Charcoals in dunes – an example from Northern Germany

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Summary: *Dunes are palaeoarchives hitherto rarely investigated for charcoal. Here we present a study of charcoals from an inland dune complex in Northern Germany. The charcoal assemblages were analyzed as part of a project which aims at the reconstruction of historical wind erosion in high spatial and temporal resolution. Different layers can be separated, containing considerable amounts of charcoals, which were taxonomically identified. Oak (*Quercus*) is dominating the spectra, and together with significant proportions of Ericaceae-charcoals (probably heather,* Calluna vulgaris*) indicate the presence of semi-open or open heathland, which was managed by fire. In the upper, younger sand layers a greater diversity of* taxa *was found, with dominating* Quercus*, and other species like* Fagus*,* Alnus*,* Betula*,* Corylus*,* Fraxinus*,* Salix*,* Populus-Salix-*type, as well as some Ericaceae. This diversity might indicate that the charcoals were blown in together with the sand from the surroundings, and do not represent the local vegetation on the dunes. The differences in the charcoal assemblages and the thus possible correlations of layers support the stratigraphical correlation made by the geomorphologists.*

Key words: *dune development, wind erosion, geoanthracology, charcoals origin, heather*

INTRODUCTION

Since the beginning of human-made deforestation and the rise of agriculture erosion became important for soil as well as landscape development. In Northern Germany sandy soils are very common. With the opening of the forest wind erosion and consequently sand drifts are resulting in the formation of inland dune complexes.

The research here presented focuses on a dune complex, Kurharder hill, in the vicinity of Joldelund (Schleswig-Holstein, Germany, Fig. 1). The Kurharder hill covers an area of around 2 ha and belongs to an inland dune field of about 80 ha. The Holocene dune development is the subject of a PhD project by U. Lungershausen who studies soil-sediment-sequences and ancient dune surfaces along several exposures made by an excavator. In this project's context, archaeological and historical records are considered and the analysis of palaeo-botanical material, especially charcoal, is carried out.

Main questions for charcoal analysis are spectra and possible origin of the charcoal.

MATERIAL AND METHODS

49 soil samples were taken from the dune profiles for charcoal analysis. Samples were dry- and/or wet-sieved in the lab, and the very small charcoals (1 to several milimeters, very rarely up to 1 cm) were analysed with a stereo lens (magnification 7.5-112.5x) and an incident light microscope with 100x, 200x and 500x magnification. For each sample it was tried to analyse at least 30 pieces but due to the sometimes low charcoal content this was not possible for every sample.

RESULTS

In total we determined 1085 charcoal pieces. The spectrum contains 14 species and is dominated by oak (*Quercus*). Further common species are the family Ericaceae (most probable *Calluna vulgaris*) and beech (*Fagus*). Birch (*Betula*), alder (*Alnus*), hazel (*Corylus*), poplar-willow type (*Populus*/*Salix*), ash (*Fraxinus*), pine (*Pinus*), maple (*Acer*), lime (*Tilia*), and apple subfamily (*Maloideae*) occur in several samples.

Five different layers can be found in the profiles (Fig. 2). Layer 1 is the older soil (formation before sand erosion started). Layers 2 and 3 are humus rich whereas Layers 4 and 5 are primary sandy, and are the upper, thus youngest layers. For layer 1 just one soil sample is available, with *Betula*, *Populus*/*Salix*, and *Pinus* charcoals. The other layers are dominated by *Quercus*. In some samples of layer 2 and 3 Ericaceae have high values, other species just occur as single pieces. In layers 4 and 5, the appearance of Ericaceae is less significant and other species like *Fagus*, *Betula* and *Alnus* reach higher values. The samples contained between 1 and 7 taxa (mean: 3.2±1.7). The assemblages of layers 4 and 5 are taxonomically more diverse than the others.

DISCUSSION

The charcoal seems to originate from different times and sources. For layer 1 we estimate that this layer was formed during the Late Allerød / Younger Dryas (which is confirmed by one AMS date). The high values of *Quercus* and Ericaceae in layer 2 and 3 indicate an open or semi-open landscape with *Calluna* heather which was burned during medieval times, probably due to fire management by humans. After the clearance of the

semi-open landscape wind erosion took place and formed the dunes. Layers 4 and 5 contain charcoal from the surrounding of the dune, but it is not clear yet how far the charcoal can be transported with the sand due to wind erosion. The bigger "catchment area" might explain a more species-diverse charcoal spectrum. We assume that a couple of the species found, especially species of wetlands, did not grow on the dunes, but were transported by wind from the surroundings.

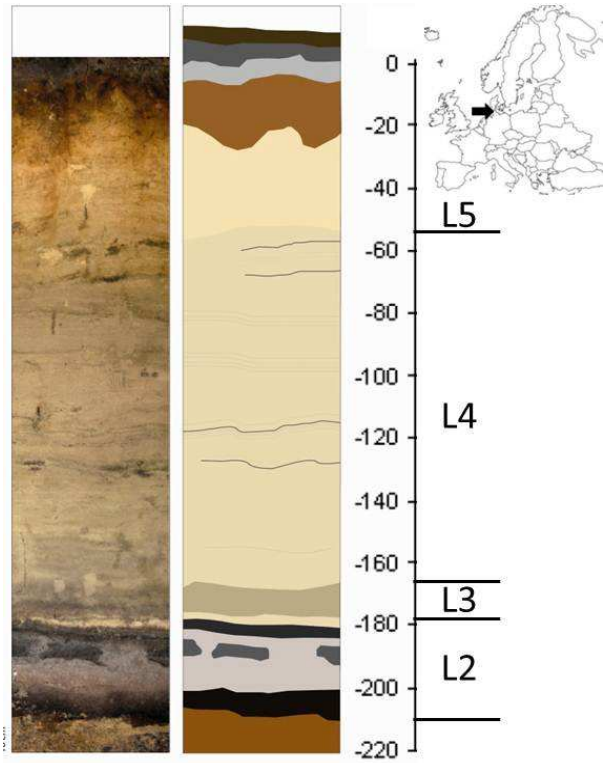

FIGURE 1. Photo and schema of a profile of the Kurharder hill with different layers (U. Lungershausen); on the right top: Map of Europe, arrow pointing at Joldelund.

CONCLUSION

The different layers of the dune are formed due to different processes were erosion plays an important role during medieval times. Charcoal analysis helps to interpret the origin of the material which formed the dune. The understanding of the formation of such dune complexes is improved by the cooperation of several disciplines. Anthracology can support stratigraphical interpretation of sediment profiles, while the investigation of these dune complexes by soil scientists and geomorphologists gives access to palaeoarchives like dune complexes, hitherto rarely explored by botanists.

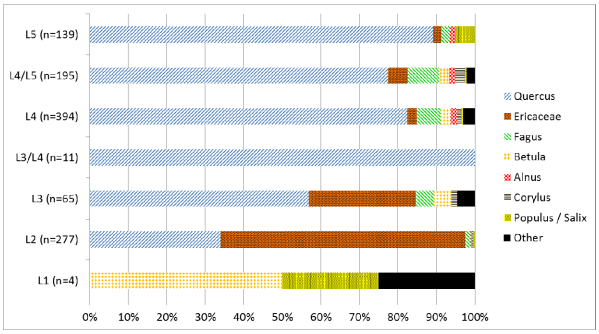

FIGURE 2. Charcoal spectra from the five different layers, when two layers are named (e.g. L3/L4) the soil samples were taken at the border between both layers. Other includes Fraxinus, Pinus, Acer, Tilia, Maloideae, Sorbus *and* Lonicera.

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