

The measurement of multiple stable isotopes in tree rings and leaves with Sercon and Teledyne Cetac

Studying stable isotopes in tree rings allows the reconstruction of past climate with annual resolution and statistically defined confidence limits¹. The $\delta^{13}\text{C}$ value in tree rings depends on the $\delta^{13}\text{C}$ in CO_2 in the atmosphere surrounding the tree, the stomatal conductance of $\delta^{13}\text{C}$ in the sugars produced during photosynthesis and fractionation during metabolic processes as the sugars are transferred from the leaf to the xylem cells². When $\delta^{13}\text{C}$ values from tree rings, which can be made via laser ablation – combustion – GC – IRMS,

are combined with EA-IRMS measurements of $\delta^{13}\text{C}$ values in leaves, this allows an evaluation of post-photosynthetic fractionation processes occurring at leaf level and downstream at high resolution during a growing season, and so the intra-annual pattern of $\delta^{13}\text{C}$ variability can be studied. Furthermore, $\delta^{18}\text{O}$ and δD measurements can be made via pyrolysis-IRMS, and so the isotopic signature of source water can be measured, which allows temperature to be inferred and leaf transpiration to be measured.



A system has been developed by Sercon and Swansea University which allows the measurement of $\delta^{13}\text{C}$ values in tree rings via laser ablation - combustion - GC – IRMS, the reader is referred to apps note 022 for more details.

A Sercon GSL elemental analyser, coupled to a Sercon 20-22 IRMS, can be used for $\delta^{13}\text{C}$ analysis in tree leaves, and $\delta^{15}\text{N}$ and $\delta^{34}\text{S}$ can also be measured using this system. A high temperature furnace can be added to the system for pyrolysis measurements of $\delta^{18}\text{O}$ and δD .





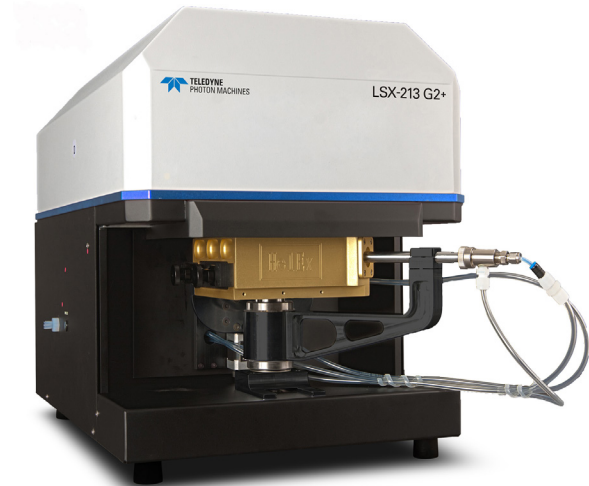
The Sercon 20-22 IRMS



The Sercon Cryoprep, with optional XYZ autosampler



The Sercon GSL and HT-EA



The Teledyne Cetac 213nm laser

The variety of techniques offered by Sercon in sample analysis, isotopic measurement, and data treatment allow for a multi elemental and isotopic analysis of stable isotopes in tree rings. As the only manufacturer to be actively involved in development

of the laser ablation -IRMS system, in collaboration with Teledyne Cetac, this application note summarises all of the laboratory requirements which would be needed for this multivariate analysis.



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References

- 1 McCarroll and Loader, Quaternary Science Reviews 23, Issues 7-8, 771-801, 2004
- 2 Rinne-Garmston et al. 2014



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