

Agroisolab GmbH

**Nature ignores borders !**

**Stable isotopes in timber  
tracking**



### Stable isotopes for timber tracking

- ✓ 2006-2007: database of spruce,  
(boreal timber project)
- ✓ 2008-2010: database of teak, mahogany
- ✓ 2009-2010: concession project  
(Cameroon)
- ✓ 2012-2014: oak project (China / Russia)
- ✓ 2011-2015: ITTO project  
(Iroko, mapping of 8 African countries)



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ITTO project – timber tracking

## Project:

Development & implementation of a species identification and timber tracking system with DNA and isotopes in Africa.

Funding: ITTO

Iroko

Start: 1.02.2012

Sapelli

End: Nov. 2016

Ayous

Budget: > 2.000.000,- €

Technology: Wood anatomy : species

DNA : species & origin

Stable isotopes : origin

Mapped countries:

DRC, CAR, Congo, Gabon, Ghana, Ivory Coast, Kenya, Cameroon

\* Executive Agency \*\* Collaborative Agency

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## Issues in the project: 1) sampling



### Sampling of timber for stable

#### Short summary

#### Recommendation:

- Cordless screwdriver (>60Nm in wood)
- + extra battery + car charger
- wood driller: 20 cm
- drilling location: 50 to 100cm above ground
- drilling depth: 15 cm
- sawdust stored in cotton bags
- > GPS Data

#### Preliminary:

1. **Assessment of the sampling site:** A sampling site is described through wood samples from different trees. The ideal scenario is to identify different wood species in the field and take wood samples of five different individuals from each species. This will not always be possible in the field.
  - a. Is it possible to identify wood species in focus on the sampling site?

- b. Is it possible to identify five trees of the same species within a circumference of 100 to 200 m?
- c. Is it possible to identify five species of different species within the same circumference?

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collected entirely.

5. Give clear ID to each sample
6. Place drill chips into cotton bag and mark sample ID in clear letters with water resistant marker on the cotton bag.
7. Record recommended information in Excel sheet (see "Preliminary", Nr. 3)
8. Storage of the sample: to prevent mould, cotton bags should stay in contact with air and should not be put or carried inside a plastic bag or plastic box. Any drying is helpful. The cotton bags are practical for avoiding fungi and for drying the samples easily e.g. in the sun.
9. Clean Auger and box after each tree to make sure reminder from the last tree are removed. A brush can be helpful.

#### Actual:

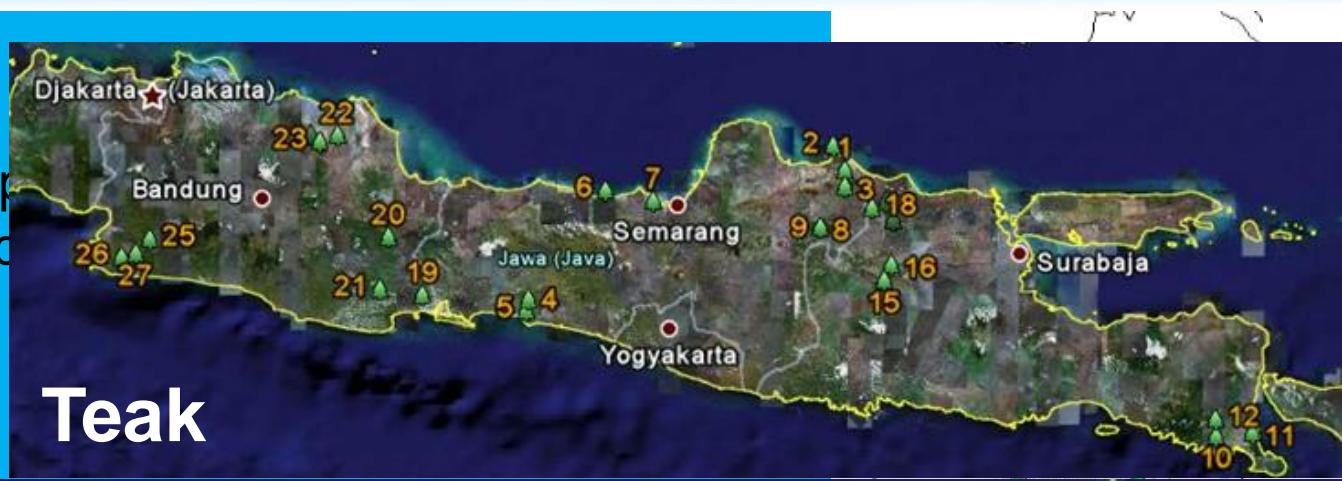
- 453 samples collected
- most of the samples were cuttings
- 10 % of the samples were problematic:  
e.g. bark or branches
- several confusions in the GPS data

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Issues in the project: 2) sample location

Recommendation:

- more or less a complete sampling
- Two sampling rounds
- > first year:
  - > second year:



Sulfur: 34S/32S



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Stable isotopes – Principle to track back the origin



## Country level:

The D/H (hydrogen) and  $^{18}\text{O}/^{16}\text{O}$  (oxygen) ratios depending on the water / rainfall cycle could differentiate a wide region.



## Regional level:

The  $^{13}\text{C}/^{12}\text{C}$  (carbon), as a climate and  $^{87}\text{Sr}/^{86}\text{Sr}$  (strontium) as a geological parameter could differentiate a closer region.

