

Reconstructions of paleoclimatic changes in the 8th-9th centuries BC based on analysis of changes in ^{14}C radioisotope content and the ratio of stable C and O isotopes in subfossil wood from Poland

ABSTRACT

Carbon and oxygen are elements that are commonly found in the environment. They are contained in wood, which is a natural archive of past data. Analysis of changes in the ratio of stable carbon and oxygen isotopes in annual tree rings, combined with dendrochronological analysis, provides information on the conditions, in which a tree lived. This research is an attempt of reconstruction of paleoclimatic changes between 830 and 650 BC. During this period the Hallstatt disaster took place i.e. the change in climate from mild and dry to cool and humid. The research material consisted of subfossil oaks recovered from a gravel pit by the Vistula river in the village of Grabie, near Krakow.

Analyzed annual tree rings were precisely dendrochronologically measured. This allowed to determine periods with reduced widths of annual tree rings. This was the reaction of the trees to unfavorable climatic conditions. It was observed that almost the entire 8th century BC was a period in which the widths of annual tree rings oscillated below the average. Extremely narrow annual tree rings were recorded in 751 and 723 BC.

Studies of the carbon and oxygen isotopic composition in α -cellulose extracted from absolutely dated annual tree rings, showed the dependence of trees reactions on climatic and environmental factors. Characteristic periods of climatic deterioration were identified, mainly in the 8th century BC. Indicator years with the lowest $\delta^{13}\text{C}$ and $\delta^{18}\text{O}$ values were also determined, which is particularly visible around 745 and 720 BC.

Moreover, measurements of radiocarbon concentrations in selected annual tree rings showed that the Miyake event, a sudden and sharp increase of radiocarbon concentrations, took place between 665 and 661 BC. This phenomenon was most plausibly related to increased solar activity.

The analysis of changes in the ratio of stable carbon and oxygen isotopes, as well as in the ^{14}C radioisotope content in subfossil wood from Poland, clearly indicates an abrupt change in climate from dry and mild to cool and humid in the analyzed part of the Hallstatt period. This is consistent with data available in the literature.