



ANATOMY OF ARCHAEOLOGICAL WOOD CHARCOALS FROM YENIBADEMLI MOUND (IMBROS), WESTERN TURKEY

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ABSTRACT

In this study, the qualitative and quantitative anatomy of six wood charcoals from an early Bronze Age settlement in the island Imbros (Gökçeada) were presented. Taxonomic identification on the basis of wood anatomy showed that two of them belong to the genus *Quercus* (section *Ilex* and cf *Quercus*), and four of them belong to the genus *Pinus*. Any fireplace is absent at the location of wood charcoals in G9 plan square. It appears that the woody branches on the horizontal roof of the building fell down to the floor after a big fire. It is most likely that the woody genera identified in the study were used for roof construction.

KEYWORDS: anatomy, Imbros (Gökçeada) island, *Quercus*, *Pinus*, wood charcoal

INTRODUCTION

From several Turkish archaeological sites, charred or non-charred plant remains as well as artefacts have elucidated the history of civilization in Anatolia (Asouti and Hather, 2001; Asouti, 2003a, Akkemik *et al.*, 2004; Fairbairn *et al.*, 2002). In terms of providing not only food but also fuel-wood and timber, woody species have been played an important role in the life of the historical settlement in Anatolia (Aytuğ and Görçelioğlu, 1987; Şanlı, 1989). The anatomical identification of archaeological wood samples amongst plant remains assemblage has provided a valuable insight about woody flora, cultivation, climate, ecology, trunk trade and deforestation in prehistoric and historic times (Wilcox, 1974; Kuniholm, 1997; Newton and Kuniholm, 2001; Asouti and Hather, 2001; Fairbairn *et al.*, 2002; Asouti, 2003a; Riehl and Marinova, 2008).

Wood charcoal forms as a result of slow pyrolysis of wood when burned in an inadequate supply of oxygen (Asouti, 2006). Despite a number of physical and chemical changes in charring wood, its some anatomical properties remain unaffected, and thus archaeological wood charcoals can be identified anatomically to the family or genus level (Prior and Gasson, 1993). However, making species-level identification is usually impossible due to a very similar cellular morphology of taxa within the same genus (Tennessee *et al.*, 2002).

Yenibademli mound is an Early Bronze Age settlement in the island Gökçeada (Imbros) in Northern Aegean Region of Turkey (Hüryılmaz, 2002). According to Hüryılmaz (2002), it dates back to the third millennium B.C. The crop plants of Early Bronze Age from Yenibademli mound have been analyzed by Oybak Dönmez (2005). However, little is known about archaeological wood charcoals of Yenibademli. Thus, the present study aims at identifying the wood charcoals from 2008 excavation in Yenibademli mound (Gökçeada), Western Turkey.

MATERIALS AND METHODS

The materials of the present study are wood charcoals, collected in 2008 excavation, from Yenibademli mound (Fig. 1). Six different wood

charcoal samples from the G9 plan square of the mound were identified in the wood anatomy and dendrochronology laboratory of Faculty of Forestry of Bartın University in Bartın, Turkey. Each of charred woods were fractured with a razor blade in order to observe the transverse, radial and tangential planes of them (Barnett, 2008) and were examined under an optical microscope of reflected-light (model no: Olympus CH-BI45-T-S 300811) at magnifications x40, x100 and x160. The sizes of wood charcoal examined range from 5 mm to 3 cm. The key anatomical properties allowed identifying each of wood charcoal fragments. Identifications were made using the some manuals of wood anatomy (Fahn *et al.*, 1986; Merev, 1998; Schoch *et al.*, 2004; InsideWood, 2004-onwards) and the charred specimens, and thin sections of fresh wood from Turkey.



Figure 1. The map of Turkey and Northern Aegean Region (Created by Norman Einstein, 2006). The arrow indicates the island Gökçeada of Turkey.

RESULTS AND DISCUSSION

All of the wood charcoals examined were identified to genus-level. Results showed that

the archaeological wood charcoals in Yenibademli mound belong to *Pinus* sp and *Quercus* sp (section of *Quercus* and section *Ilex*). The definable anatomical properties of examined

wood charcoals are as shown in Table 1 and 2. In addition, the micrographs of them were shown in Figure 2 and 3.

