholes (average diameter about 20 cm; e.g. graves 105, 155, 252, 412, 436, 448, 470 and 610) were observed often. Some of these postholes were already visible directly below the topsoil or on the first documentation level (e.g. graves 16, 18, 42, 36, 74, 79, 293, 301, 369, 437, 447 and 571). Similar features are also known, for example from Leobersdorf [4] or Budapest (Rákóczi Ferenc út) [16, pp. 154–155]. Due to the small diameters, these are probably definitely from postholes and not post pits. It is assumed that they are derived from wooden upright beams, which have been incorporated into the open grave pit. One possible interpretation of these features was that the coffins stood on feet. Another possibility is – especially in cases of features (e.g. graves 293, 301) where the postholes were recognizable already on documentation level 1 – that these were constructions for lowering the coffin into the grave pit [for similar assumptions see 4, p. 84]. Maybe the uprights were also used as grave markings (by stele or in the form of a superstructure as in the case of grave 118).

A grave fixture in the form of a wooden chamber that contained the coffin itself was found in grave 140 (fig. 5). It was the richly furnished, though robbed/disturbed, double burial of a man and a woman.

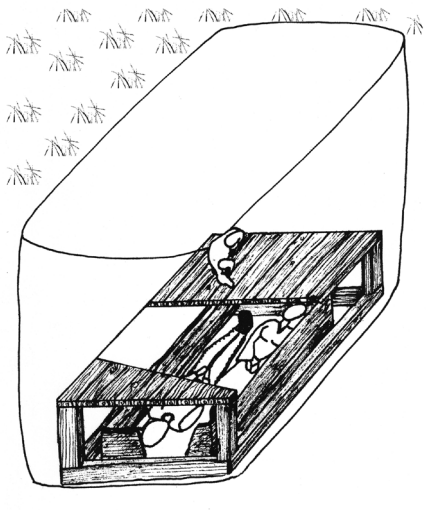

Figure 5: Chamber respectively wooden grave fixture in grave 140 (reconstruction drawing: Andreas Weihs)

3.3 Wood species analysis

From a total of 298 verified wooden coffins or wood fixtures from the cemetery of Frohsdorf we analyzed 132 wood samples from 80 graves. Samples were only used if they could be clearly assigned to a coffin. Charcoal residues, some of which were in the grave filling but not attributable to a coffin were not included in the analysis.

Wood species analysis was performed on freshly broken sample surfaces under a light microscope. For publication purposes, certain samples were documented using a SEM (scanning electron microscope) with high magnification and better depth of sharpness. In 64 samples from 41 graves, we identified the genus *Quercus sp.* (oak) (fig. 6). In the cases of ring-porous oaks even with the best maintenance, the species cannot be reliably separated. This also applies to a sample of the genus *Acer* (maple) (fig. 7). 31 samples from 19 graves could be assigned to the genus *Fagus sylvatica* (European beech) (fig. 8). One sample we assigned to the genus *Ulmus* (elm) (fig. 9). 13 samples from nine graves were assigned to hardwoods, and ten from seven graves to conifers (tab. 2). If conifers are completely transformed into charcoal, they are easy to identify. If – as observed in Frohsdorf – the transformation did not take place or was incomplete the wood remnants decay mostly along the growth ring boundaries into smallest particles which are not determinable.

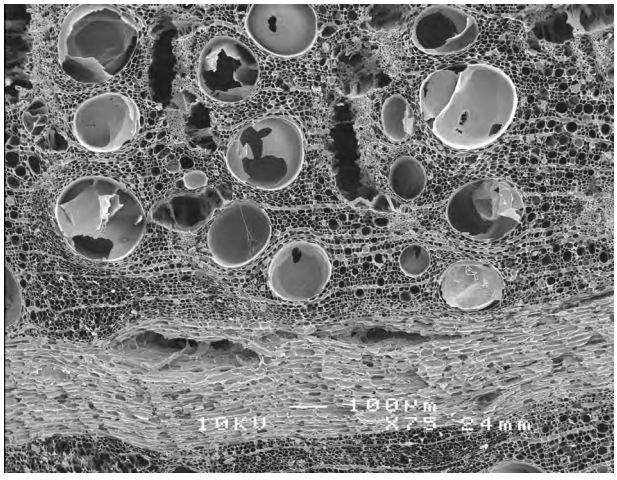

Figure 6: Oak (*Quercus sp.*), grave 415, cross-section (SEM micrograph: Otto Cichocki)