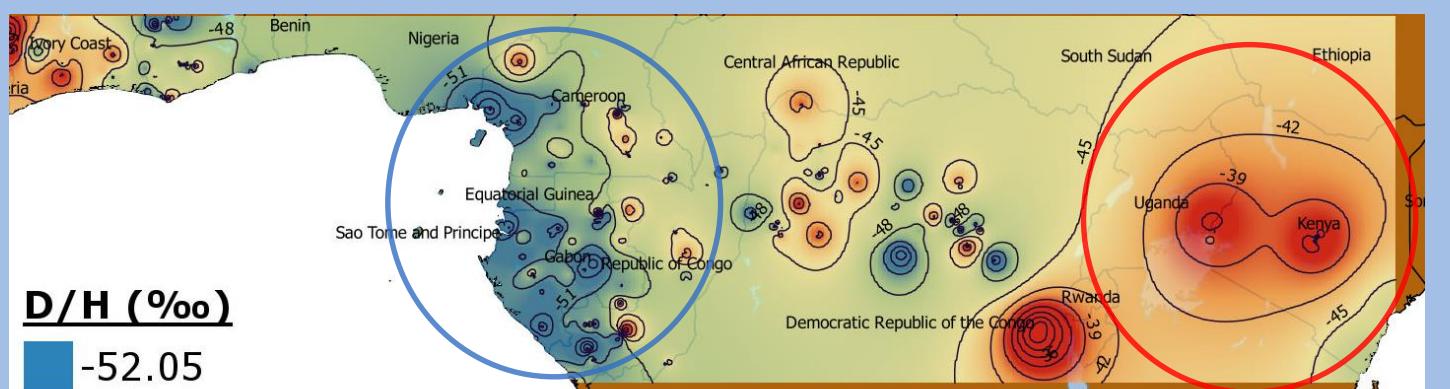


## Local / soil level:

The  $^{34}\text{S}/^{32}\text{S}$  (sulfur) and  $^{15}\text{N}/^{14}\text{N}$  (nitrogen) as geological parameter reflect the local soil.

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ITTO-project: hydrogen and oxygen ratios in timber (Iroko)

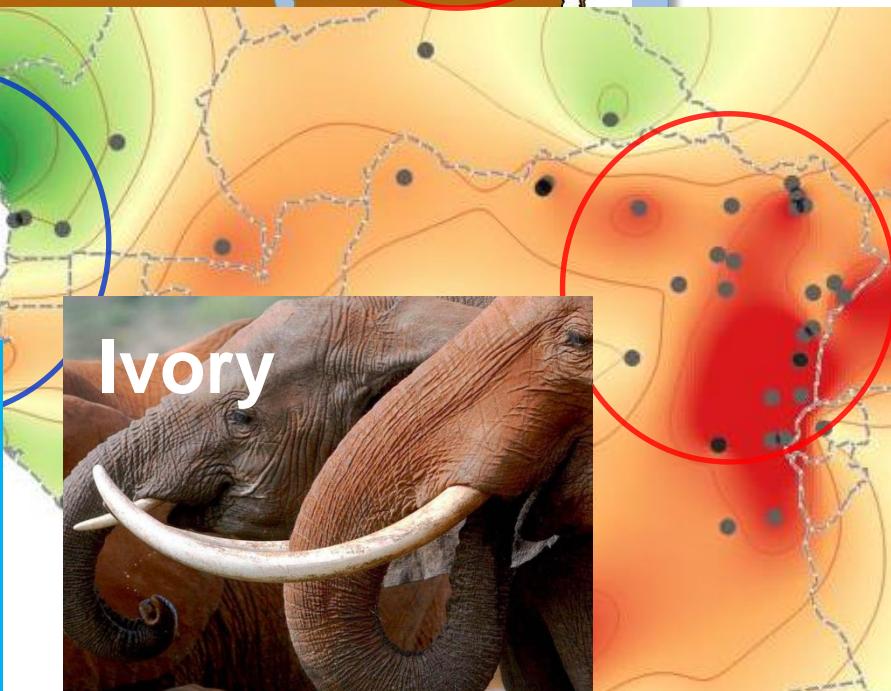


D/H (‰)

- 52.05
- 48.38
- 44.70
- 41.03
- 37.35

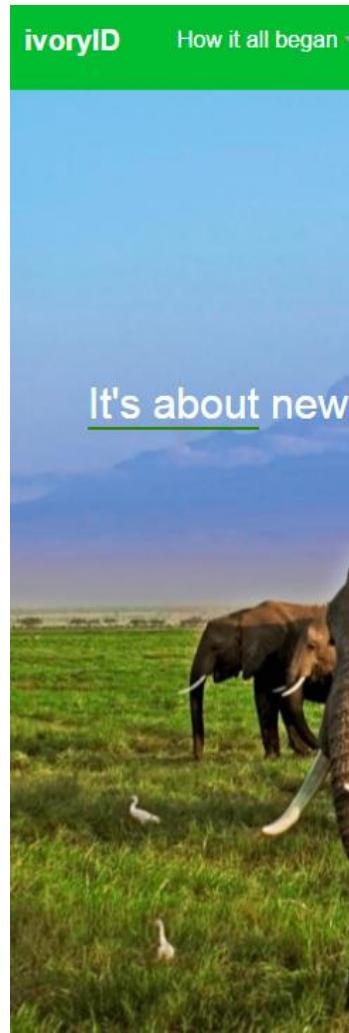
## Conclusion:

Stable Isotope Analysis is a universal analytical tool for authenticating the origin of biological material to a location.



