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Istanbul has hosted different cultures for thousands of years, brought together eastern and western culture in one place, been the capital city of the Roman, the Byzantine, the Latin and the Ottoman Empires, and reached the Byzantine and Ottoman Empire's structures to day. All these make the city important for the world history.

Every period of history, the city has maintained its importance but meanwhile as the city grows, transportation in Istanbul has become a major problem. Therefore, in 2004, the Ministry of Transportation and Istanbul Metropolitan Municipality started a project together which called «Marmaray Project» (Fig.1) (a 78-kilometer rail and metro network that will ultimately link Europe and Asia via a tunnel under the Bosphorus.).



Characterization Of The Excavation Site

Yenikapı excavation site is located in southern coast of the European side of Istanbul.

- The site of marine and filling piles samples showed barren sandy sediment characteristics;
- The site of Neolithic tree remains showed dark gray-black clay sediment characteristic.

What We Want To Get

«information about ancient times»

- woody plants diversity
- land uses
- possible usage fields of the wood species
- the climate that prevailed in this region
- life styles of the people

«information about wooden remains»

- the degree of degradation
- environmental conditions the wood specimens may have faced
- the process of wood decomposition
- information on wood conservation
- degree of chemical degradation
- how biological degradation in wood specimens affects its chemical structure

What We Investigate

Wood samples (marine and filling piles) at the Port of Theodosius I in varying sizes and characteristics were obtained about 0.5m to 4.52m below the sea level from the Yenikapı Marmaray site (Fig.4).

Also, a great number of the bottom parts of Neolithic period tree remains that took place upright and connected to the soil with their roots were found from 8.5 m below the sea level (Fig.5).



Fig.4. General view of the excavation site and wooden marines (marine and filling piles)



Fig.5. The bottom parts of Neolithic period tree remains

How We Investigate

•Identification of wood species

•Detection of the type and degree of microbial degradation

For this purpose we have used;

- the IAWA criteria,
- stereomicroscope,
- light microscope with polarize and fluorescence attachments,
- sliding microtome for well-preserved wood specimens,
- hand-cut by razor blade or paraffin-embedding methods for excessively soft specimens,
- different staining methods, and
- scanning electron microscope (SEM)

•Determination of physical properties of wood specimens

For this purpose we have used;

- color change and softening zones in the samples
- water content (%) ((wet weight-dry weight) / dry weight)) 100%
- density in volume (gr/cm³) (dry weight / wet volume)

•Examination of changes in the chemical structure of wood

For this purpose we have done;

- examination on stained and unstained sections to detect existence of cellulose and lignin
- analysis of extractives content
- elemental analysis with SEM-EDX

Macroscopic investigations

The Port of Theodosius;

All of the wood samples have different softening zone levels;

- Only on their surfaces in some samples
 - Only on outer layer with degradation at early stage,
 - Sound in inner part without a microbial attack
- Also, some discoloration in the cross section of the samples (Fig.6).



Fig.6. Macroscopic view of The port of Theodosius's wood samples: a. Hardwood b. Softwood

Neolithic age tree remains;

The surface of wood specimens generally showed yellowish brown color. It was observed that some parts of the wood specimens were covered with a layer in orange and/or blackish color. Although the dimensions and surfaces of the wood specimens apparently were well-preserved, considerable soft and spongy structures were generally observed due to organisms and the site conditions (Fig. 7).