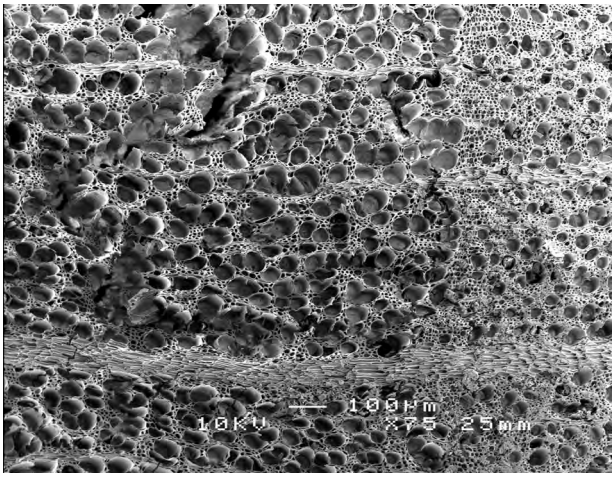

Figure 7: Beech (*Fagus sylvatica*), grave 565, cross-section (SEM micrograph: Otto Cichocki)

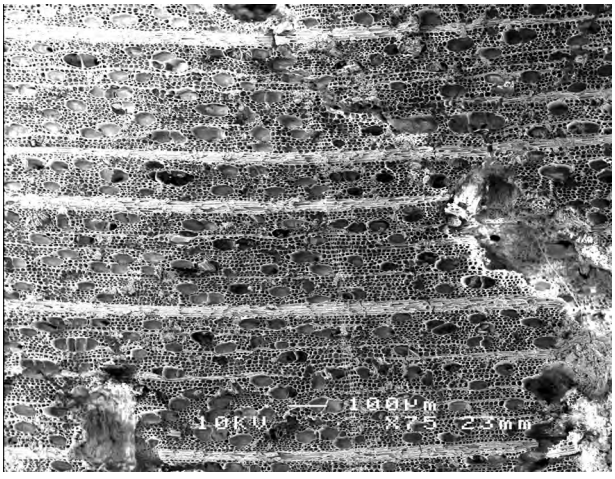

Figure 8: Maple (*Acer sp.*), grave 4, cross-section (SEM micrograph: Otto Cichocki)

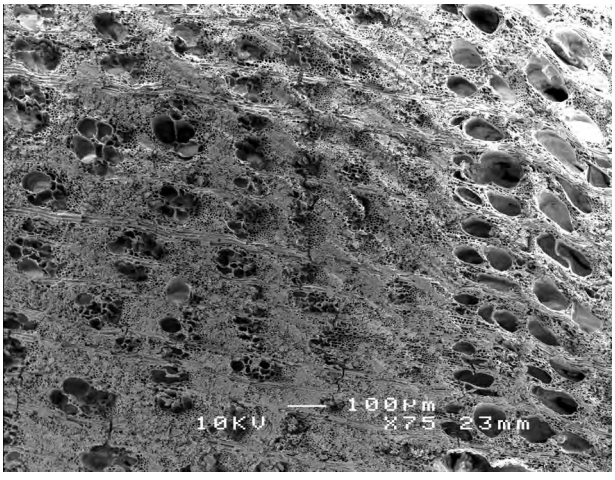

Figure 9: Elm (*Ulmus sp.*), grave 586, cross-section (SEM micrograph: Otto Cichocki)

Table 2: Overview of genus and quantity of determinable wood remnants

number of identified samples	number of graves	genus	
64	41	oak	*Quercus sp.*
31	19	beech	*Fagus sylvatica*
1	1	maple	*Acer sp.*
1	1	elm	*Ulmus*
13	9	hardwood indet.	
10	7	conifer indet.	
39	31	wood indet	
2	2	bark indet.	

3.4 Wood species selection

Looking at the distribution of the wood to the individual graves predominantly one species of wood (mostly oak, followed by beech) was detected in the samples. But there are also a few graves with two kinds of wood species (e.g. oak / beech in graves 40, 103, 146 and 199 and oak / conifer in grave 113) or three (beech / oak indet. / conifer within graves 50, 104, 310, 321 and 349). Within 37 samples of indeterminable wood remnants, 13 samples of indeterminate hardwood and ten samples of indeterminate conifers other wood species than those detected might be hidden.