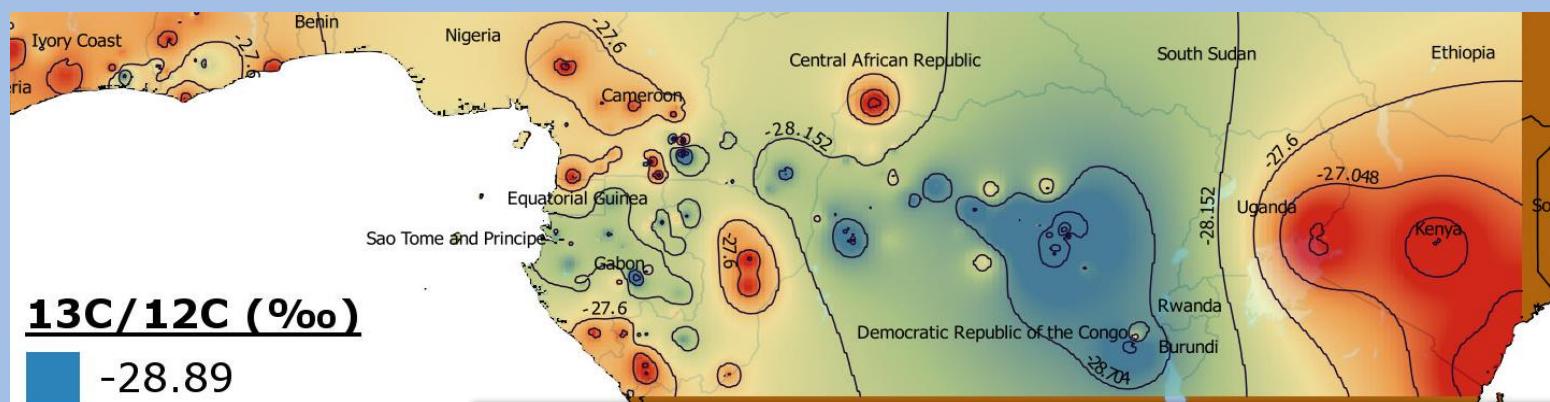
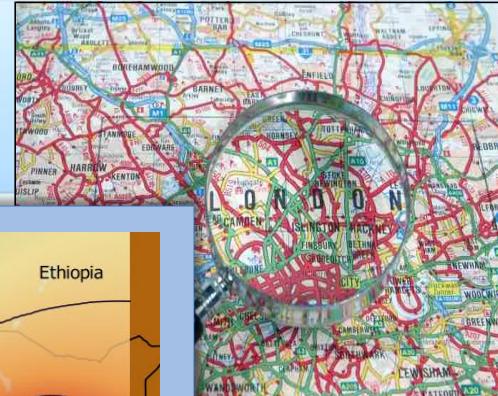
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Official ivory database: <http://ivoryid.org>

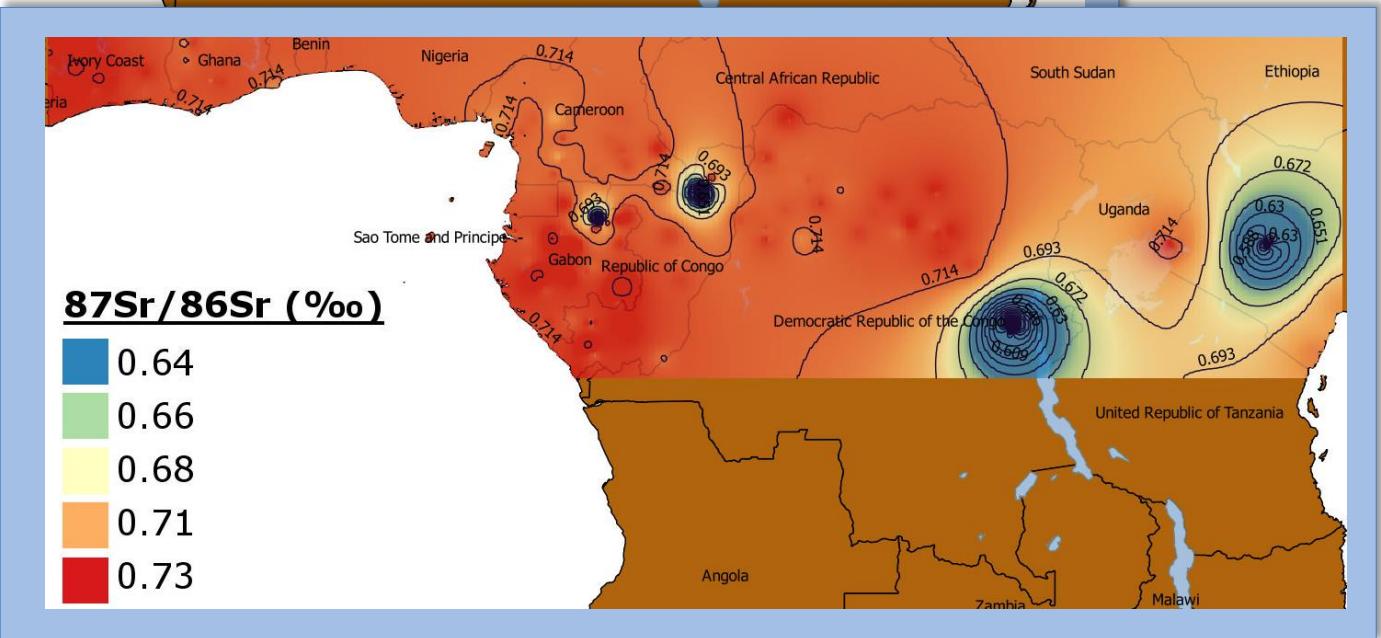
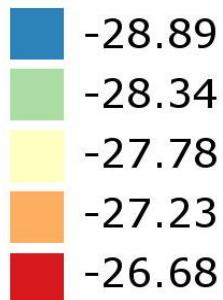


# Agroisolab.

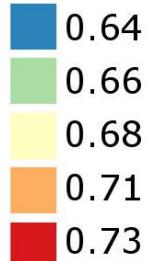
## ITTO-project: carbon and strontium ratios (Iroko)

