8 CHARCOAL ANALYSIS

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8.1 INTRODUCTION

Wood and charcoal remains are relatively rare at medieval sites, since medieval castles were most commonly positioned on hilltops and elevated sites, i.e. on well drained dry areas, and in which archaeobotanical remains (i.e. wood, charcoal, fruits, seeds and pollen) are poorly preserved.

Some of the most common medieval archaeobotanical finds are finds of wood from former wells, such as for instance from the sites at *Mura pri Lendavi*, *Nedelica pri Turnišču* and *Gornje njive pri Dolgi vasi*, where oak (*Quercus* sp.) wood was identified (amongst others).[1] Also researched were a few old building remains, e.g. at medieval sites in Croatia (*Gudovac* and *Torčec*), where the analysis of the relatively well preserved, non-charred wood remains infused with water and large damp charcoal chunks has shown that oak was the most commonly used wood. Apart from oak, European silver fir (*Abies alba*) and common beech (*Fagus sylvatica*) were also found.[2]

Wood is a rare find at prehistoric sites, an exception to this being the relatively well researched pile-dwelling settlements in the Ljubljana marsh.[3]

8.2 METHODOLOGY

We took and analysed 20 charcoal samples during the 2011/2012 excavations. Most samples originated from the remains of the medieval walls, while a few samples might be wood remains from prehistoric layers. The charcoal samples were crushed into smaller pieces (measuring between 2 mm and 1 cm), which were still large enough to identify the wood species.

We used a scalpel and a razorblade to slice the charcoal into smaller pieces which made it possible for us to view the typical anatomical wood sections (transverse, radial and tangential). We used play dough to fix the charcoal, and we observed it through *Leica MZ75* and *M165C* stereomicroscopes with up to 50x magnification and an *Olympus SZ11* microscope with up to 120x magnification. Wood-anatomical identification keys[4] and our own referential charcoal collection[5] were used to identify the wood.

Wood belonging to coniferous trees was mainly identified by the fact that the wood is mainly composed of tracheids, however the presence and size of the resin channels were also taken into account. Wood belonging to deciduous trees was mainly identified by the presence and layout of the tracheas (diffuse, semi-ring or ring porous), but also by the layout, width and height of the rays (uniseriate, multiseriate and aggregate rays with a height either below or above 1 mm) (e.g. *Fig. 8.1*) and in some cases by the perforations between the tracheas (simple or scalariform).

Due to the limited preservation and size of the sample and the low magnifications we limited ourselves to the aforementioned signs, thus the classification often reaches to the genus or the two possible species, as the small sample often made it impossible to distinguish between the oak (QUSP) and chestnut (CASA) for example (*Figs. 8.2* and *8.3*).

It was impossible to estimate the number of charcoal samples, for while we were mainly dealing with small particles, fragments of larger pieces, we were limited to the number and type of identified plant taxa in our interpretation (*Figs. 8.2* and *8.3*).

[1] Čufar, personal communication, Levanič and Čufar 2008, Čufar and Krže, 2011.

[2] Čufar et al. 2006, Čufar and Šimek 2008, Čufar et al. 2008.

[3] E.g. Čufar et al. 2010, Čufar and Velušček 2012.

[4] Schweingruber 1990; Torelli 1991; Richter and Dallwitz 2002, *Commercial timbers: descriptions, illustrations, identification, and information retrieval* (INTKEY computer software – key for determining commercial wood species); Schoch et al. 2004, Čufar and Zupančič 2009a.

[5] http://iza.zrc-sazu.si/pdf/recenten_les_oglje.pdf.