This raises the question whether the selection of wood was intentional – possibly due to their technological quality and characteristics or a cultic postulate – or if wood selection was based on availability offered in the region [for comparable questions in other contexts see 17]. The choice of wood species seems to have no significant association with sex/gender or age of death of the buried individuals (tab. 3). Thus, oak was found in seven men's and nine women's graves. Beech we found in one man's grave and three women's graves. Oak was found in all seven graves identified as girls' (three of them unsure). Oak and beech wood apparently were available in sufficient quantity. These tree species have been fostered by the medieval climate optimum [18] and were then as today abundant in this geographic region.

Table 3: Wood species analysis of coffins (hw – hardwoods, conif - conifers, cc – charcoal, wood – not carbonized, indet. – indeterminable)

grave	find no.	preservation	wood species
4	4-002	cc	maple, beech?
10	10-006	cc	oak, conif
	10-008	cc	oak
	10-010	wood	conif indet.
	10-012	cc	indet.
12	12-001	cc	oak
	12-002	cc	beech?
16	16-003	cc	oak
18	18-014	cc	oak
20	20-002	cc, wood	indet.
	20-019	cc	indet.
31	31-004	cc	oak
34	34-007	cc	oak
	34-023	wood	oak
35	35-002	cc	indet.

continued **Table 3:** Wood species analysis of coffins (hw – hardwoods, conif - conifers, cc – charcoal, wood – not carbonized, indet. – indeterminable)

grave	find no.	preservation	wood species
40	40-003	cc	oak, beech
	40-027	cc	oak
	40-028	cc	oak
	40-030	cc	beech
	40-046	cc	oak
41	41-012	cc	oak
42	42-003	cc	oak
	42-004	cc	indet.
	42-009	cc	indet.
43	43-006	cc	oak
45	45-001	cc	oak
50	50-001	cc	beech, oak
	50-003	cc	beech, oak
	50-004	wood	hw
	50-005	cc	conif indet.
	50-007	wood	conif indet., hw indet.
	50-008	cc	beech
	50-009	cc	hw
	50-011	cc	beech, oak
	50-012	wood	conif indet.
51	51-012	cc	oak
	51-014	cc	hw
57	57-003	cc	beech
69	69-003	cc	oak
76	76-001	cc	oak
85	85-002	cc, wood	oak, conif indet.
	85-003	cc	oak
98	98-020	min.	conif
101	101-001	cc	indet.
103	103-018	wood, bark, roots	bark indet.
104	104-002	cc	oak, beech
	104-004	cc	oak
	104-005	cc	beech, oak
	104-006	cc	oak, hw
	104-007	cc	beech, oak, hw
	104-008	cc	beech, oak, hw
	104-011	cc	oak
	104-012	cc	oak, beech
	104-014	cc	oak
	104-015	cc	oak, beech, hw
	104-019	cc	beech, oak
	104-030	cc	beech, oak
113	113-001	cc	oak
	113-004	cc	oak
	113-005	cc	hw
	113-006	cc	oak
114	114-007	cc	oak

continued **Table 3:** Wood species analysis of coffins (hw – hardwoods, conif - conifers, cc – charcoal, wood – not carbonized, indet. – indeterminable)

grave	find no.	preservation	wood species
117	117-008	cc	beech
118	118-008	cc	indet.
130	130-002	cc	indet.
132	132-001	cc	oak
140	140-007	cc	indet.
	140-088	cc	indet.
	140-096	cc	oak
142	142-008	cc	indet.
	142-009	cc	oak
146	146-001	cc	oak
	146-002	cc	beech
	146-003	cc	beech
153	153-001	cc	oak
155	155-005	cc	indet.
158	158-002	cc	indet.
167	167-001	cc	indet.
170	170-005	cc	indet.
173	173-001	cc	oak, beech
187	187-003	cc	oak
197	197-001	cc	beech
199	199-006	cc	beech, oak
201	201-005	cc	beech
208	208-003	cc	oak
210	210-001	cc	oak
	210-003	cc	oak
211	211-001	cc	indet.
213	213-002	cc	indet.
217	217-007	cc?	indet.
236	236-001	cc	indet.
	236-017	cc	oak
242	242-003	cc	indet.
	242-011	cc	indet.
	242-021	cc	conif indet.
256	256-007	humos	indet.
257	257-001	cc	oak
258	258-008	cc	indet.
267	267-001	cc	beech
270	270-010	cc	oak
	270-012	cc	oak
310	310-001	cc	oak
	310-003	cc	hw? indet., indet.
	310-018	cc	indet.
321	321-003	cc	beech, oak, hw indet.
324	324-005	cc	oak
349	349-008	cc	indet.
	349-009	cc	beech, oak, hw indet.
350	350-015	wood, bark	indet.

