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The Wooden Remains from the Prehistoric Ore Processing Site Schwarzenbergmoos near Radfeld/Brixlegg (Tyrol)

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Introduction

Mining on copper took place in the lower Inn valley (Tyrol) already during the Bronze and Iron Age. However, archaeological excavations of mining and ore processing sites in this area are still rare. The dating of the mining activities has been based on archaeological interpretations and radiocarbon dating and has shown limited accuracy. Here we present results of dendrochronological analysis and dating of wooden remains found by new archaeological excavations at the ore processing site Schwarzenbergmoos near Radfeld/Brixlegg. These are the first dendrochronological results established for prehistoric mining activities in that area.

Site

The archaeological site is located in the centre of a peat bog called Schwarzenbergmoos (11°56′18″, 47°25′47″; 1130 m a.s.l., Fig. 1). At that place ore was crushed and the obtained material was washed. The remains of these operations form an about 8 x 12 m large and up to 0.8 m thick heap. Moreover, also a huge amount of wooden artefacts used for these operations was preserved due to the wet conditions in this peat bog. The site was excavated by the Innsbruck HiMAT archaeology group (G. Goldenberg and co-workers) during the summers 2007 and 2008 (Klaunzer et al., 2009). Suited timber was sampled for dendrochronological analyses.

Material and Methods

Measurements of the total tree ring width as well as the identification of wood species were carried out on 100 wooden artefacts. This group of samples comprehends two troughs, several posts, boards and logs as well as other types of worked wood. Tree-ring width measurements were done using a binocular and a measurement device with 1/1000 mm precision. The tree
Fig. 1: Section no 5 of the archaeological excavation at Schwarzenbergmoos. Some wooden relics lying on the surface of the heap were only covered by few decimetres of peat. The trench was dug few years ago to drain the peat bog (photo: T. Pichler, 2008).

Fig. 2: Tree species of the prehistoric wooden mining relics from the Schwarzenbergmoos. PCAB: Picea abies (spruce), ABAL: Abies alba (silver fir), LADE: Larix decidua (larch), ALNUS: Alnus sp. (alder), FASY: Fagus sylvatica (beech), SAAL: Salix alba (white willow), FREX: Fraxinus excelsior (common ash), ACER: Acer sp. (acer), BEPE: Betula pendula (silver birch).
Fig. 3: The dendrochronologically dated wooden relics from the ore processing site Schwarzenbergmoos. Each rectangle represents a sample. The length of the rectangles indicates the length of tree-ring series obtained from the samples. The tree species, the sample code and the calendar year of the last ring measured of each tree-ring series is displayed. +: no terminal ring; WKL: terminal ring, logging following autumn/winter; WKE: terminal ring, logging during summer period; WK+: terminal ring nearly measured. PCAB: Picea abies, ABAL: Abies alba, LADE: Larix decidua, ALNUS: Alnus sp., FASY: Fagus sylvatica, FREX: Fraxinus excelsior, BEPE: Betula pendula.
species distribution is dominated by spruce (*Picea abies*, 63% of the samples) and two further conifer species (*Abies alba*, 13%; *Larix decidua*, 3%). The other artefacts were made of six different species of deciduous trees (Fig. 2).

Radiocarbon dating was used for a first estimation of the time range of the Schwarzenbergmoos samples. The number of reference chronologies for Alpine samples from the Bronze Age is still limited. However, it was possible to utilize the Eastern Alpine Conifer Chronology (Nicolussi et al., 2009), the Dachstein Conifer Chronology (Grabner et al., 2007) and some spruce and silver fir chronologies from the Swiss Alps and Alpine foothills.

**Results**

The sample tree-ring series established are between 7 and 225 rings long. However, the median value of 52 indicates the dominance of samples with relatively few tree rings. A splitting of the samples into different types of wooden artefacts (e.g. boards, beams, posts, tools) does not show any strong selection according to wood species with the only exception that hardwood was mainly used for posts. As a consequence the average diameter of the hardwood samples is clearly below the total average of all samples (11.0 cm).

Nearly half of the tree-ring series were cross-dated and a local tree-ring width chronology covering 247 tree rings was established. This chronology is mainly based on spruce and fir samples but also includes samples of other tree species. The absolute dating of the Schwarzenbergmoos Chronology (1116-870 BC) was possible by using reference series mainly from the foothills of the Swiss Alps. However, the crossdating of some of these Swiss series with the Alpine chronologies provide indirect affirmation of the dating results. Moreover, the wiggle matching results of five $^{14}$C dates obtained from cross-dated wooden artefacts are in perfect agreement with the dendro-dates.

The analysis of the felling dates of the absolutely dated wooden artefacts documents activities at the site Schwarzenbergmoos for a period of about 30 years: from c. 900 to 869 BC. Figure 3 gives the length of the tree-ring series of the dendrochronologically dated samples together with information on tree species and the last measured tree ring. Due to the distribution of the felling dates established two ore processing phases (c. 900 to 887 BC and 874 to 869 BC) can be suggested. These two phases are separated by a about one decade (886 and 873 BC) without any documented workings at that site.
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