Table 1. Anatomical features of wood charcoals belonging to softwoods from 2008 excavation in Yenibademli, Gökçeada

Code	YBD.08 Kov.203a	YBD.08 Kov.203b	YBD.08 Kov.241	YBD.08 Kov.243
Taxon	<i>Pinus</i> sp	<i>Pinus</i> sp	<i>Pinus</i> sp	<i>Pinus</i> sp
Common name	pine	pine	pine	pine
Growth ring	boundaries	distinct	distinct	distinct
	transition from ew to lw	abrupt	abrupt	abrupt
Tracheid	pit rows	uniseriate	uniseriate	uniseriate
	pit diameter (µm)	19,7 (19-20)	19,5 (18-20)	non-measured
	wall thickness in lw	thin-walled	thin-walled	thin-walled
	tangential diameter in ew (µm)	34,6 (30-40)	34,3 (25-40)	32,5 (30-40)
	radial diameter in ew (µm)	37,08 (28-47)	45,7 (35-50)	32,5 (25-45)
	tangential diameter in lw (µm)	20,7 (17-25)	22 (17-22)	21 (17,5-25)
	radial diameter in lw (µm)	10,7 (7-12,5)	12,1 (10-15)	14 (10-17,5)
Cross-field pitting	fenestriform or pinoid	fenestriform	fenestriform or pinoid	fenestriform or pinoid
Ray width	uniseriate	uniseriate	uniseriate	uniseriate
Axial resin canal diameter (µm)	150 (140-170)	147,5 (110-180)	146,7 (100-180)	170 (150-190)
Radial resin canal diameter (µm)	non-measured	non-measured	non-measured	non-measured
Resin canal number / 10 mm ²	non-measured	6,8 (5-11)	non-measured	non-measured

ew: earlywood, lw: latewood, µm: micrometer. The figures outside the parentheses show average values.

Table 2. Anatomical features of wood charcoals belonging to hardwoods from 2008 excavation in Yenibademli, Gökçeada

Code	YBD.08 Kov.256	YBD.08 Kov.51
Taxon	<i>Quercus</i> sp (section of <i>Quercus</i>)	<i>Quercus</i> sp (section <i>Ilex</i>)
Common name	oak	oak
Growth ring boundaries	distinct	indistinct
Vessels	porosity	ring-porous
	arrangement	dendritic pattern
	groupings	exclusively solitary
	tangential diameter in ew (µm)	209,3 (140-300)
	radial diameter in ew (µm)	277,8 (170-380)
	tangential diameter in lw (µm)	52,5 (20-90)
	radial diameter in lw (µm)	59,6 (20-100)
Ray width	Uniseriate and multiseriate multiseriate rays commonly > 10 - seriate	Uniseriate and multiseriate multiseriate rays commonly > 10 -seriate

ew: earlywood, lw: latewood, µm: micrometer. The figures outside the parentheses show average values.