continued **Table 3:** Wood species analysis of coffins (hw – hardwoods, conif - conifers, cc – charcoal, wood – not carbonized, indet. – indeterminable)

grave	find no.	preservation	wood species
384	384-008	wood	conif indet.
387	387-001	cc	hw
415	415-033	cc	oak
417	417-002	cc	beech
	417-003	cc	conif
453	453-010	cc	indet.
459	459-001	cc	indet.
469	469-002	cc	indet.
473	473-005	cc	beech
490	490-001	cc	indet.
540	540-002	cc	beech?
542	542-004	cc	oak
564	564-002	cc	indet.
	564-003	cc	indet.
565	565-006	cc	beech
580	580-021	wood	indet.
586	586-001	cc	elm
605	605-001	cc	oak
	605-012	wood	hw? indet.
613	613-003	cc	indet.
626	626-001	cc	oak
636	636-009	cc	indet.
659	659-023	cc	oak

The trunks of oak (and also limited beech) are freshly felled, easy to split and thus can be processed into planks and boards. Since we found the wood remains only in small particles, no traces of processing were recognizable. The woods (especially oak) are durable. Therefore, depending on wood species, thickness of wooden planks, temperature and O2 content of the soil, the decay of a coffin until collapse can take between seven to 15 years. Although the degradation of coffins is not yet documented in the literature, we suggest this period based on our own observations as well as those of other project groups and recent burial laws in Middle Europe [19].

3.5 Preservation of wood residues

In Frohsdorf, wooden remains are preserved mainly as small-sized pieces of charcoal. The effects of fire on wood cause this conversion. Part of the wood tissue is subjected to a dry distillation by heat and lack of oxygen. The other part is used as an energy source by burning to ash while gaseous and liquid components are separated. A brittle and slightly shrunken black wood structure remains, which comprises all cellular details but is resistant to biodegradation. These pieces crumble by mechanical impact or wet/dry or cold/warm change to ever-smaller particles over time. This state of preservation is typical and only due to fire exposure.

Sometimes the transformation to charcoal is not complete and the wood residues can be biodegraded further. Alternatively, the temperature at carbonization was too high or too low and the wood coked. In both cases a blackish-blistered bulk remains that does not show any anatomical details or only sometimes allows a distinction between hardwood and coniferous trees sometimes.

In a few graves (e.g. grave 50), wood was preserved in very thin black layers which had a wavy structure due to shrinkage phenomena. This state of preservation was probably the consequence of a weak shallow

charring. The non-charred wood was gone and only the thin charred layer was preserved.

This state of preservation is sometimes attributed to fungi. In fact, this can be observed in tree stumps or broken trunks with a surface partially carbon-blacked as burnt. Generally these are attributed to the fire-crust fungus (*Kretzschmaria deusta*; syn. *Hypoxylon deustum* and *Ustulina deusta*). This fungus is parasitic on living and dead beech wood or lime trees and generates a thin dark, later black layer (*stroma*) on the outer surface of the infected area. It is not inconceivable that occasionally fungus-infected wood was used for making coffins and that after the funeral the coffin developed such a layer, which was preserved as a black surface. However, pieces of charcoal cannot develop through this process, as only black dyeing of the wood surface takes place (similar to contact with sulphuric acid), lacking the typical brittle structure developed inside the wood when it is burnt. Nevertheless, due to the poor preservation of anatomical details and the small sizes of the samples proof of the fungus is difficult to determine (e.g. in graves 140, 453, 459, 469, 490, 564 and 580). Moreover, this assumption is applicable only for a small minority of the graves of Frohsdorf.

The effect of coal diagenesis, which is sometimes called carbonization, cannot be observed among the archaeological samples. This process which occurs within long time spans (1000s of years for peat, 100000s of years for young brown coal and millions of years for higher coalification stages), forms coal from wood by time, pressure and slightly higher temperatures (below 80 °C) [20, pp. 71-73]. No fire or high temperatures are involved. Thus, only very early stages might be visible when investigating uncarbonized archaeological wood samples, which never turn to black, but to a light brown color [21].

Uncharred wood (e.g. in graves 50 and 605) is rarely preserved. This conservation is rare, because wood becomes infected by bacteria and fungi and degrades under normal humid ambient conditions. This degradation takes place within a few years. Sometimes uncharred wood remains are present because substances, which worked abiotically, were present and penetrated the cell structure. Thus, metal parts (especially copper or bronze but also iron) could form salts, which dissolve in ground water and soak the wood substance as 'preservatives' to hinder wood-degrading organisms in their activities [22].

