"Use of a specification approach for determining geographical origin"

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(and many others)

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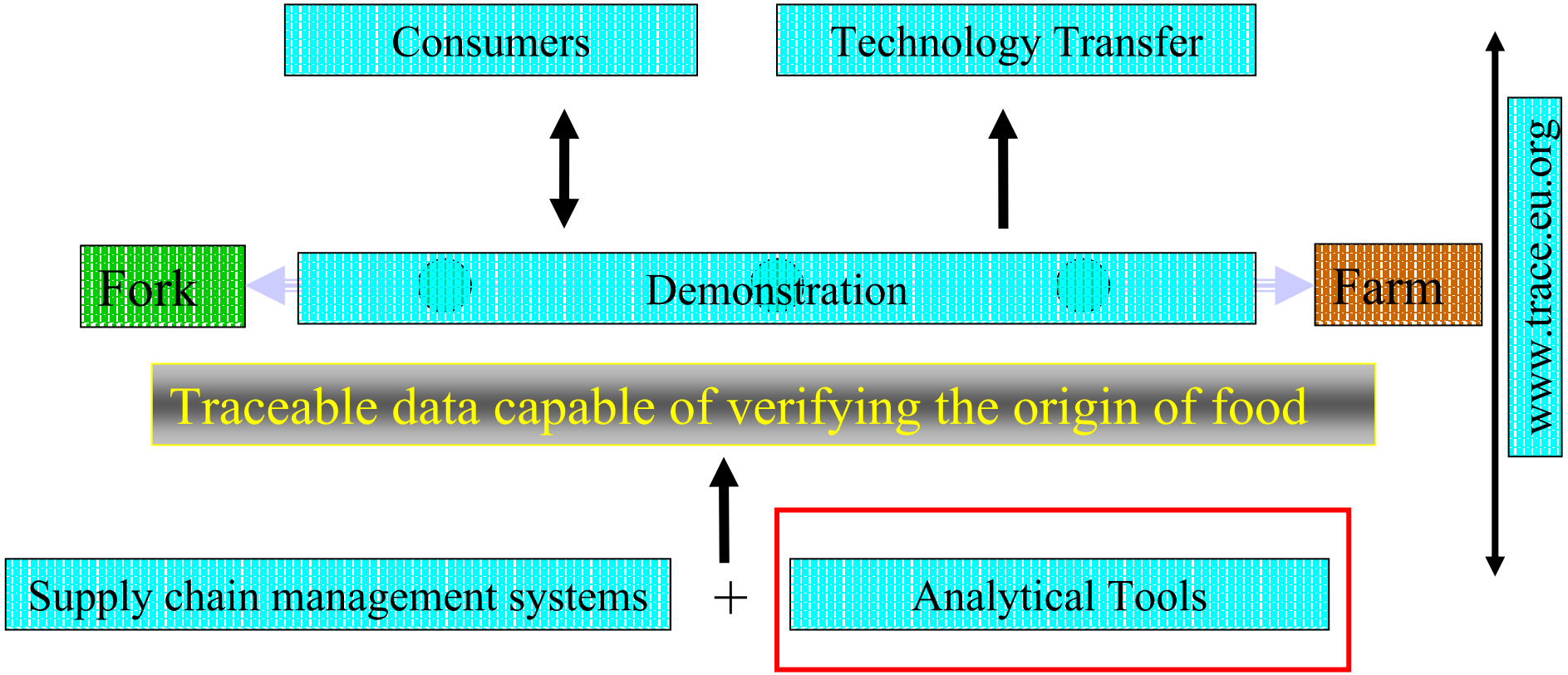
To be discussed

- Overview of TRACE
- Food Origin mapping
- Specification Prediction Models
- Application of specification approach to mineral water sector

- **18. 6 M€**
- **60 months**
- **50 participants (13 SME's)**

➢ **"To develop traceability methods and systems that will provide consumers with added confidence in the authenticity of European food."**



Analytical tools

- Developing cost effective tools:
  - to verify geographical origin (Food Origin Mapping)
  - to characterise foods (profiling)
  - to verify species/variety aspects of food