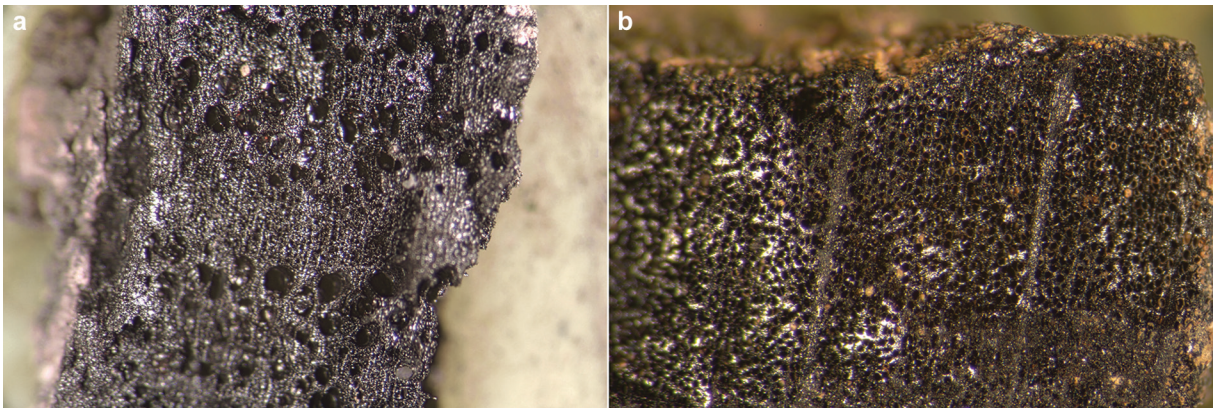

Fig. 8.1: Cross-section of the charcoal anatomy.
a: a ring-porous deciduous tree with narrow rays. b: a diffuse-porous deciduous tree with wide and narrow rays.

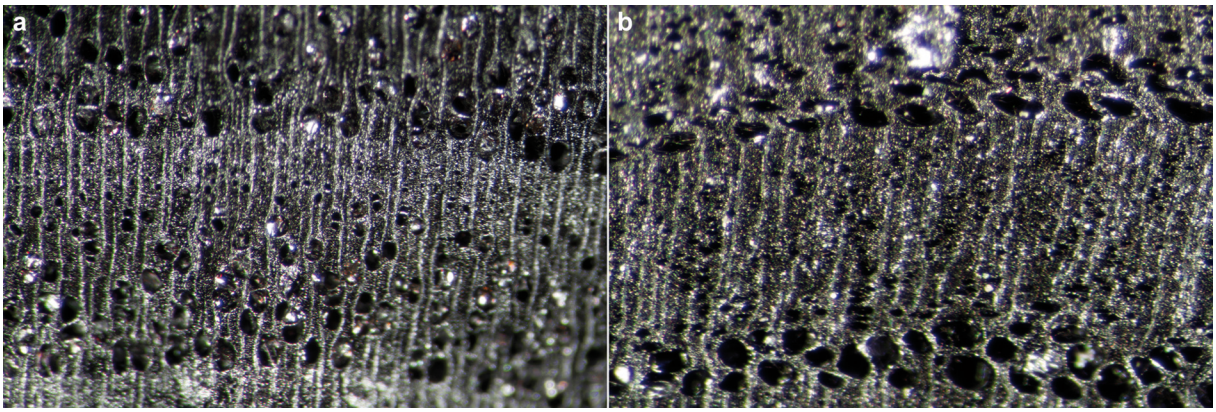

Fig. 8.2: Two charcoal fragments belonging to a ring-porous tree; only the narrow rays are visible.
a: ash: pores in latewood are scattered individually. b: oak / chestnut: pores in latewood are arranged radially.

8.3 RESULTS AND DISCUSSION

The analysed charcoal samples were found in 14 stratigraphic units, most of them medieval (*Fig. 8.3*) and a few prehistoric (*Fig. 8.4*).

In most cases the samples were preserved together with pieces of mortar.

The *figure 8.2* indicates a great diversity in the tree species within the analysed charcoal remains, since at least 10 taxa, mainly tree species, were identified.