Two samples from grave 256 and grave 350 are whitish flaky remains that is indicative as ash. This is formed as predominantly inorganic remnant of complete combustion.

3.6 Remaining questions

Based on the situation in Frohsdorf one question in connection with the wooden coffins and fixtures and their carbonization arises. A massive fire exposure of the coffins is hard to imagine since we found no traces of heat exposure on all other finds and features. However, some coffin woods (e.g. grave 310) show such a high grade of carbonization that carrying the coffins and lowering them and their contents down to the grave bottom in this condition is inconceivable. We tried to verify a hint [23] that a fungus could have possibly caused this charring. However, we could not verify this theory (see 3.5). As other possibilities to cause black color together with typical charcoal tissue do not exist, the only remaining explanation for charring of the coffins' woods is that of fire exposure (see 5.1).

4 Wooden coffins and wooden fixtures in Frohsdorf compared to those in other Avar period cemeteries

Usually in the case of a coffin burial in an earthern grave as observed in Frohsdorf the decomposition process of the deceased to skeletonisation needs around five to seven years. Predominantly microorganisms or the bodies own enzymes [24; 25, pp. 6–7] execute the decomposition (autolysis).

So far, many Avar period cemeteries with a total of 60,000 graves have been excavated and documented in eastern Central Europe [26; 5, p. 95]. Wooden coffins and wooden fixtures as well as the surface marking of graves have not only been found not only in Frohsdorf but also elsewhere.

Péter Tomka dealt repeatedly with the theme of coffin burials in Avar graves. In 1979 he wrote: „Die Knochen eines ohne Sarg bestatteten Toten können sich nicht mehr von der Stelle bewegen, da sie das Erdreich von oben niederdrückt. Der Sarg trägt das Erdreich im Allgemeinen länger als die Muskeln die

Skeletteile zusammenhalten (see paragraph 3.4), so daß die Knochen sich wahrnehmbar verschieben können. Insbesondere der Schädel pflegt zu „wandern", im Verhältnis zum Unterkiefer zu kippen, sich nach hinten oder seitlich zu verschieben. Allein schon daraus kann man mit ziemlicher Sicherheit auf einen Sarg schließen."[6]

Alfred Dieck noted similar statements about post-funeral natural postmortem position changes of the corpse in the coffin due to autolysis [27]. However, his work has been critically evaluated today [28; 29]. This criticism relates primarily on alleged finds that were actually not available. Because of this practice, all of Dieck's works have to be considered with caution. Regardless, the reasons for position changes of the corpse inside the coffin are probably gas developments caused by putrefaction, which is also addressed in recent publications [25, p. 9].

In 1996, Tomka stated in a summary article that „die Verwendung von Holzsärgen aus Baumstämmen oder Brettern roh zusammengefügt oder gezimmert" was widespread [12]. As in Frohsdorf, wood or charcoal remains of coffins or grave fixtures were recovered partially from other Avar cemeteries. For example we know of such finds from Münchendorf (A) [30], Kisköre (H) [31, pp. 42–43], Alattyán (H) [32, p. 66], Vác-Kavicsbánya (H) [33, p. 118], Szarvas-Grexa-Téglagyár (H) [7, p. 67] and Orosháza-Bónum Téglagyár (H) [8, pp. 41–42]. In contrast to the wood and charcoal residues from Frohsdorf no further systematic investigations of wood anatomical genus and species' analyses have been carried out so far. Only wood samples from grave 146 in Kisköre [31] were identified – the only example from the Avar period known to the authors. It was oak (*Quercus cf. robur*), which was believed to have been brought from the nearby floodplain of the river Tisza.

As in Frohsdorf, the wooden coffins from other sites contained longitudinal and transversal planks. These were observed at Sommerein (A) [15, p. 32], Orosháza-Béke Tsz-Homokbánya (H) [8, p. 94], Szentes-Kaján (H) [34, p. 92], Tiszafüred (H) [11, p. 166] and Pilismarót-Basaharc (H) [35]. At some sites the compound of the coffin planks was achieved with iron coffin brackets like in Leobersdorf (A) [4, p. 84], Szekszárd (Bogyiszlói-Street) (H) [10, p. 101], Szegvár-Sápoldal (H) [36], Orosháza-Bónum Téglagyár [8, pp. 41–42], Tiszafüred [11, p. 166], Zamárdi-Rétiföldek (H) [37], Orosháza-Béke Tsz-Homokbánya (H) [8, p. 93–95], Környe (H) [38, p. 32], Szentes-Kaján [34, p. 92], Üllő (H) [39, p. 55] and even relatively common in Szarvas-Grexa-Téglagyár [7, p. 67]. However, plank coffins could also be held together by wood joints as the example Frohsdorf shows, but also finds from Sommerein (A) [15, p. 32] or Horgoš (SRB) and Stara Moravica (SRB) [40] show.