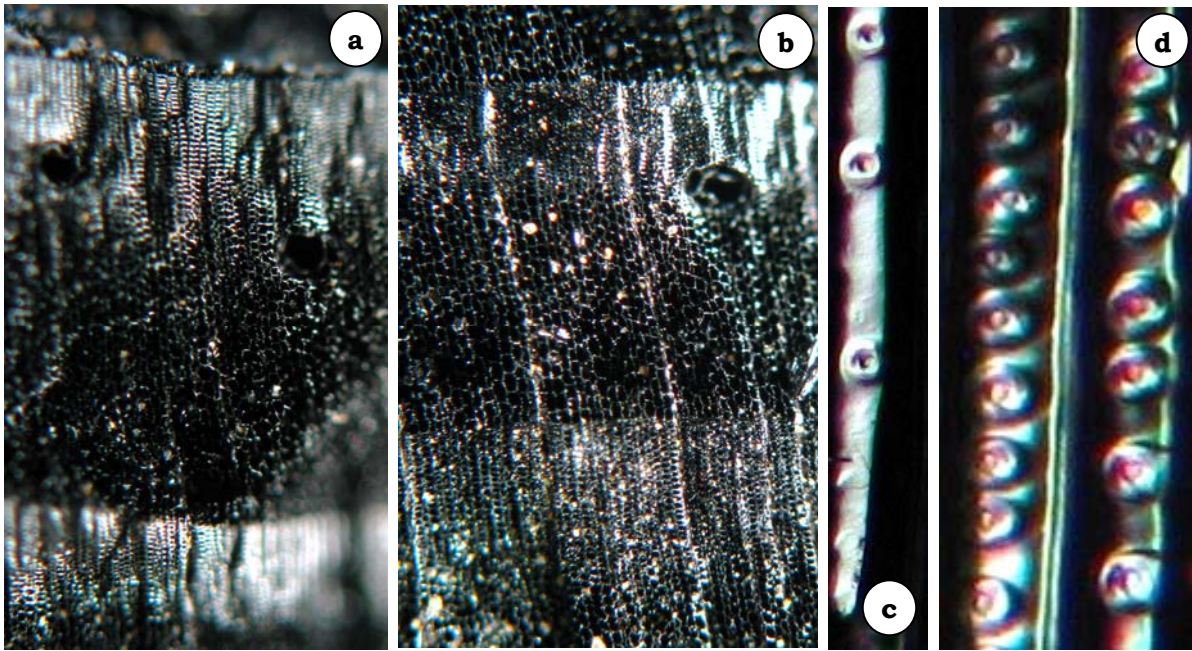


Figure 2. – a and – b. Of *Pinus* sp., growth ring boundaries, earlywood and latewood, and axial resin canals. – c and – d. Uniseriate bordered pits of tracheids

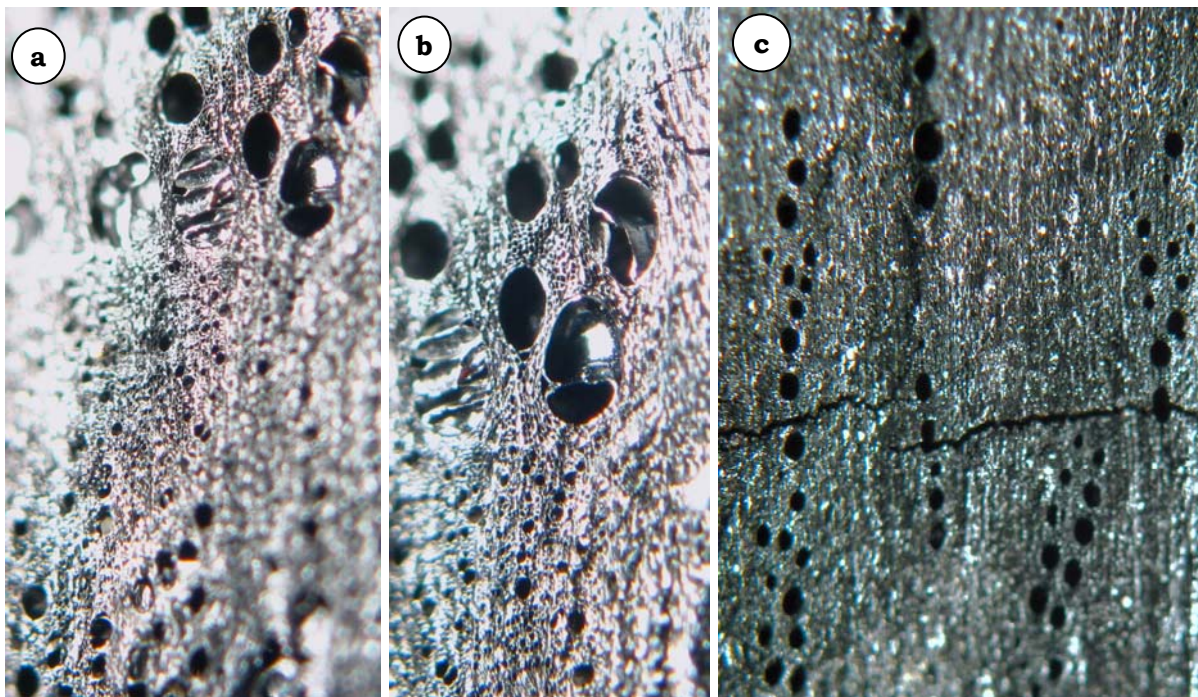


Figure 3. – a and – b. Of *Quercus* sp. (section *Quercus*), ring-porous wood. Wide vessels in earlywood (upper side of micrographs a - b) and narrow vessels in latewood (underside of micrographs a - b). Thyloses within some earlywood vessels. – c. Of *Quercus* sp. (section *Ilex*), diffuse-porous wood; vessels in radial and/or diagonal pattern.

Two of six wood charcoals from Yeni-bademli mound (Gökçeada) belong to the genus *Quercus* (section *Ilex* and cf *Quercus*), and four of them belong to the genus *Pinus*. Present-day vegetation on the island Gökçeada is peculiar to the Mediterranean phyto-geographic region. Seçmen (1977) defined the main vegetation units of the island as phrygana, maquies, sandy

vegetation and forest. Maquies vegetation includes shrubs and small trees such as eastern strawberry tree, strawberry tree, tree heath, Kermes oak, mastic tree, wild olive tree, prickly juniper. The main tree species of the forests in Gökçeada is *Pinus brutia*, however, some patch of *Quercus coccifera* and *Quercus pubescens* also occur (Seçmen, 1977).