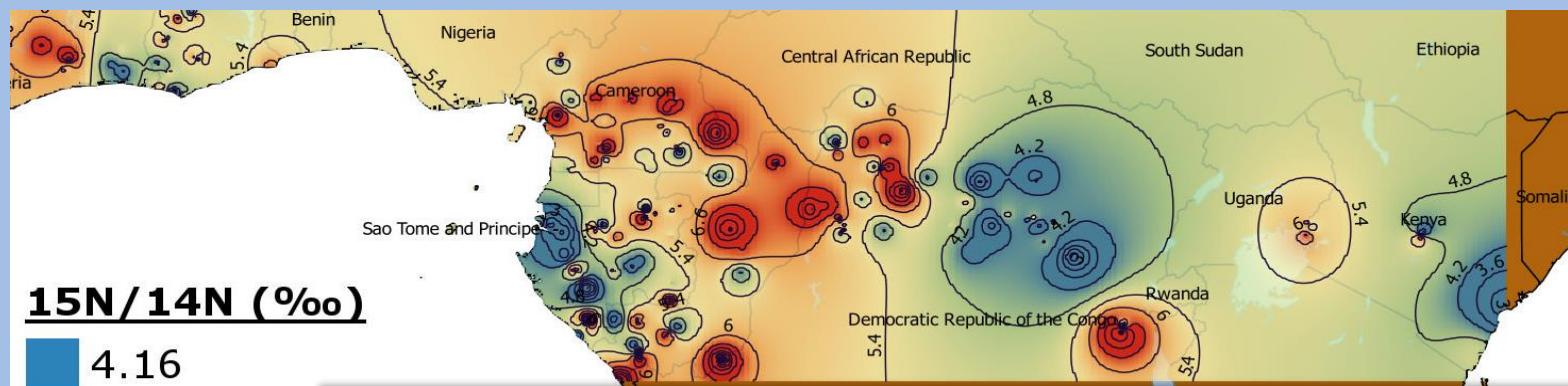


**$^{13}\text{C}/^{12}\text{C} (\text{\textperthousand})$**



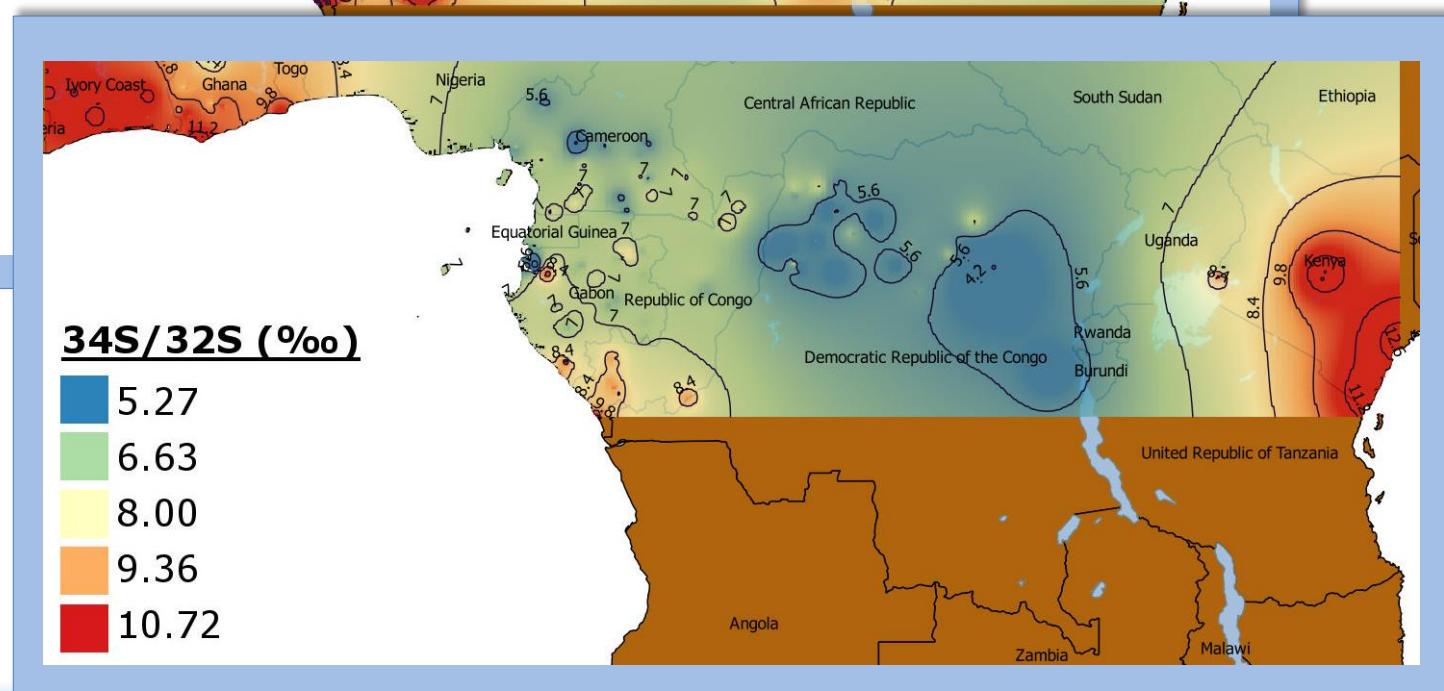
**$^{87}\text{Sr}/^{86}\text{Sr} (\text{\textperthousand})$**