Another form of the wooden coffin is the log coffin which is known from an example found at Leithaprodersdorf (A) [9, p. 35], Szekszárd (Bogyiszlói-Street) (H) [10, p. 101], Szarvas-Grexa-Téglagyár (H) [7, p. 67], Környe (H) [38, p. 32] or Orosháza-Bónum Téglagyár (H) [8, pp. 41–42] and Orosháza-Béke Tsz-Homokbánya (H) [8, p. 93–95].

Additionally we know occasionally of boards supporting the dead which were positioned under the corpse. Examples we know for example from Leithaprodersdorf (A) [9, p. 35], Münchendorf (A) [30, p. 75] or Szekszárd (Bogyiszlói-Street) (H) [10, p. 101].

The width of the coffins is usually rather tight (for adult individuals 40-55 cm, see tab. 1). This feature is not only seen at Frohsdorf, but also from examples at Sommerein (A) [15, p. 32], which seem prove this fact. Presumably, the size of the coffin was largely adapted to that of the deceased and the grave goods provided.

Extensions of the longitudinal planks of the sidewalls were partially observed in the case of planks coffins on the head and feet end of the coffins. Examples were found in Frohsdorf, but also in cemeteries in the area of Budapest (H) [16, p. 86], in Sopronkőhida (H) [41] or Komárom (H) [42, pp. 59, 67–68, 77]. Maybe these extensions were used as handles similar to those at the so-called St. Michael's horse (see below). Examples with both, extensions of longitudinal and broad planks are known, e.g. in Mistelbach (A) [43, p. 131].

As in Frohsdorf, four postholes or hollows at the head and feet ends of the grave basement were observed elsewhere, for example some sites in Stara Moravica [40, pp. 97–100], Horgoš [40, pp. 102–105] or in Münchendorf (A) [30, p. 75]. For such features in Leobersdorf Falko Daim wrote that „eine andere Bedeutung als die, nach dem Herblassen des Sarges oder Totenbrettes das Herausziehen der Seile zu erleichtern" was difficult to imagine, „allenfalls wäre es denkbar, dass die Särge Füße besessen haben" [4, p. 87]. This has

similarly been argued in the context of the burial ground of Solymár (H) [44, p. 28]. It was thought that the stretchers on which the dead were carried to the grave were left in the grave pits. This theory was put forth due to the slanted ends of grave basements and rectangular hollows at the head and foot ends of the graves' basements (graves 47, 67, 73, 75-77, 80, 89, 90, 93, 96, 100, 113). Irén Juhász interpreted holes in grave 414 of the burial ground of Szarvas-Grexa-Téglagyár (H) [7, p. 67] as a coffin burial in form of a so-called St. Michael's Horse. The St. Michael's horse was still used as part of the burial customs in Hungary in the 20th century. Before the funeral, the coffin was brought to the court and put on the so-called St. Michael's horse. The St. Michael's horse was a stretcher that was about 60 cm high and had four feet and two pairs of handles. Both sides were a little higher so that the coffin could not slip off. This carrier was made of wood [45, pp. 171–172].

Some of the postholes at the graves' bottoms were tracked into a depth from the first documentation level. Examples of this feature are not only found at Frohsdorf. We know of comparable features for example from Környe (H) [38, p. 32], which were interpreted as grave labels. In some cases, they were interpreted as evidence of superstructures resting on wooden columns or even wooden grave houses such as in Vac-Kavicsbánya (H) [33, p. 118] and Szarvas-Grexa-Téglagyár (H) (grave 416) [7, p. 67].

In some Avar cemeteries, wooden fixtures and even grave chambers have been assumed. For example, Herbert Mitscha-Märheim assumed for the Avar period cemetery of Leithaprodersdorf (A) [9, p. 35] that the grave walls were lined with wooden planks. Whether they were grave chambers or coffins constructed of wooden planks and compounds is not clear from the paper. Also in the case of Sommerein (A) [15, p. 29] the authors wrote about a wooden coating but were not entirely sure if it was definitely a grave fixture. In contrast in Solymár (H) clearly carpentered grave chambers made of timber (graves 50, 65 and 78) [44, p. 28] were postulated. More probably grave fixtures are known from Budapest (H) [16, p. 24]. In 1996 Péter Tomka wrote about remarkable large grave pits, which had wooden chambers built in [12] – which also applies to grave 140 (fig. 2) in Frohsdorf.