The wood charcoal specimen described in the section *Ilex* of the genus *Quercus* is likely to be *Quercus* cf. *coccifera*. Three different species of evergreen oaks (*Q. ilex*, *Q. coccifera* and *Q. aucheri*) are native to Turkey, and *Q. coccifera* of them commonly occurs in the Mediterranean, Aegean and Marmara regions of Turkey (Yaltrık, 1984). Other wood charcoal specimen, described as a deciduous oak, belongs to section cf. *Quercus*. Yaltrık (1984) reported that in Turkey the section *Quercus* is represented by ten different oak species. *Q. pubescens*, one of them, is also native to the island Gökçeada as well as the mainland of Turkey (Seçmen, 1977; Yaltrık, 1984).

Of four wood charcoal specimens identified as *Pinus* sp, cross-field pitting of three could not be determined exactly due to the extreme deformation in the pitting structure. They can be fenestriform or pinoid. However, cross-field pitting of other wood charcoal specimen is window-like (fenestriform). Window-like cross-field pitting can be observed in the section *Sylvestris* and *Strobus* of the genus *Pinus* (IAWA Committee, 2004). Of the section *Sylvestris*, only two pine species (*Pinus sylvestris* and *Pinus nigra*) are native to Turkey. However, the species *P. sylvestris* and *P. nigra* cannot be distinguished on the basis of their wood anatomy (Schoch *et al.*, 2004). Of having pinoid cross-field pitting, native pine species in Turkey are *Pinus brutia*, *Pinus halepensis* and *Pinus pinea* (Merev, 1998). The present-day pine species in the island Gökçeada is *Pinus brutia* (Seçmen, 1977). Even though the three pine wood charcoals are likely to be *P. brutia* (calabrian pine), it is an uncertain conclusion.

In the Neolithic Aegean, livestock such as sheep, goat, cow and pig were domesticated (Halstead, 1992). Uerpmann and Uerpmann (2001) notified the occurrence of boar hunt in the early times of Troia, but in the later times it loses ground due to pig domestication. Riehl and Marinova (2008) also reported the domesticated pigs as well as other domesticated animals in Troia I (2920-2600 cal B.C.) during the Early Bronze Age. Hüryılmaz (2006) stated that the inhabitants in Yenibademli consumed not only plant-related agricultural products, but also at least five kinds of domesticated and wild

animals. The sheep, goat and pig as well as cow were the most preferred stock in the nutrition economy of Yenibademli at the same period with Troia I. One of the most important foods for pigs is acorns and the leaves of deciduous oaks (Huş, 1974; Çanakçıoğlu and Mol, 1996). In this regard, it is likely to use the acorns and leaves of deciduous oak species aforementioned in Yenibademli settlement. Riehl and Marinova (2008) emphasized that in the Troad settlement deciduous oak has multifarious economic importance in terms of not only fodder but also fuel, building materials and tannin extraction.

The woody genera identified in this study might have been used as building material and / or fuel in Yenibademli settlement as well. Asouti (2003b) reported that *Q. coccifera* produces high-quality fuel, and it is able to survive by vegetative reproduction after woodcutting and fire. Yaltrık (1984) stated that *Q. pubescens* is a valuable species to produce fuel-wood and wood charcoal. However, in the third thousand BC, woody branches, reed and clay were used for the surface-covering of house roofs in this archaeological region (pers. comm. with H. Hüryılmaz). Hüryılmaz informed that any fireplace is absent at the location of wood charcoals in G9 plan square. It appears that the woody branches on the horizontal roof of the building fell down to the floor after a big fire. Due to the lack of wooden post marks on the stone foundation, it is impossible to affirm that the woody materials were used for the construction of the walls. As a result, it is most likely that the woody genera identified in the study were used for roof construction.

CONCLUSION

Yenibademli excavation in the island Imbros has continued since 1996. However, for the first time, the identifications were made on wood charcoals obtained from excavation in 2007. Wood charcoals obtained in 2007 belong to the genus *Quercus*. As well as *Quercus*, the genus *Pinus* was identified in 2008 excavation. In 2009 excavation, *Quercus* and *Phillyrea* in F9 plan square and *Quercus* and *Pinus* in G9 plan square have been identified, but their quantitative anatomy haven't been studied in detail yet. Due

to the identifications on a limited number of wood charcoals, the present study is of preliminary nature. Yenibademli excavations in the following years can allow us more certain results on identification and origin of more intact wood charcoals.

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