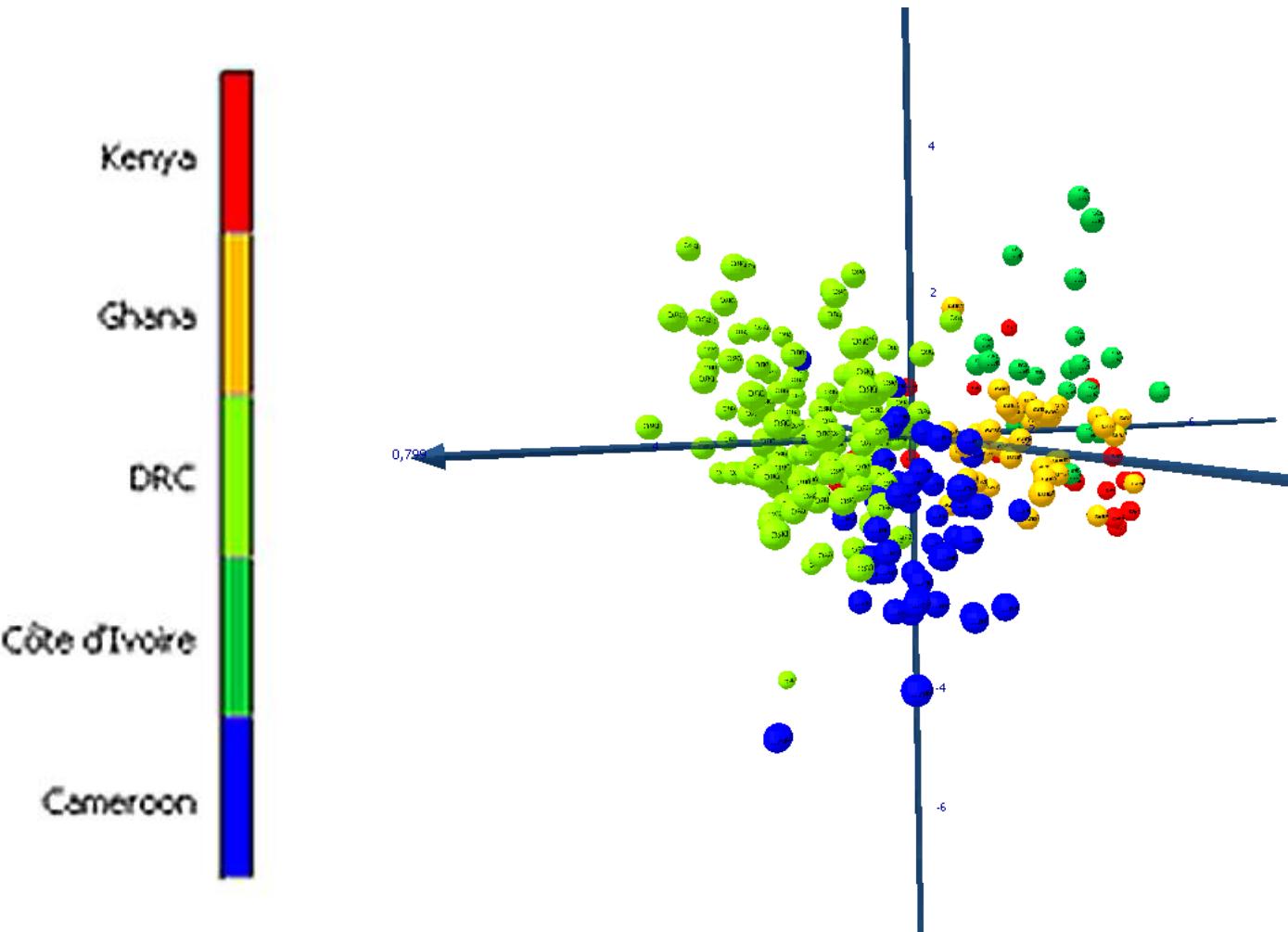
**15N/14N (‰)**

- 4.16
- 4.79
- 5.42
- 6.05
- 6.68



**34S/32S (‰)**

- 5.27
- 6.63
- 8.00
- 9.36
- 10.72



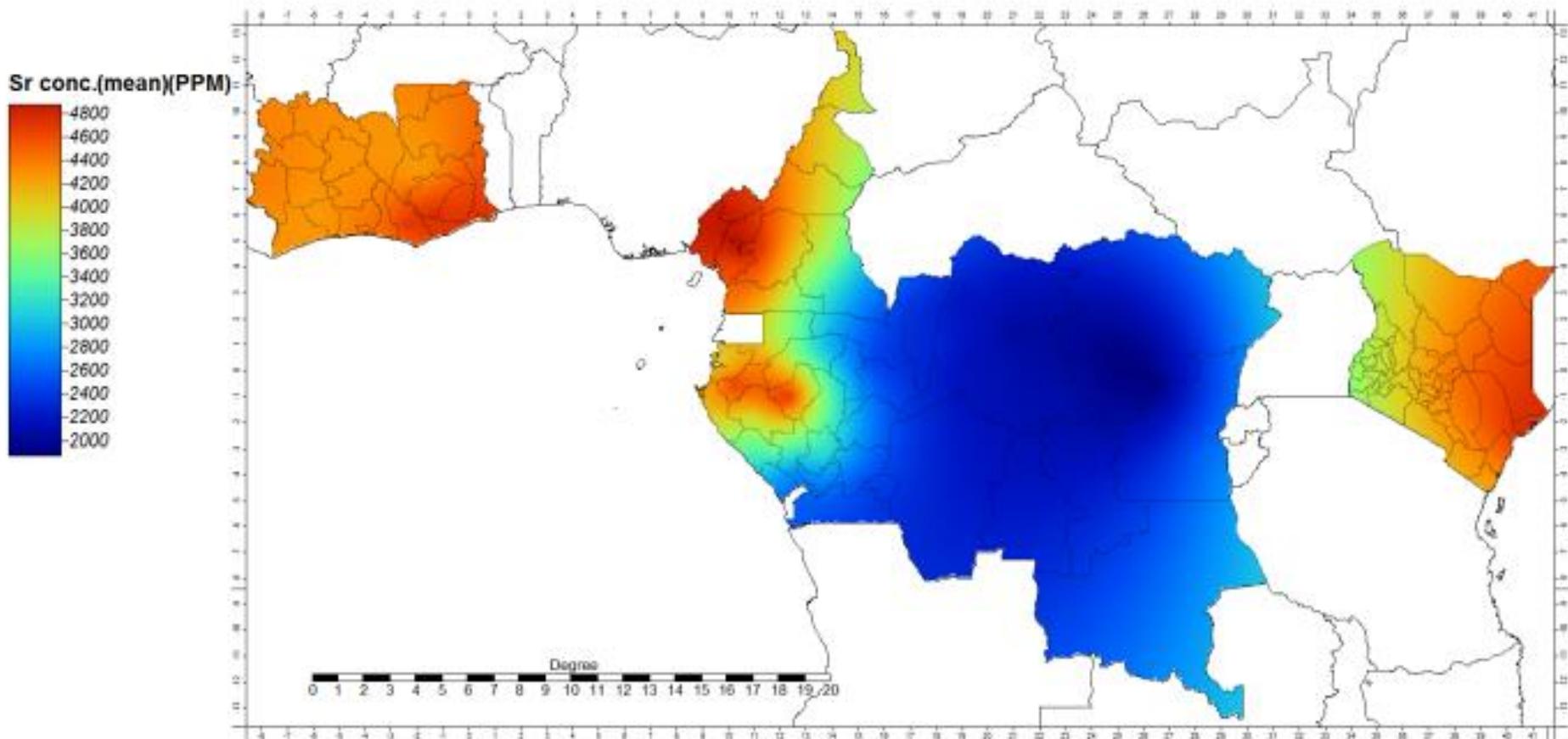
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ITTO-Project: Mapping of 8 African countries; results of the blindtest