It should be noted that the evidence of wooden coffins and wooden fixtures depends on its state of preservation. Thus, a lack of evidence does not necessarily prove the absence of the object. The differing percentage of proven coffins and wooden fixtures in Avar cemeteries may be due to that fact. While in Frohsdorf we proved these in approximately 60% of the graves, for example evidences of coffins were observed only in 10% of the graves in Leobersdorf (A) [4, p. 84] and even only in 3.5% of the graves in Szekszárd (Bogyiszlói-Street) (H) [10].

Overall, the evidences of coffins and the like are relatively often succeeded in the Avar milieu. Therefore, the burial in coffins might always be assumed. Walter Pohl noted that the deceased were often laid in coffins; "in einzelnen Fällen gewinnt man sogar den Eindruck einer liebevoll als Wohnraum eingerichteten letzen Ruhestätte. [...] Vornehme Awaren der Frühzeit wurden sehr aufwendig in Brett- oder Baumsärgen [...] bestattet" [46, p. 202]. This opinion has also been expressed regarding the burial ground of Vösendorf (A) [47, pp. 75–94] – probably due to the rider graves with coffins. In contrast, Gulya Rosner wrote regarding the burial ground of Szekszárd (Bogyiszlói-Street) (H) [10, p. 101] that this custom of burial in wooden coffins could be bound neither to a period nor to the social status.

Together with Falko Daim [15, p. 126] and Walter Pohl [46, p. 202] it has to be noted that these archaeological evidences and findings help to make accessible mandatory traditions and customs of a community with their scopes and local variants.

5 Experiment

5.1 Hypothesis

After extensive research (see above), the authors have excluded the Frohsdorf site from other causes for charring most of the wooden coffins, other than the effects of fire. A significant fire exposure – possibly by deliberately setting the coffin and its contents on fire – was just as unlikely as skeletons, clothing

accessories and grave goods do not show any traces of exposure to fire. On the other hand, a smoldering fire that had started unintentionally is possible. This would also explain the coffins' different degrees of charring and preservation in Frohsdorf.

To investigate this the starting point of the experiment was the following hypothesis: During the funeral ceremony – for which little archaeological material remains, is inconsistent and hard to develop [46, p. 202] – the coffin and its contents was lowered into the grave pit. There may have been a funeral ceremony with fire nearby the open grave. At the end of the ceremony, ash and embers of the fire were put into the still open grave, which was subsequently refilled. Whether smoldering could occur or not depended on the amount of embers, the volume of the coffin and the air contained therein, the degree of dryness of the wood, the speed in filling up the grave pit, and last but not least the weather (rainfall or none). All of these highly variable factors set the strength and extent of the smoldering fire, which caused different degrees of charring, as we were able to demonstrate in the archaeological record.

A similar theory has been advocated Éva Garam in connection with the burial ground of Kisköre (H) [31, pp. 42–43]. It was found here in grave 146, that the earth was partially burned reddish and even the leg bones of the deceased were charred. Garam's interpretation of the situation was that the coffin was lowered into the grave pit and the remains of the funeral feast held on the edge of the grave were thrown to the feet end of the coffin. Burning logs burnt the coffin so that even the corpse lying in the coffin was affected. Ilona Korvig was of the same opinion due to a similar feature. She also could prove fire traces on the legs in grave 89 in Alattyán (H) [32, pp. 68–69]. Korvig wrote that glowing ashes were shoveled over the dead or that a fire was lit over the deceased. She also thought of sacrificial fires or of smoking out in the course of the funerary feast [32, pp. 67–69].

5.2 Realization

To test the hypothesis the authors carried out the following experiment taking advantage of an excavation festival with one open fireplace during the final excavation campaign of 2011 in Frohsdorf.

First we built three wooden coffins with dimensions of 154 × 40 × 30 cm respectively 180/148 × 40 × 30 cm out of ca. 3.5 cm thick oak planks. Although we could exclude the use of iron nails or iron brackets for constructing the Avar coffins in Frohsdorf, we used these for constructing the new comparison coffins for the experiment. In these wooden boxes, we deposited extremities of pigs and wet textile remains.