As we are uncertain as to the role of the wood in the wall, the results are hard to interpret. In Slovenia the wood species used for construction changed through time, depending on the growth characteristics and the state of the environment and the socio-economic conditions.[6] Also, usually much larger pieces of charred construction wood remains are preserved than they were in our case.[7]

The ring porous **oak** (*Quercus* sp.), which has a similar construction to the **sweet chestnut** (*Castanea sativa*) is amongst the most commonly identified wood remains at Smlednik Castle. Due to the similarity in the construction of the two tree species *Fig. 8.3* often includes the result QUSP/CASA (oak/sweet chestnut). Oak and sweet chestnut both have relatively dense, hard and solid wood and a coloured heartwood[8]. Both types of wood have long natural durability, which is a result of the high share of tannins found in their wood. This is why both species are often used in construction.[9] Oak and sweet chestnut have a similar composition, which can anatomically be differentiated only when we have fragments large enough to include broad strips. Oak is the most common archaeological wood found in Europe. This is most likely not merely a result of its wide spread use due to its good qualities, but it also remains preserved for a longer period of time as it is more resistant than wood of other species. Oak-wood was commonly

[6] Čufar, personal communication, Čufar and Zupančič 2009a.

[7] E.g. Čufar et al. 2006.

[8] Čufar 2006.

[9] Čufar 2006.

SE	Charcoal samples	
6	**QUSP** (3 samples)	oak
	QUSP / CASA	oak / chestnut
51 / 52	ACSP (5 samples)	maple
61	**QUSP / CASA** (3 samples)	oak / chestnut
	DPDT with 1-2 CWR (4 samples)	DPDT; poplar or willow
	QUSP	oak
62	ALGL / COAV	alder / hazel
63	**QUSP** (8 samples)	oak
	POSP / SASP (2 samples)	poplar / willow
	ABAL (2 samples)	fir
	DPDT with 1 CWR (2 samples)	DPDT
64	ALGL / COAV	alder / hazel
67	**QUSP / CASA** (3 samples)	oak / chestnut
	QUSP (3 samples)	oak
68	**QUSP / CASA**	oak / chestnut
	DPDT with up to 4 CWR and SP with more than 20 scales	DPDT
68	DPDT	DPDT
68	POSP / SASP (10 samples)	poplar / willow
	QUSP / CASA (4 samples)	oak / chestnut
	ALGL / COAV (3 samples)	alder / hazel
	QUSP (2 samples)	oak
	ACSP (3 samples)	maple
	coniferous tree	coniferous tree
	DPDT (2 samples)	DPDT
68	ABAL (2 samples)	fir
73	? ACSP	DPDT, ? maple
	DPDT with 1-2 CWR and SP with 20 scales (4 samples)	DPDT
	QUSP / CASA (2 samples)	oak / chestnut
	QUSP	oak
	ALGL / COAV	alder / hazel
76	**QUSP / CASA** (2 samples)	oak / chestnut
	FASY (2 samples)	beech
	DPDT (? branch)	DPDT
	POSP / SASP (2 samples)	poplar / willow
	ALGL / COAV (2 samples)	alder / hazel
	ACSP (2 samples)	maple
	QUSP (3 samples)	oak
79	DPDT, less CWR (7 samples)	DPDT
	QUSP / CASA (8 samples)	oak / chestnut
	FASY	beech
	ALGL / COAV (3 samples)	alder / hazel
	ACSP (4 samples)	maple
	DPDT with up to 4 CWR	DPDT
	ABAL	fir
83	ALGL / COAV	alder / hazel

DPDT – diffuse porous deciduous tree; CWR – cells wide rays; SP – scalariform perforation

Fig. 8.3: Charcoal analysis results – the remains of building blocks from a medieval wall (**oak / ash / chestnut** are highlighted).