Country level	species	Blind test partner	Evaluation in blindtest			Performance of isotopes in %
Stable isotopes laboratories			Right	Wrong	No answer	
<b>Agroisolab</b>	<b>Milicia Excelsa</b>	WWF	7	3	0	72
		G2S	7	3	0	
Fera	<i>Enfandrophragma cylindricum</i>	WWF	7	3	0	
		G2S	9	1	0	
Josephinum	<i>Triplochiton sclorxyylon</i>	WWF	5	5	0	
		G2S	8	1	1	
Total			43	16	1	
Reference sample used			828			
Genetic laboratories						Performance of Genetic in %
VTI-Thünen	<b>Milicia Excelsa</b>	WWF	4	6	0	50
		G2S	6	4	0	
VTI-Thünen	<i>Enfandrophragma cylindricum</i>	WWF	5	5	0	
		G2S	6	3	1	
Adelaide	<i>Triplochiton sclorxyylon</i>	WWF	5	3	2	
		G2S	4	1	5	
Total			30	22	8	
Reference sample used			3324			

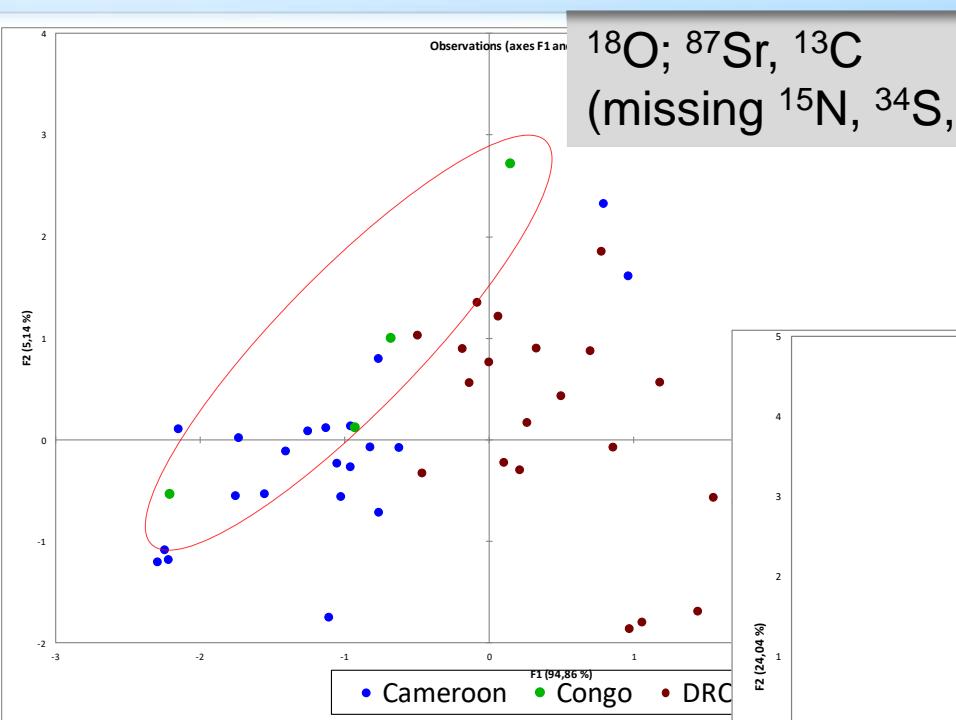
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ITTO-project: Strontium concentration (Iroko).



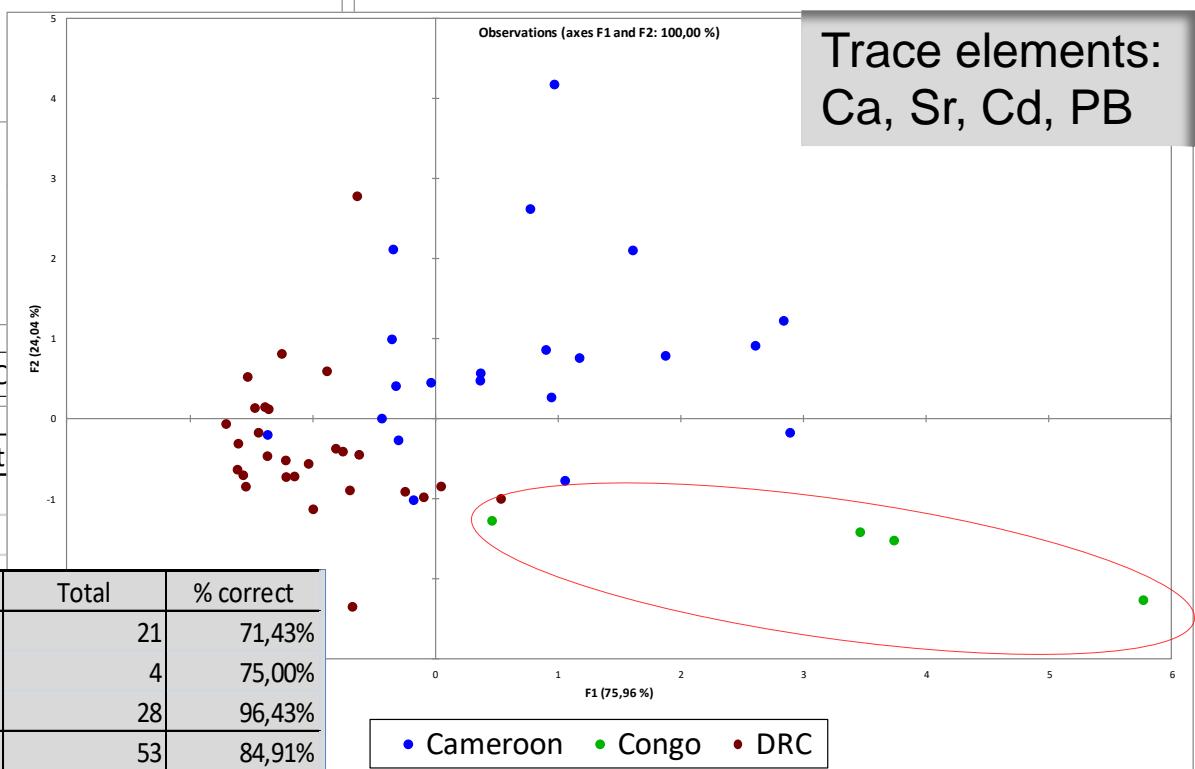
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## Sapelli-project (FERA): Isotopes & Trace elements



