Paleo-forest Reichwalde
Late Glacial event chronologies from pollen, botanical macro-remains and tree rings

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Fig.1 View on lignite pit.

A vast and well preserved Late-Glacial pine-birch forest has been excavated in a lignite mine in Reichwalde. The advantageous circumstances for the preservation of organic material (inundation and peat-formation) provided more than 1500 subfossil trees "in situ". They cover a period of about 800 years in the Allerød Interstadial (14100–13300 yrs BP). The Reichwalde chronology is well connected to the southern and northern German Late-Glacial pine chronologies.

Information about Late-Glacial vegetation development could be obtained from peat sediments, prior and subsequent to the preserved forest.

The dendrochronological dating of stratified pines makes it possible to date the sediment precisely, to directly connect the trees with the bog stratigraphy and thus to compare the results of the dendro-ecological investigations to the pollen and botanical macro-remains analysis. In this way, bio - and chrono-stratigraphy can be connected.

Fig.2 Excavated tree with connected sediment sample.

Fig.3 Tree with fire scars in two consecutive rings.

Using dated fire scars on the trees, we composed a fire chronology. The Mean Fire Return Interval was very short, particularly between positions 1350 and 1460 of the chronology. In that time, the forest burned on the average every 3,5 years. Fire scars in two consecutive rings document fires at the same place in two successive years. This means that the fires were probably low intensity surface fires that burned the undergrowth but left the trees only slightly to severely scarred.

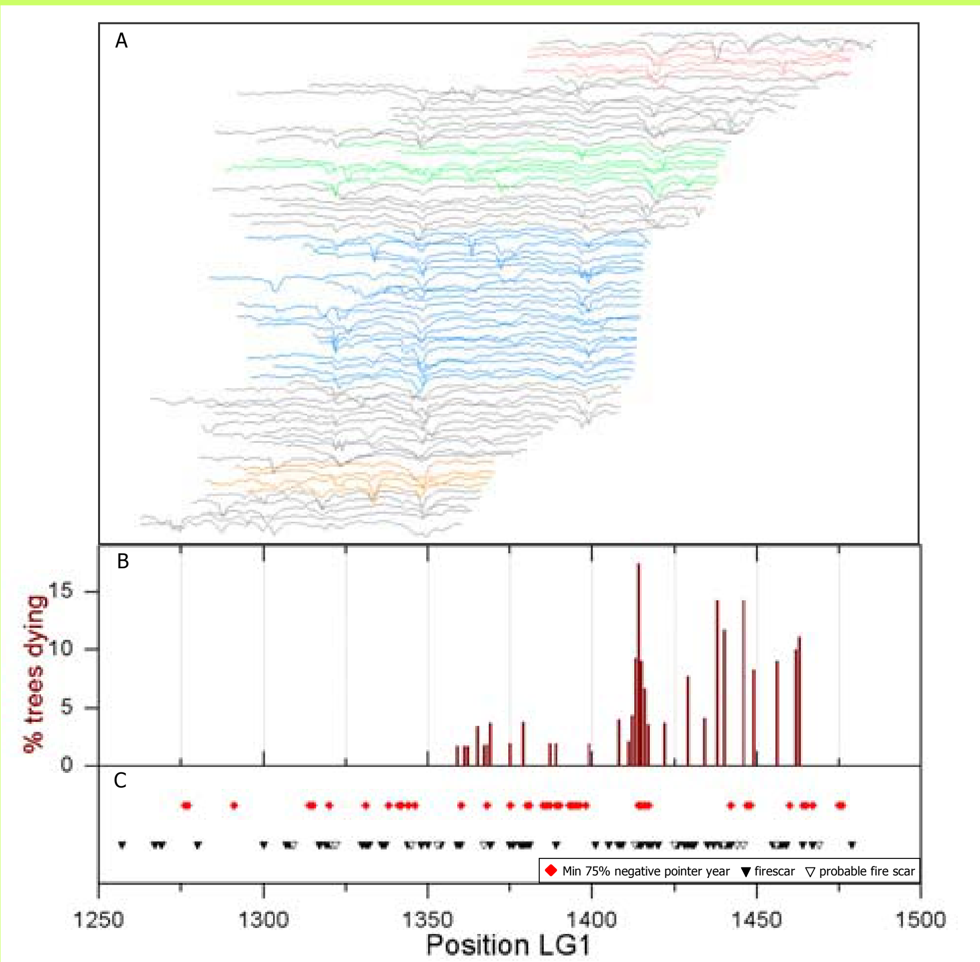

Fig.4 Relation between growth rate and die-off of the trees and events in the stand. (A) Dated trees from one excavation area, pictured by their ring width curves and sorted by dying date. The colours indicate strong die-off phases in the stand. (B) % of trees dying in the stand. (C) Negative pointer years for ring width and fires by fire scar appearance.