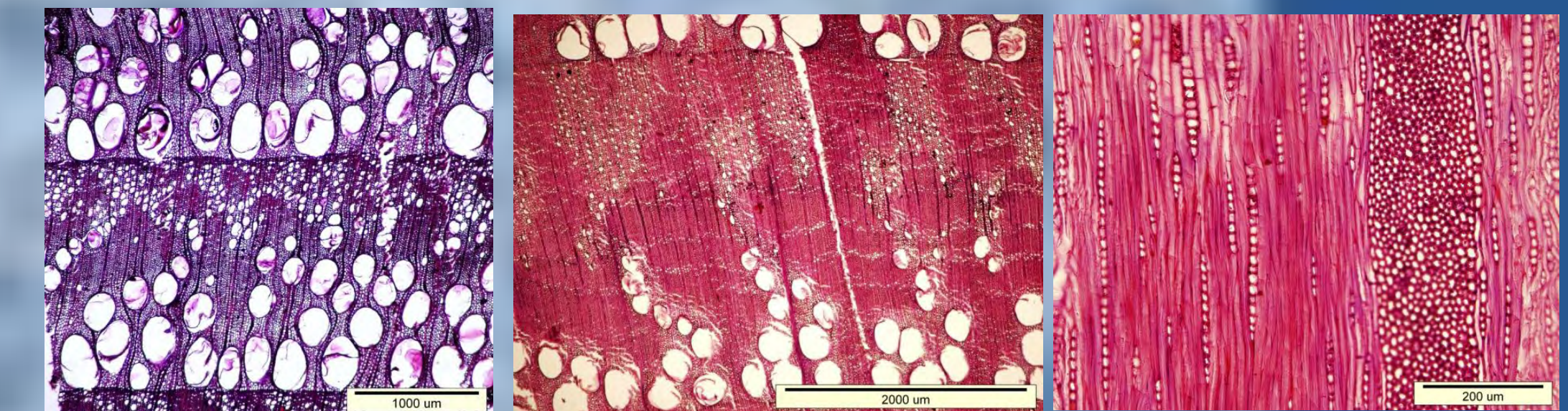


Fig.7. Macroscopic view of the tree remains

Microscopic investigations

The Port of Theodosius;

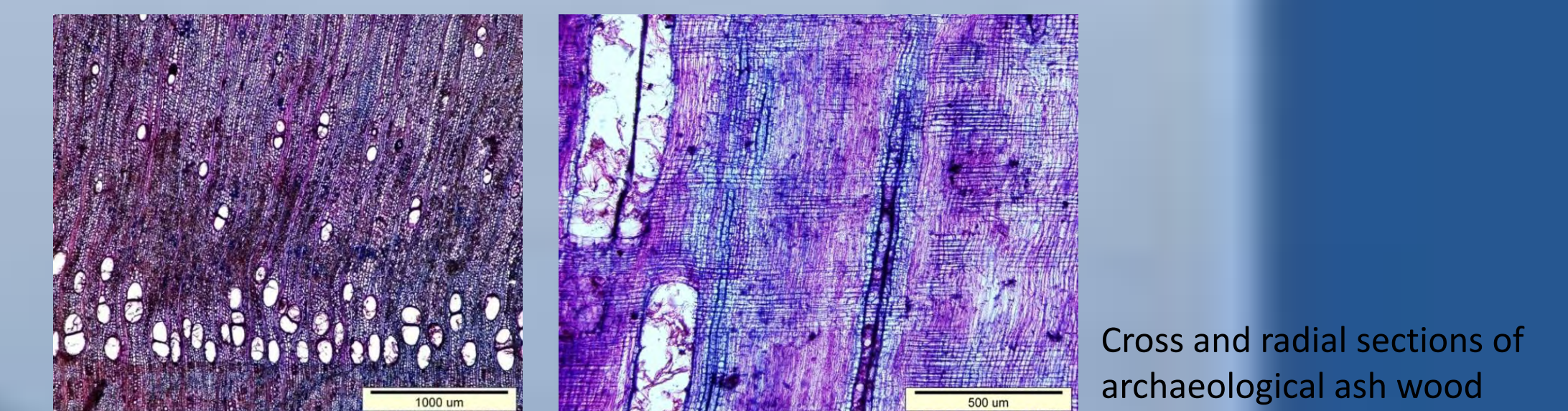
The majority of wooden marine samples evaluated were hardwood and two samples only were found as softwoods. Among the hardwoods, *Castanea* and *Quercus* were the most seen genus.