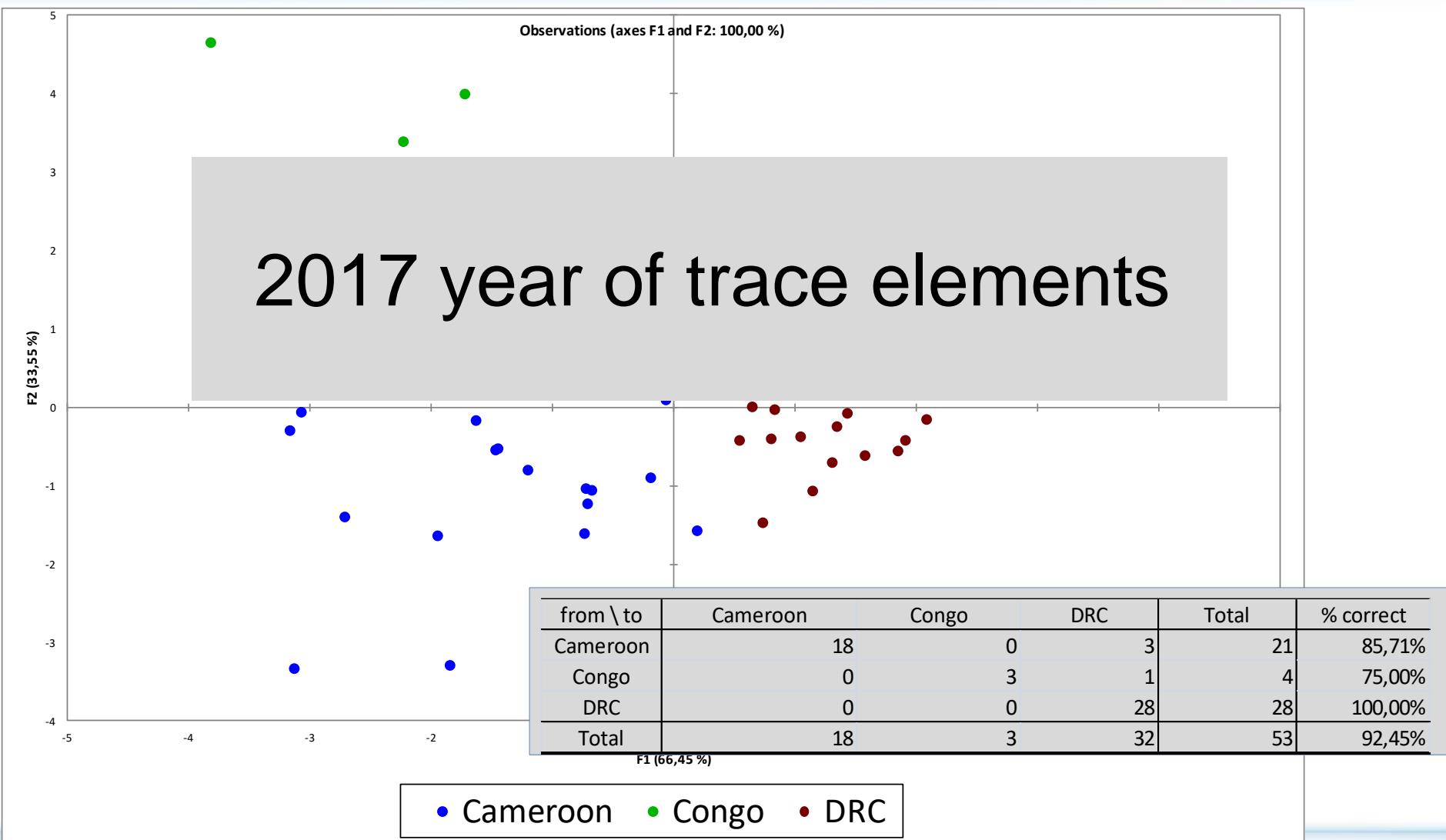
from \ to	Cameroon	Congo	DRC	Tot
Cameroon	19	0	2	
Congo	3	0	1	

from \ to	Cameroon	Congo	DRC	Total	% correct
Cameroon	15	1	5	21	71,43%
Congo	0	3	1	4	75,00%
DRC	1	0	27	28	96,43%
Total	16	4	33	53	84,91%



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Sapelli-project (FERA): 3x Isotopes & 4x trace elements



Wood Sci Technol (2011) 45:35–48  
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## Two facts are common to all new applications:

- Enormous quantity of data !
- Non-target !

**Abstract** Since trees record all the environmental factors in the wood, many wood properties are related to the site characteristics. Despite of this fact, identifying the origin of a timber has always been considered a difficult task, and no effective tools are presently available for this purpose. Significant differences among provenances can be detected with stable isotopes. Norway spruce (*Picea abies* L.) from Northern Poland and Italy were used as a test case. In the first approach samples were taken from different areas throughout Europe, while in the second approach samples were taken from provenances located in Northern Italy. In both approaches, all the specimens were cut from the same tree species. The separation among the samples was though less significant than expected. The results show that the technique is sensitive enough to detect differences between wood provenances and thus it can be used for tracking wood provenances and for detecting wood illegally from protected areas.