Fig. 4 combines the mortality rates of the pines with "event markers" in the wood - negative pointer years and fire scars. The mortality of the trees is high before and during periods of negative pointer years, this indicates "slow events" that cause some trees to die, some trees to reduce their growth. Fires seem to be more frequent during and after the negative pointer years. This means that the fires didn't produce the reduction in ring width, but were caused by the same event that brought about the growth reduction. Fire and die-off do not seem to be directly connected. However, mortality rates are much higher in periods with frequent fires (Fig.7). A possible explanation is that (low intensity) fires are not lethal for adult pines; their frequency is lethal for the population by inducing effects like insect outbreaks and elimination of young trees.

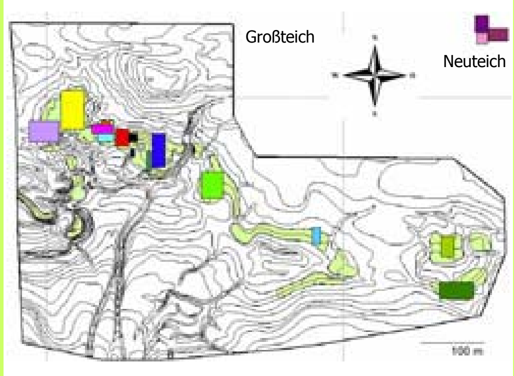

Fig.5 Excavation areas of tree samples.

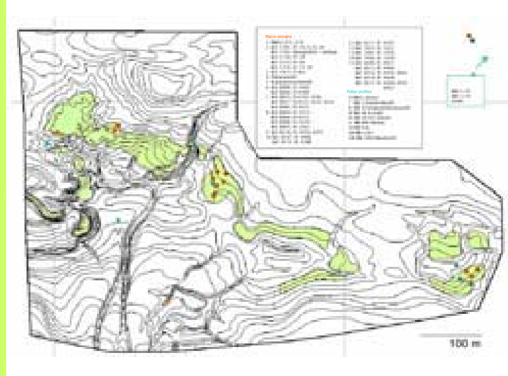

Fig.6 Location of soil samples and cores for botanical macro-remains and pollen analysis.

Fig. 5 and 6 mark the location of the tree and sediment samples in the two bog remains Großteich and Neuteich. Several sediment blocks and short profiles were taken in connection to „in situ" trees.

