

Does compression wood affect the climatic signal in carbon and oxygen isotopes of Norway spruce?

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Compression wood is a special tissue present in the trunk of mechanically stressed coniferous trees, more frequently occurring in branches and roots. The main role of the compression wood is to increase the mechanical strength and regain the vertical orientation of a leaning stem. The anatomical structure of compression wood is characterized by (i) rounded tracheids causing intercellular spaces, (ii) a thickened secondary wall (S2 layer) showing helical cavities and (iii) lack of a tertiary cell wall (S3 layer).

The aim of our study was to test if and how the presence of compression wood of different intensity influences the climatic signal in stable carbon and oxygen isotopes ($\delta^{13}\text{C}$ and $\delta^{18}\text{O}$) from tree-ring cellulose of Norway spruce trees (*Picea abies* (L.) Karst.). Four trees growing in the montane zone of the Western Tatra Mountains were selected, and two radii per tree were taken, one with compression wood (CW) and one from the opposite side of a trunk (OW). Four reference trees (REF) without compression wood were sampled from the same valley, however, from a slightly different location. All analyses were performed for the period 1935-1954 with CW present in all trees.

It was possible to establish the $\delta^{13}\text{C}$ and $\delta^{18}\text{O}$ CW, OW and REF chronologies, however, the EPS values for $\delta^{13}\text{C}$ chronologies did not reach the established threshold (0.85). In general the comparison between $\delta^{13}\text{C}$ and $\delta^{18}\text{O}$ CW, OW and REF chronologies showed statistically significant ($p < 0.05$) correlation values between CW and OW chronologies for both isotopes. The response patterns of $\delta^{13}\text{C}$ in CW, OW and REF chronologies respectively to climate were quite similar with strongest correlations to temperature, cloud cover and precipitation during summer (Jul-Aug) and to SPEI during late summer - early autumn (Aug-Sep). The correlations between the same climate variables and $\delta^{18}\text{O}$ of CW, and OW chronologies respectively revealed quite similar response patterns with strongest correlations to temperature, cloud cover and precipitation during summer months (Jul-Aug) and to SPEI during late summer - early autumn (Aug-Sep).

Overall, we conclude that the climatic signal in $\delta^{13}\text{C}$ and $\delta^{18}\text{O}$ CW and OW chronologies is not significantly altered by the occurrence of compression wood in trees.