Castanea sativa samples obtained from the ancient Port of Theodosius

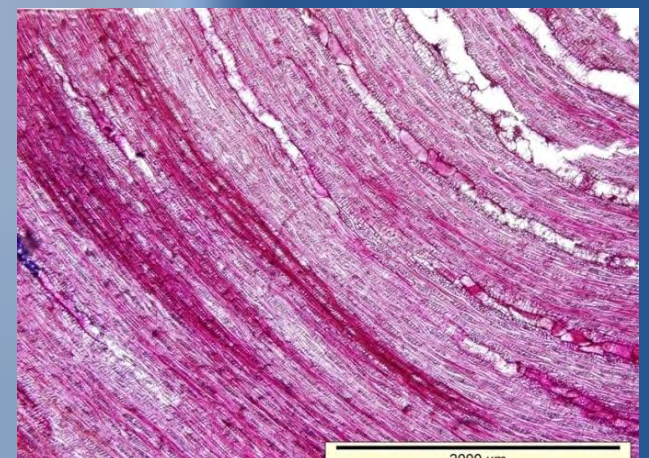
Quercus spp. samples obtained from the ancient Port of Theodosius

Neolithic age tree remains;
25 wood species to tree remains have been identified as *Fraxinus* spp. (ash wood) until now.



Cross and radial sections of archaeological ash wood

Shape changes in the wood structure and turning between the wood surfaces were observed in most of the specimens because of compressing burial conditions.



Distortion in the shape of wood structure

For wooden marine samples, *mean water content* was measured as 344 % (*min.* 93% - *max.* 964%).

Tree remains' *mean water content* was determined as 660 % (*min.* 522 % - *max.* 900 %) for 25 ash wood specimens.

CONCLUSIONS

•Archaeological wooden remains deserve special attention since they provide unique and significant information about the past and future.

•The results of the study will provide information for different scientific areas such as archaeology, history, wood anatomy, mycology, wood chemistry, wood conservation, dendrochronology and climatology.

•The results will also constitute a basis for future studies to be performed in different disciplines.

•Further studies will be carried on different wood samples obtained from different level of soil surface.



Fig.1.Yenikapı excavation area and Marmaray line



Fig.2. Archaeological excavations area.

As a part of the Marmaray Project which has been conducting in Yenikapı, Istanbul, countless archaeological remains, such as the Ottoman period remains, an ancient Byzantine Port called Port of Theodosius I, the oldest city wall of Istanbul, the Byzantine Church, a large number sunken ships and thousands of findings were unearthed during excavations at the Yenikapı site. With the progress of the archeological excavations, important Neolithic age findings that will shed light on the history of Istanbul were encountered (Fig.3.).

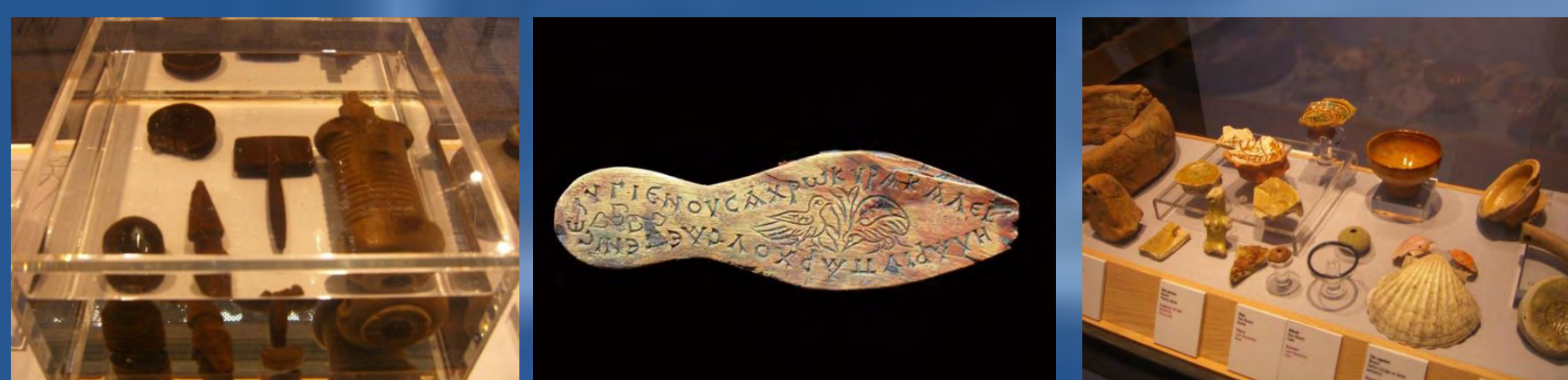


FIG 3. Archeological findings unearthed during excavation