Reconstructing forest activities in prehistoric Hallstatt, Austria

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The prehistoric salt mine Hallstatt together with its burial ground is the most prominent archaeological site in Austria – the name also standing for the Hallstatt period (800 to 400 BC). Due to the excellent conservation with rock salt a great number of organic material, primarily wooden artefacts, have been found. All these results are obtained from the bronze age “Christian Tusch-Werk, Alter Grubenoffen”.

• Mining Timber

As mining timber mainly spruce (47%) and fir (43%) was used. A small number of samples belonging to beech (8%), maple (1%) and larch (1%) (Fig.1). Compared with the forest ecotype, a higher proportion of beech-wood can be expected, therefore we hypothesize that beech was mostly used as fire wood. The small number of larch wood found in the mine indicated that almost all larch trees were used for housing. 120 samples out of 549, including the world-oldest known wooden staircase (Fig.3), are cross dated (Fig.2).

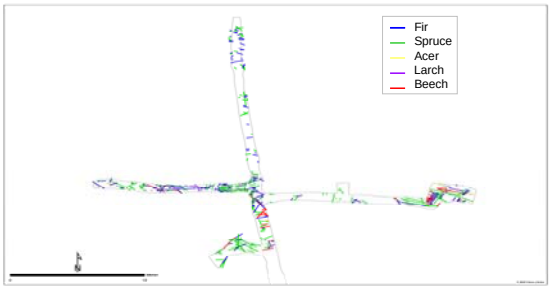

Fig.1: Distribution of the wood species in the mine

Fig.3: Original staircase inside the mine

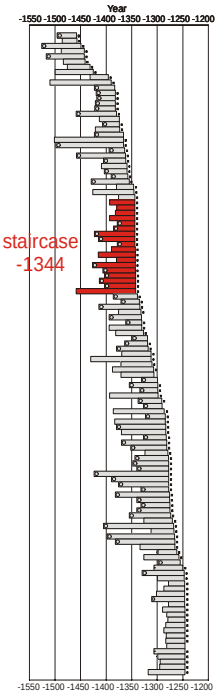

Fig.2: Dated wood samples

• Lightning Strands

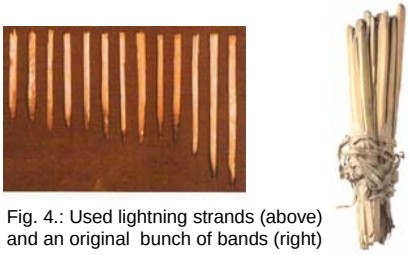

Fig. 4.: Used lightning strands (above) and an original bunch of bands (right)

Abundantly found lightning strands provided light to the workers in the mine. They were mainly prepared from fir wood by peeling-off about 1m long strands. These strands were found in bundles of about 40 pieces. The miners were carrying the bands in their mouths by clomping them between their teeth.

• Tools and Transportation Bins

Fig.5: Bin made of an overgrown stump

Transportation bins were mainly made of overgrown fir stumps (Fig.5). The texture of these bins is undirected , sometimes growing in circles. This tissue is more resistant against splitting. Some bins were made of maple, making a higher thickness of the wall necessary.

• Reconstruction of Forest Activities

❖ Facts:

- Mining timber: mainly fir and spruce, diameters between 5 and 20 cm
- Lightning strands: mainly fir, diameters between 10 and 30 cm, ring width between 1 and 3 mm
- Bins: overgrown fir stumps, diameter between 25 and 35 cm, ring width below 1mm

➡Hypothesized forest type:

- high proportion of fire
- dens stands
- small diameter trees are heavily utilised

➡Utilisation of tree stems

(Fig.6)

Fig.6 : Hypothesized stem utilisation

Supported by: Land Oberösterreich and Hochschuljubiläumsstiftung der Stadt Wien

Abstract Book

OF

EURODENDRO 2005

International Conference of Dendrochronology

SEPTEMBER, 28TH – OCTOBER 2ND

VITERBO, ITALY

Edited by
Mara Sarlatto, Alfredo Di Filippo, Gianluca Piovesan, Manuela Romagnoli

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of the tree. This is one of the basis of the use of dendrochronology in archaeology and art history. The research considered it till recent times as for evident that the today number of year-rings belonging to the sapwood can be regarded as relevant for the past as well, since it is constant.
Felix Walder presented on his poster at the conference Eurodendro 2004 (Rendsburg, September 15-19 2004) a series of 9538 samples proving that the thesis is not true in the case of some Swiss regions.
While analysing Hungarian samples we recorded a similar feature at the wood-material of an 18th century well excavated within the boundaries of Szihalom. Several colleagues criticised – with reason - the poster presented on the Kaunas conference because of the low number of samples (23 pieces), saying that it can be a local feature characterising this very material that cannot be generalised.
In 2004 an unexpected finding made the deeper analysis of the problem possible. One of the Turkish thermal baths of Budapest (Rudas-Bath) was reconstructed and the archaeological rescue excavation connected to the work discovered that the octagonal basin was based on 1,5 m long posts driven into the hot-water mud. All together 328 posts came to light, a great number of which contained the bark as well thus the number of year-rings belonging to the sapwood could be exactly established.
Despite the low number of samples that could be used for the analysis it seems that the oaks fallen in June 1571 in Hungary also had a different number of sapwood year-rings as it is today.
Of course, further research is needed.

