

**UNIVERSITY OF SZEGED  
DOCTORAL SCHOOL OF EARTH SCIENCES**

**IDENTIFICATION AND EVALUATION OF CHARRED  
WOOD REMAINS DERIVE FROM ARCHAEOLOGICAL  
SITES IN GEOARCHEOLOGICAL RESEARCH**

**THESIS OF DISSERTATION**

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## **INTRODUCTION AND AIMS**

The anatomical analysis of arboreal wood remains is called xylotomy; one of its particular disciplines is called charcoal analysis or anthracology (Horváth, 1982). Its significance is that it makes the reconstruction of the local deposited woody plants possible. This way it lends itself for the reconstruction of the former local vegetation. Several studies from the last decades show that anthracological analysis became a very important method in palaeoecological studies. By the results of the analysis we can get information about the natural environment of a certain human population, the relationship between man and its environment, the changes in the vegetation composition, about the preferred species and the climatological and ecological conditions of an area.

In the dissertation on the basis of identification of wood macro remains deriving from Hungarian archaeological sites I reconstructed the transitional vegetation change for the second part of the Holocene; i.e. changes of the flora of the last 6000 years. Furthermore, my aims were to present the significance, applicability, possibilities and limits of charcoal analysis and the conditions of the paleoecological reconstruction. I evaluated the data obtained from the charcoal identification considering the human effect on the plant communities, its selection, the relationship and the interaction of man and its milieu.

Anthracological analysis and palaeoecological reconstruction based on such amount of charred wood remains that is presented in this dissertation have not been performed yet in Hungary. Although several worldwide known Hungarian anthracologists, like Ferenc Hollendonner, Sándor Sárkány, József Stieber and Pál Greguss carried out charcoal identifications.

## **METHODS**

The primary aims of my PhD research was the anthracological analyses of charcoal samples and the evaluation of data. This includes the proper sampling method, treatment and preparation of wooden remains, the learning of wood anatomical features and the identification of different genera. In terms of the evaluation of the results it is very important to consider the phytosociological and ecological features, the archaeological cultures, the relationship between mankind and its environment, the selection of wood, forest management and the exploitation of wooden areas.

The archaeobotanical material was obtained from samples of archaeological profiles and the deposits of the archaeological features. In obtaining and processing the samples we followed the guidelines of the German standards (Jacomet-Kreuz, 1999) and Ferenc Gyulai (2001) regarding sampling and flotation process. Afterwards charcoal fragments were selected and counted. There is no unique opinion among scientist in relation to the minimum number of charcoal fragments for palaeoecological reconstruction, nor is the sample defined. I defined the samples according to age, namely by the integration of the archaeological features of the sites by age. I determined the minimum fragment number in 100 pieces for the statistical analysis. So those samples were included in the statistical and palaeoecological evaluation whose sum total in an archaeological stratigrafical level (Late-Bronze age) was at least 100.

The microscopic identification of wood is possible by the different, unique tissue map of the given genera or species. Cross-sectional, radial and tangential sections shall be prepared when analysing charcoals (Sárkány, 1938), creating new breaking surfaces by hand or scalpel. The charcoal

pieces were placed in fine sand for the easier movability. The three directional sections were analysed using polarisation microscope. The used magnifications were 10x, 20x, 50x and 100x. The identification was carried out using reference books and scientific papers.

The anthracological results were compared to pollen analytical data applied for the studied regions. In many cases pollen results give information about the regional vegetation; opposite to it the locally deposited wood fossils show the local buried vegetation picture. Moreover, it is a very applicable method for the vegetation reconstruction of arid regions because of the lack of well preserved pollen depositional basins.

## STUDY AREAS

The samples come from the rescue archaeological excavations of Rákóczifalva, M0 motorway, the Main Road. No. 86. and the M7 motorway. The archaeological chronology of the samples is as follows: Neolithic, Copper age, Bronze Age, Iron Age, Imperial period, Migration period, Arpadian Age and the Middle ages. A total amount of 569 evaluable samples, altogether more than 34 thousand pieces of charred wood fragments were analysed.

The total amount of samples derives from Rákóczifalva, Bagi-föld and Rökkant-föld is 51 that contained 3827 pieces of charred wood remains. The archaeological chronology of the samples is as follows: 14 samples are from Late-Bronze Age, 2 samples from Lat-Iron Age archaeological features, 7 from the Sarmatian period, 4 from the 4-5<sup>th</sup> Century of the Migration period, 13 samples from the 6-7<sup>th</sup> Century of the Migration period, 9 from the Late-Migration period and 2 from the Arpadian Age.

Altogether 140 samples, containing 6102 pieces of charcoal derive from the rescue excavations of the M0 motorway (Ecser-6, Ecser-7, Maglód-1, Üllő-5, Üllő-9). The archaeological chronology of the samples is as follows: 2 samples are from prehistoric times, 1 from Late-Bronze Age, 11 from Late-Copper Age, 19 from Middle-Iron Age, 14 from Late-Iron Age archaeological objects, 61 samples are Sarmatian, 24 are Late-Sarmatian, 1 sample is from the 5<sup>th</sup> Century, 4 from the Arpadian Age and 1 from the Middle ages.