### Introduction

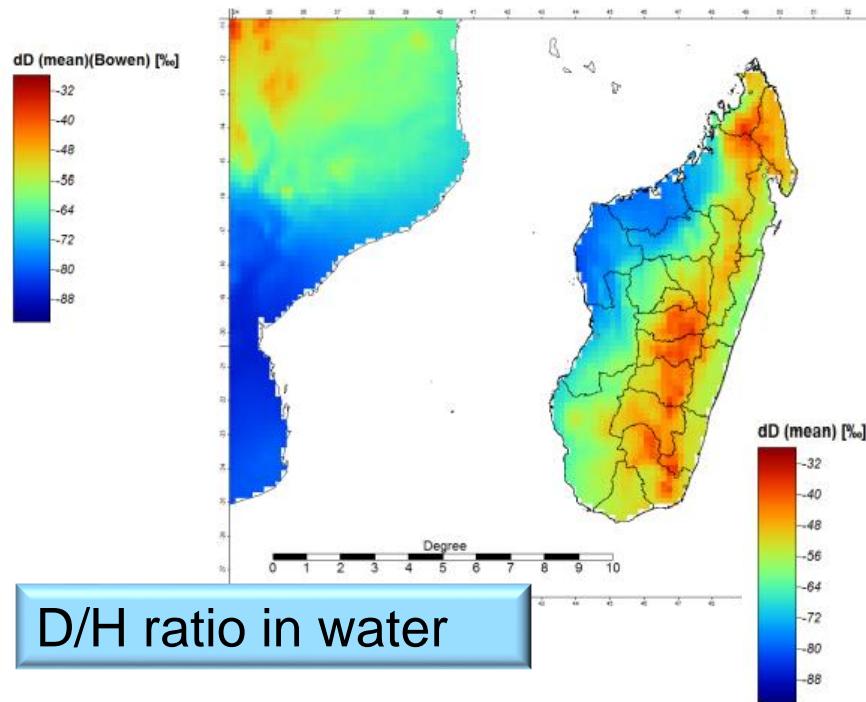
Norway spruce (*Picea abies* L.) is a multipurpose tree species with various purposes ranging from general construction to specific uses in wooden aircraft and ships.

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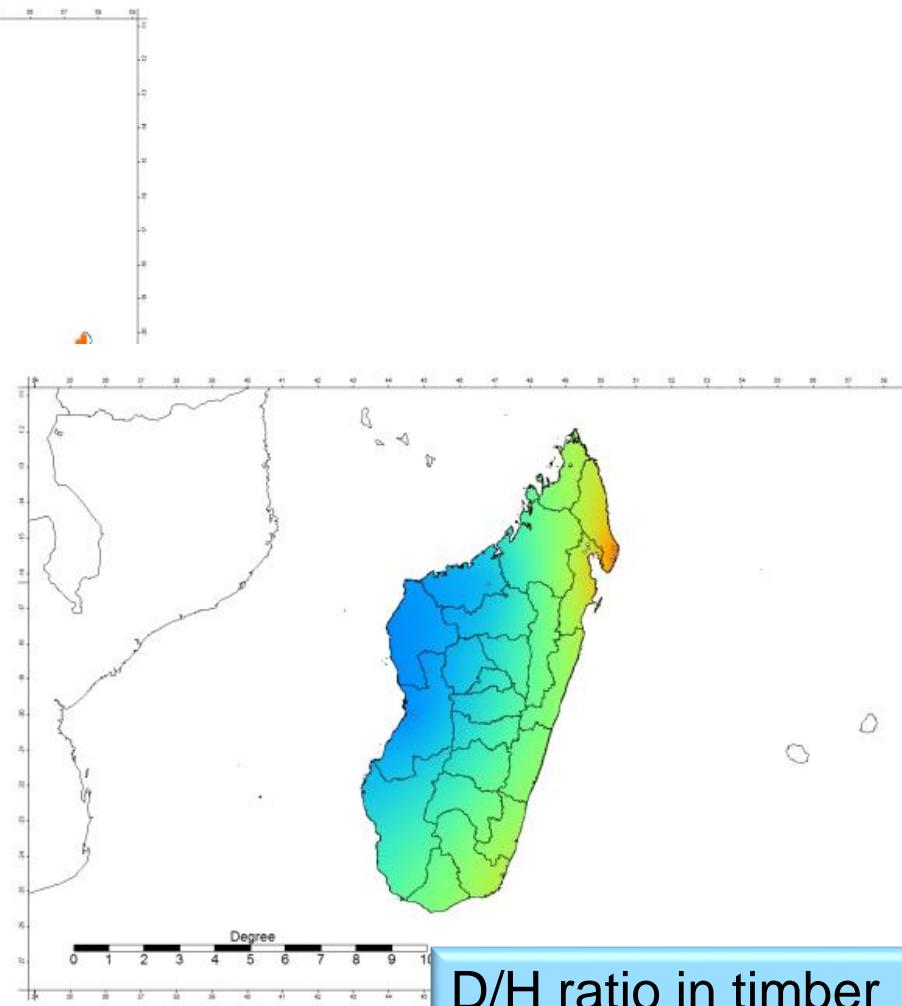
Next step in 2017:  
combination of **Stable isotopes**  
**+DNA**  
**+Trace elements**  
**+Non-target methods**  
**(NIRS signatures)**

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New cooperation 2017: ETH Zürich & Agroisolab: Origin of Dalberghia



D/H ratio in water



D/H ratio in timber

An aerial photograph showing a large area of deforestation on a hillside. The ground is brown and shows signs of erosion. A winding road cuts through the deforested area. In the foreground, a single, leafless tree stands prominently. The surrounding area is covered in green forest.

Nature ignores borders !

Thank you very much  
for your attention

[www.agroisolab.com](http://www.agroisolab.com)