SINCOS (Sinking Coasts) – New dendrochronological and dendroclimatological results

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SINCOS (Sinking Coasts: Geosphere, Ecosphere and Anthroposphere of the Holocene Southern Baltic Sea) is an interdisciplinary research project established by the Deutsche Forschungsgemeinschaft (DFG). It is concerned with the causes and effects of the sinking of the coast along the southern Baltic Sea.
One task of dendrochronology, a subproject of SINCOS, is the age determination of archaeological and marine-geological wooden remains, e.g. from the Baltic Sea bottom. For this purpose we are assembling chronologies for the southern Baltic Sea area which extend far into the past. Data from several hundreds of trees in Schleswig-Holstein (Germany) and Mecklenburg-Vorpommern (Germany) as well as from underwater material, altogether covering some thousands of years (with some gaps), is the basis for this intention. The absolute dating of these chronologies was supported by the comparison with dated chronologies from northern Germany (dendrolaboratory Cologne, B. Schmidt, and dendrolaboratory Göttingen, H.H. Leuschner) and from Denmark (dendrolaboratory Copenhagen, N. Bonde).
A second task of dendrochronology within the SINCOS-project is the reconstruction of past climate. For this purpose, chronologies of up to 180 years old living oaks from four different stands in Mecklenburg-Vorpommern are analysed. The study sites differ with regard to the nutrient and moisture content of the soil. First results regarding the climatic signal will be shown.

Reconstructing forest activities in prehistoric Hallstatt, Austria

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The prehistoric salt mine Hallstatt together with its burial ground is the most prominent archaeo-

logical site in Austria – the name also standing for the Hallstatt period (800 to 400 BC). Due to the excellent conservation with rock salt a great number of organic material, primarily wooden artefacts, have been found.
Due to the topography of the surrounding region, it was possible to harvest trees and transport them to the salt mine only within a restricted area. This area is bordered by steep rocky slopes in the north, also south and east; and by the timberline in the west. The elevation ranges between 900 and 1500 m asl. Wooden findings are mining timbers, illumination chips, bowls and cups, tool handles and partially buildings at the surface. For illumination purposes in the mines people have used band-like wooden shavings with a length up to one meter, functioning like a torch. These bands were split-off from knot free spruce- and fir-wood.
The question arises how it was possible to ensure the supply of such a huge amount of wood. There are two possibilities to split these illumination bands: They may originate from the outermost knot-free part of the bud log of old trees grown in a closed canopy site or from knot-free internodial wood of rapid grown young trees in an open canopy stand. There is also the question if the amount of knot-free wood was increased on purpose by e.g. pruning activities. To answer these questions ring-width and the curvage (bending) of the tree-rings of the illumination bands were measured. With the help of tree-ring boundary bending the diameter of the log portion from where the chips were split was estimated. Comparisons of the ring-width data with the log diameters, and the mean age-trend curves (similar the RCS curves), established within 900m and 1400 m asl, helped to assess size, age and the approximate site of the trees. As mining timber mainly spruce (47%) and fir (43%) was used. Small number of samples belonged to beech (8%), maple (1%) and larch (1%). When compared with the expected forest ecotype, a far high proportion of beech-wood can be expected. However, we hypothesize that beech wood was mostly used as fire wood. The small number of larch found in the mine indicates that almost all larches were used for housing.
Our data are unique and play an important role in the reconstruction of the forest-use in the Bronze Age at Hallstatt.

The potential of micro-focus X-ray CT for wood structure and wood density analysis

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The micro-focus X-ray CT has been applied to observe the intra-ring density fluctuations of a tree-ring core from Japanese fir (*Abies firma* Sieb. et Zucc.), Japanese beech (*Fagus crenata* Blume), and Mongolian oak (*Quercus mongolica* Fischer ex Turcz.) without preparing thin or block wood specimens that are usually essential for wood structure and wood density analysis.
X-ray densitometry is one of the most feasible techniques to measure both ring width and wood density by calibrating the radial wood-density profile from the optical density of X-ray photographs of wood. However, in order to obtain a clear X-ray image, which is sufficient for intra-ring density analysis, it is required to prepare a thin (1-2 mm) wood specimen of uniform thickness. The specimen also should be cut perpendicular to the direction of the wood fibers. Custom built twin-bladed saws would be needed to fulfill these requirements. Furthermore, in advance and during x-ray photographing, the moisture content of the specimen must be adjusted. Without this moisture-control procedure, the wood-density values would be biased by irregular water distribution in the sample because water has a higher X-ray absorption than cellulose. X-ray computed tomography (CT) allows us to examine the interior of a specimen non-destructively. However, the spatial resolution of medical CT scanners is limited to the level of a millimeter. Synchrotron radiation can be used to enhance the spatial resolution, though the number of this special fa-