SE	Charcoal samples	
59	ACSP	maple
	QUSP	oak
59	**QUSP**	oak
77	**QUSP** (3 samples)	oak
	SASP / POSP (3 samples)	willow / poplar
	ALGL / COAV	alder / hazel
	QUSP / CASA	oak / chestnut
	ACSP	maple
77	DPDT with up to 3 CWR and SP	DPDT

DPDT – diffuse porous deciduous tree; CWR – cells wide rays; SP – scalariform perforation

Fig. 8.4: Charcoal analysis results – the remains from prehistoric contexts (oak / ash / chestnut are highlighted).

used also in Slovenia, and as it is much more common than sweet chestnut-wood, it can be found in large quantities in sites from all periods.[10]

The remaining charcoal originates from diffuse porous wood species which were generally not commonly used in construction.[11]

Apart from wood from deciduous trees we have also identified wood from coniferous trees, or to be more precise of the European silver fir (*Abies alba*). At this stage we should mention that in the past silver fir wood was more commonly used than spruce for construction in central Slovenia.[12]

Four pieces of charred wood (i.e. charcoal) were found together with prehistoric pottery fragments (samples 35 and 39 in SU 59 and samples 33 and 36 in SU 77). These samples include oak wood as well as wood from four diffuse porous wood species (*Fig. 8.3*).

The best researched wood from prehistoric sites in Slovenia came from the archaeobotanical and dendrochronological research of the pile dwellings in the Ljubljana marsh. This site revealed a lot as regards the quality and use of individual wood species.[13] For these pile dwellings, where large chunks of wood were preserved, oak and ash and the wood of approximately 10 diffuse porous deciduous trees, mainly cut down in the vicinity of the settlement, were used.[14]

No sweet chestnut wood has been identified so far in the pile dwellings in the Ljubljana marsh.

Sweet chestnut is naturally present in areas with a mild climate and a longer vegetation period[15]. It mainly grows on non-carbonate, humus rich and acidic soil,[16] thus the pile dwellers from the Ljubljana marsh probably did not encounter it often.

The studied wood samples from the Smlednik castle were not large enough to allow us to confirm that the wood was that of sweet chestnut (*Castanea sativa*), which supposedly spread from its natural (southern) growth areas with the Etruscans and Romans.[17] The people who followed continued to spread the sweet chestnut as it was a useful all round tree (solid and durable wood and edible fruits), thus it can today be found much further north of its natural borders.[18] However, we can safely state that sweet chestnut appeared naturally in Slovenia, as this is confirmed by the pollen finds that can be dated to a few thousand years ago[19], which would mean that it should come as no surprise if sweet chestnut wood/charcoal remains were found in Slovenian archaeological sites.

8.4 CONCLUSION

The charcoal analysis indicates that medieval layers included the wood of ring and diffuse porous deciduous trees as well as small amounts of wood from coniferous trees.

Prehistoric layers have revealed the existence of wood originating from ring and diffuse porous deciduous trees. The charcoal fragments were small, preserved in small quantities and in some cases disintegrating.

Almost half of the charcoal particles (approximately 40 percent), which should - according to archaeological interpretations - represent construction parts of the medieval castle, were oak, which could confirm the archaeological assumptions that the charcoal represents the remains of construction timber. On the other hand, this assumption is opposed by the small size of the charcoal remains and the high number of diffuse porous taxa. Over the last millennia diffuse porous deciduous trees were not often used as construction timber.

The charcoal from prehistoric layers (SU 59 and 77) also originated from oak timber (in approximately 46 percent of the analysed samples) and diffuse porous deciduous trees. According to what we know so far different trees found in the vicinity of the settlements were used in prehistoric times (e.g. marsh pile dwellings from the 4th millennia BC), however oak and ash, i.e. the more solid and hard types, were most commonly used for construction purposes.

[10] Čufar, personal communication.
[11] Čufar, personal communication.
[12] Čufar and Zupančič 2009b.
[13] E.g. Tolar et al. 2008, Čufar et al. 2010, Tolar et al. 2011.
[14] E.g. Tolar et al. 2011.
[15] Kotar and Brus 1999.
[16] Brus 2004.
[17] Kotar and Brus 1999.
[18] Kotar and Brus 1999.
[19] E.g. Šercelj 1996, Andrič, personal communication.