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EA-IRMS: Tracing geographical origin of timber using oxygen and hydrogen isotope fingerprints

Authors: Oliver Kracht, Christopher Brodie, Thermo Fisher Scientific, Bremen, Germany

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Goal

Illustrate how isotope fingerprints provide a framework for the provenance of wood using oxygen and hydrogen isotopes.

Introduction

Exotic types of wood have become an object of world's illegal traffics. Their wide usage for luxurious furniture, souvenirs, to housing commodities has resulted in fraudulent activities and illegal trade worth billions of dollars every year, as reported by Interpol[1]. Besides negative economic effects on impacted countries, illegal wood trafficking is responsible for environmental damage, due to its unsustainable approach to wildlife, often harming endangered animal and plant species. In order to fight criminal groups exploiting high-value woods, international efforts are put in place for identification of timber species and their geographic origin. Certificates for timber wood have been introduced to prove sustainability and legality of forest cultivation (e.g. EU timber regulation No 995/2010).

Tracing back the origin of wood species can be done by investigating their isotope fingerprints. Oxygen and hydrogen isotope fingerprints can help identify geographical origin.

This application brief reports oxygen and hydrogen analysis of 25 different types of tree bark. Three international certified isotopic reference wood materials have been analyzed to demonstrate the precision and accuracy of the elemental analyzer for wood analysis.

Isotope fingerprints of timber wood

Oxygen and hydrogen isotope fingerprints can be used to identify the geographical origin of wood. Plant samples carry a fingerprint derived from local-regional rainfall, but that can also be influenced by cultivation practices, soil processes and geological characteristics of the local area. Oxygen and hydrogen isotope fingerprints change in rainfall as you move further inland from the shoreline and with increasing altitude because heavier isotopes are released from the clouds first, meaning heavier isotopes are closer to the coast line compared to further inland[2,3].

Method

Analyses were undertaken with the Thermo Scientific™ EA IsoLink™ IRMS System using around 0.3 mg of tree bark, which is amount large enough to account for sample inhomogeneity. Finely powdered material was crimped in silver capsules and dried over night at a temperature of 80 ˚C to account for the hygroscopicity of the sample material. Silver capsules were introduced into the pyrolysis reactor from the Thermo Scientific™ MAS Plus Autosampler. The CO and H_2 gas produced was analyzed by the Thermo Scientific™ DELTA V™ Isotope Ratio Mass Spectrometer. All values referenced against VSMOW and GISP (SD = 1s standard deviation, N=4).

Results

In this study, 25 different types of tree bark samples were analyzed. Accuracy of OH wood analysis was assessed by analyzing USGS wood reference material 54 – 56 with the certified OH isotope values (Table 1).

Table 1. Comparison of measured OH isotope analysis of USGS wood reference material 54 – 56 with the certified OH isotope values.

Reference material	Measured δ^2H (‰)	SD	Certified δ^2H (‰)	Measured $\delta^{18}O$	SD	Certified $\delta^{18}O$
USGS 54	-151.64	0.82	-150	-18.23	0.36	17.8
USGS 55	-27.20	3.26	-28	-18.95	0.14	19.1
USGS 56	-44.11	0.76	-44	-26.97	0.09	27.2

Combining results of oxygen and hydrogen could be used to provide the platform for origin identification of the different samples, showing different results in terms of their isotope fingerprints. (Figure 1).

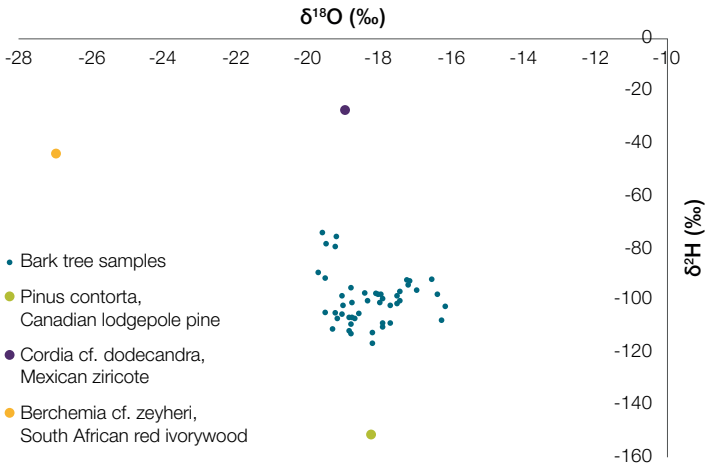

Figure 1. Combined O and H isotope fingerprints of tree bark samples and wood reference material.

Summary

Conclusion

The correct determination of origin of wood affects positively economic systems and environmental concern. Laboratories require an analytical technique providing conclusive answers on origin and authenticity. The oxygen and hydrogen isotope fingerprint of wood provides a framework for determining the geographical origin and verifying the correct labeling of wood. This helps ensuring sustainability of forest cultivation and protection of wildlife by detecting fraudulent activity.

Using the EA IsoLink IRMS System, laboratories gain the ability to trace the origin of samples with fast and low-cost sample analysis, completed with automation and all-in-one flexibility to meet changing analytical requirements.

References

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