During the rescue excavation of the Main Road No. 86. altogether 50 samples were collected (Zanat, Szombathely, Lukácsháza, Nemesböd, Vát, Vép). The total amount of charcoal fragments is 14 691 pieces. The archaeological chronology of the samples is as follows: 6 samples derive from the Bronze Age, 4 from the Middle-Iron Age, 4 from the Lat-Iron Age, 6 samples are from the Imperial period, 1 sample from the Migration period, 19 samples are from Arpadian archaeological features, 3 from the Arpadian Age/Middle ages and 7 from the Middle ages.

Altogether 328 samples were collected from the excavations of the M7 motorway (Bagod-Kelet, Balatonmagyaród, Letenye-Egyeduta, Nagykanizsa-Palin anyagnyerőhely, Nagykanizsa-Palin szociális otthon, Nagyrécsce-Baráka-dűlő, Nagyrécsce-Bakónai-patak, Sormás-Török-földek, Sormás-Mántai-dűlő, Tornyiszentmiklós-Zabos-telek, Zalacsány-Kőfejtő-dűlő, Zalacséb-Malom tanya and Zalacséb-Körtvélyes) that contained 9595 pieces of charred wood fragments. The archaeological chronology of the samples is as follows: 105 samples were collected from Neolithic objects, 5 samples from the period of the Late-Neolithic-Early-Lengyeli Culture, 3 samples from the Lengyel Culture, 18 samples are from the Copper age, 13 from the Early-Bronze Age, 30 from the Late-Bronze Age, 14 samples were

collected from Early-Iron Age archaeological features, 15 samples are from the Late-Iron Age, 7 from the Imperial period, 27 from the Migration period, 49 from the Arpadian Age, 5 from the Arpadian Age/Middle ages while 34 samples were collected from Middle ages objects.

## **THE SUMMARY OF THE RESULTS**

The short summary of the results presented in the PhD dissertation are as follows.

1. Anthracology is a viable method for the reconstruction of the local vegetation of past environments provided that appropriate sampling, preparation and identification are followed with proper evaluating strategies. Prior to every study the number of samples and charcoal fragments shall be defined. Heterogeneous sediments and long-term deposits should be sampled.
2. On the basis of the anthracological and pollen analytical analysis of samples deriving from Rákóczfalca archaeological sites oak forest can be reconstructed together with elm, maple and ash trees for the Bronze Age. During the Sarmatian and the Migration period the amount of oak trees decrease and the ratio of fruit trees increase. In the Arpadian Age the presence of oak and willow trees show reforestation.
3. On the basis of the anthracological analysis of samples deriving from the rescue excavations of the M0 motorway elm and ash mixed oak forests lived in the surroundings of the former settlement. The higher amount of poplar and willow trees indicates a riverside. The fossils of fruit trees

appear from the Sarmatian period that suggest the anthropogenic opening up of the forest canopy, horticulture or edge vegetation. The pollen remains of arboreal vegetation disappear from the archaeological objects during the late-Imperial period, whereas the anthracological results show a high amount of beech and hornbeam trees. Since the charcoals indicate local accumulation, these genres could be found in the 5-10 km surroundings of the settlement, because the firewood and the construction wood could be transferred effectively from this distance by the technique of that age. The appearance of beech and hornbeam trees is the result of forest management and the exploitation of woody areas because the pollen analytical data does not support climatic change.

4. On the basis of the anthracological analysis of samples deriving from the rescue excavations of the Main Road No. 86 the dominance of oak trees is provable from the Bronze Age until the Imperial period. During the Arpadian Age and the Middle ages beside the oak dominance ash and elm trees occurred in the forested areas and with a smaller amount beech and blackthorn. The significant dominance of oak remains draws the attention to the anthropogenic selection of wood or the fragmentation of samples and as a result of it the over-representation of the *Quercus* genus. The anthracological results supported by the pollen analytical data oak-ash-elm gallery forest surrounded the human settlements. The presence of blackthorn shows the opening up of the forested areas.

5. On the basis of the anthracological analysis of samples deriving from the rescue excavations of the M7 motorway oak gallery forest mixed with maple, elm and ash trees lived from the Neolithic. On the colder and

moister valleys or on higher elevations the oak forest appeared with beech trees, on the riversides alder, poplar and willow trees lived. The appearance of beech from the Neolithic is in relation to climatic change and human forest clearance activity. By the thin of the oak trees beech could spread on the forested surfaces closer to the human settlement. The hazel, juniper and fruit fragments indicate a mosaic environment.

6. The comparison of the anthracological and pollen analytical results show that in the case of the horticulture and the insectiphylous and smaller amount of pollen grains emitter fruit trees the results of charcoal analysis give a more accurate and reliable data.

7. By the evaluation of the anthracological results (in the case of data obtained from archaeological sites) it is necessary to take into consideration the human role and the selection of some species. As a consequence of the anthropogenic activity certain genus can under- or over-represented so the palaeoecological reconstruction shall be explained together with the archaeological data.



**PUBLISHED ARTICLES IN THE SUBJECT OF THE DISSERTATION**

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