In the course of the excavation festival, we lowered each of the three coffins in to one of the excavated but still open grave pits. The pits were those of the graves 614, 624 and 633 which we had already documented and which contents we had recovered. Subsequently we put a fire's embers into the grave pits as an imitation or substitute for the remains of an assumed funeral meal. Afterwards we refilled the pits. Upon finishing, heavy rainfall started.

After four days, we dug up the experimentally buried wooden boxes. We did this according to the usual rules of archaeological excavation and documentation.

5.3 Documentation

The experiment's "graves" were numbered 901, 902 and 903.

Grave 901: The simple "wooden coffin" (external dimensions 154 × 40 × 30 cm) was deposited in the pit of grave 614 at a depth of 190 cm below soil top edge. Top of the wooden box, mainly on its northwestern half, was carbonized. Fewer residues we found below and to the sides. The "coffin lid" was only slightly blackened. To a lesser extent, this was also the case at the sides and at the bottom. The degree of carbonization was negligible.

Grave 902: The simple "wooden coffin" (dimensions 180 (148 inside) × 40 × 30 cm) was deposited in the pit of grave 624 at a depth of 140 cm below soil top edge. In this one of the three experimental arrangements between deposition of the wooden box and filling the pit the largest period occurred. On the "coffin lid" and on the sides of the box were accumulations of charcoal. The "coffin" showed signs of carbonization on the lid, at the top edges and sidewalls. The degree of carbonization was generally relatively low (fig. 10).

Figure 10: Experiment: Carbonization Marks on the "coffin" in "grave 902" (photo: Judith Benedix)

Grave 903: The simple "wooden coffin" (external dimensions 154 × 40 × 30 cm) was deposited in the pit of grave 633 at a depth of 200 cm below soil top edge. While refilling this pit we had shoveled the dirt quickly. Thereby the majority of the glowing pieces of wood were catapulted down from the lid of the box. When excavating the wooden box we found a few charcoal remains on the northern side of the coffin lid. Due to rainfall soon after refilling the pit, the grave filling was strongly soaked. Because of falling most of the embers down from the coffin lid on the northwestern pit basement the wooden box also showed carbonization on its underside.

5.4 Discussion

After the "excavation", the "coffins" of all three experimental "burials" showed carbonization – though in a rather limited extent. On the one hand, rainfall, which had started while shoveling the grave pits, certainly had influence. On the other hand, we divided the remains of only one burnt down fire to three pits, which also might have limited the effect. Nevertheless, the carbonization was clear.

Some of the archaeological wood samples respectively charcoal samples may also be interpreted as the remains of the presumed fires in the course of the funeral ceremony. However, only samples clearly assigned to coffins were used for these considerations. The probability of our hypothesis to explain how it could have come to (partially) carbonization of the historic wooden coffins got strong support from this experiment.

6 Resume

This paper deals with the coffin burials in the Avar cemetery of Frohsdorf. As in many other cemeteries of the Avar period, we found burials in wooden coffins at this site. However, studies that are more detailed for this period are lacking.

In Frohsdorf approximately 60% of all graves were interred with wooden coffins in various states of preservation. Therefore, we assume the burial in a wooden coffin had been common practice at this time.

Through analysis of wood samples, it is determined that the coffins were primarily made of oak followed by beech. We could not observe a correlation from wood species selection to sex/gender and age of death of the deceased or grave furnishing. Most probably, those woods were available in the nearby area.

The majority of the coffins' woods we found as charred wood/charcoal. We explain this state of preservation in inhumation graves by the following hypothesis: During the funeral ceremony, the coffin and its contents were lowered into the grave pit. There may have been a funeral fire near the open grave. At the end of the burial ceremony, the remains of the fire (ash and embers) were put into the open grave, which was then refilled. During this process depending on various factors a smoldering fire could arise in certain cases, which could lead to carbonization of random parts of the coffins' woods and in consequence to their preservation. This hypothesis was supported by experiment.

Acknowledgements: The authors kindly thank Danica Staššíková-Štukovská (Archeologický Ústav SAV, Nitra, Slovakia) for discussing theories about the possibility of fungi causing the charring of wooden coffins. We also express gratitude to Erich Draganits (Institute for Prehistory and Historical Archaeology and Department for Geodynamics and Sedimentology, University of Vienna) for discussing the possibilities causing charring of wood on the Frohsdorf site and Herbert Böhm (VIAS, University of Vienna) for analyzing and providing archaeozoological data. The authors thank FWF, the Austrian science funds for providing financial support to make this study possible.

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