A portable and unilateral nmr device to measure tree water and locate conductive tissues

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A PORTABLE AND UNILATERAL NMR DEVICE TO MEASURE TREE WATER CONTENT AND LOCATE CONDUCTIVE TISSUES

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The use of NMR technology in the plant sciences has traditionally been limited due to the immobility of the devices, and restrictions with regard to sample size and shape. To overcome these limitations and to be able to study plants directly in their natural environment, we evaluated the NMR capacities of a portable, unilateral magnet: The Nuclear Magnetic Resonance Mobile Universal Surface Explorer (NMR-MOUSE), designed by Blümich *et al*. [1]. This device permits measuring the NMR signal in increments of up to 100-micrometers, and within a depth of approximately 25-millimeters. We tested the capacity of this device to measure tree water content, and its variation over time, by following the dehydration dynamic of cut branches from six different species and two different functional types. There was a significant linear correlation between the integral of the NMR profiles obtained and the water content of the branches. This significant correlation was present regardless of tree species or functional type. We were also able to visualize the dehydration dynamic of individual branches, over time, through the NMR profiles. We then tested the capacity of the device to differentiate the conductive tissues, i.e. the xylem and phloem fluxes, within conifer branches. The NMR profiles of the branches presented distinct peaks which corresponded to the xylem and phloem tissues, whose location was validated with x-ray microtomography imaging which allows the high-resolution visualization of the tissues within the sample (see Fig. 1). In conclusion, the NMR-MOUSE is a promising candidate for measuring plant water dynamics in the field. Future work will test the capacity of this device to measure tree water content *in-situ*, and to measure the speed of both the xylem and phloem fluxes.

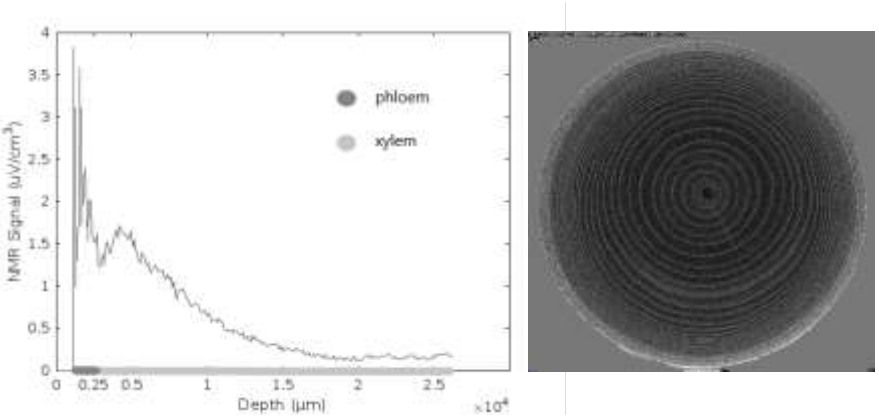

Fig. 1. The graph presents the NMR profile of a silver fir branch, showing the distribution of water within the branch. The peaks correspond to the xylem and phloem tissues. The microtomography image shows the cross-section of the branch, enabling us to precisely locate the depth of the xylem and phloem tissues.

References

[1] B. Blümich, P. Blümler, G. Eidmann, A. Guthausen, R. Haken, U. Schmitz, *et al*. *Magnetic Resonance Imaging* **16**, 5-6: 479-484 (1998)