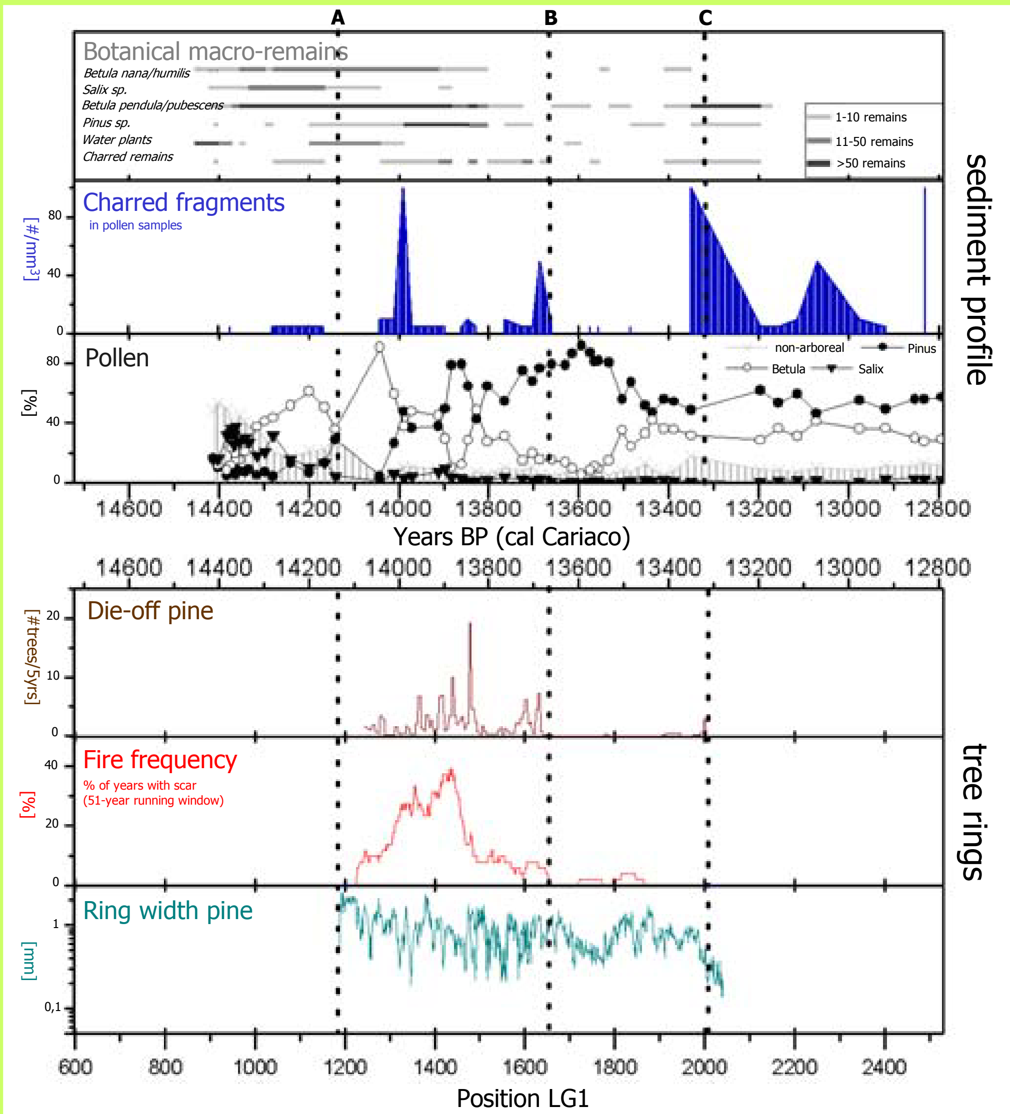

Fig.7 Comparison of different tree-ring proxies with proxies out of the sediment profiles. Tree-ring parameter are plotted against their relative time scale (LG1) and against the absolute ^{14}C time scale from Cariaco (Hughen et al. 2000). Proxies from the sediment are synchronised through an age model based on ^{14}C-dates and pollen concentrations and on the connection between trees and sediment. The lines border 3 important stages in Reichwalde: (A) start of tree conservation, (B) end of tree growth in Großteich and (C) end of forest in Neuteich and end of Late-Glacial wood conservation in Reichwalde.

Pollen and macro-remains show that the pine-birch forest existed since 14.250 BP, 150 years before the conservation of trees. The strong fluctuations in Pine and Birch pollen curves and the local changes in vegetation, as well as the vegetation composition (bushes were rarely found, the undergrowth was dominated by sedges, grasses and other grass-like vegetation) confirm frequent fires and indicate strong water-level fluctuations. Amounts of charred fragments found in the sediment agree with the fire frequency derived from fire scars in the pine wood, partly even quantitatively. The high amount of charred particles found after (C) is floated material, washed away by the water after the general wettening of the area. This is proven by finds of algae in the pollen profiles (not on the graph).

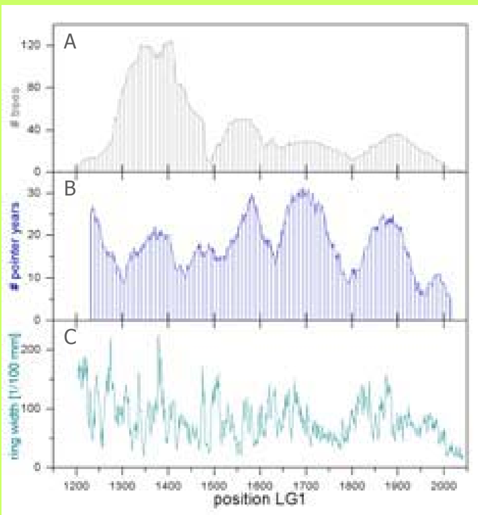

Fig.8 A Sample depth of chronology, B Min. 75% pointer years in 51-year window, C Tree ring widths. All with >75-year old trees.

The tree-ring parameters before position 1600 in the chronology are very different from those after 1600. In the older part of the chronology the rings are wider and the tree-ring series are more sensitive than in the younger part (fig. 8C). The maximum fraction of pointer years rose from 20 to 30 after position 1550 (fig. 8B). These features indicate that in the earlier Allerød, the trees were more influenced by local environmental factors than by climate and that in the later Allerød, the climate must have become more interfering with tree growth.