Tracers of geographical origin

- Trace element composition and stable isotope signature is affected by:
  - Geology e.g. $\delta^{87}Sr$, trace elements
  - Agronomy e.g. $\delta^{15}N$, trace elements
  - Physiological processes e.g. $\delta^{13}C$, trace elements
  - Environment e.g. Pb, trace elements
  - Climate e.g. $\delta^{2}H$, $\delta^{18}O$

Food Origin Mapping: rationale

- Can components in a food and its environment be linked?
- If so can we predict the levels of certain components in a food of declared provenance ?
- Can the predicted levels (specifications) be used as an objective means of verifying geographical origin ?

Experimental Design

- 21 Model sampling sites
  - Climate
  - Geography
  - Geology

- ~12,000 groundwater, soil and food samples analysed
  - $\delta^{2}H$, $\delta^{18}O$, $\delta\ ^{13}C$, $\delta^{15}N$, $\delta\ ^{34}S$, $\delta\ ^{87}Sr$ and trace elements
  - >~600,000 analytical data points to be produced

- Geochemical modelling to produce Specification Prediction Models

SPMs for mineral water

- SPMs modelled on climate produced for ^{2}H-excess and $\delta^{18}O$
- SPMs for $\delta^{87}Sr$ based on link to geology
- CART model for minerals and trace element based on link to geology?

Production of SPMs

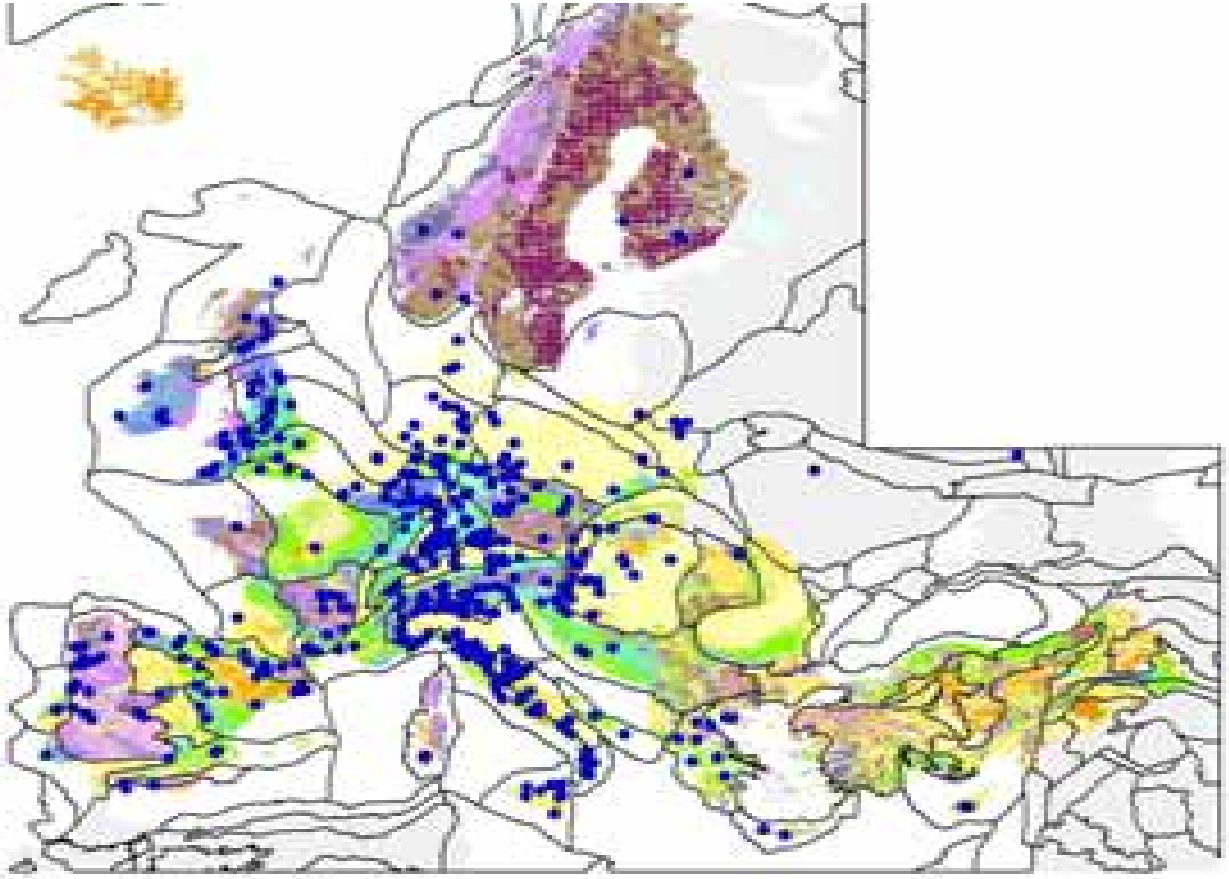
Specification maps for different (independent) variables:

→ What determines the variation of a parameter in some commodity
→ How can we use this information to make specification maps

Example for mineral water:

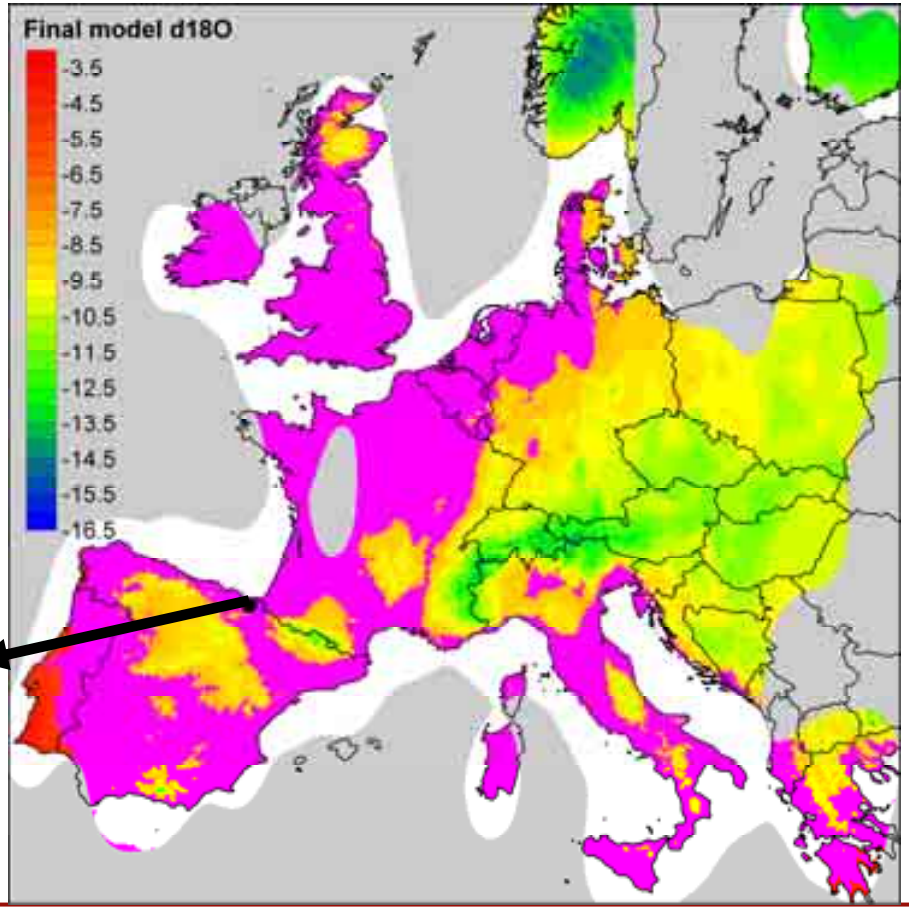
$\delta^{2}H$ (or $\delta\ ^{18}O$ because related)	-> (min.) surface temperatures
$\delta\ ^{87}Sr$	-> lithology and age of rocks
Trace elements	-> linked to lithology???

Geological map with sample locations



Specification map for mineral water: δ ^{18}O

Pink=specification area

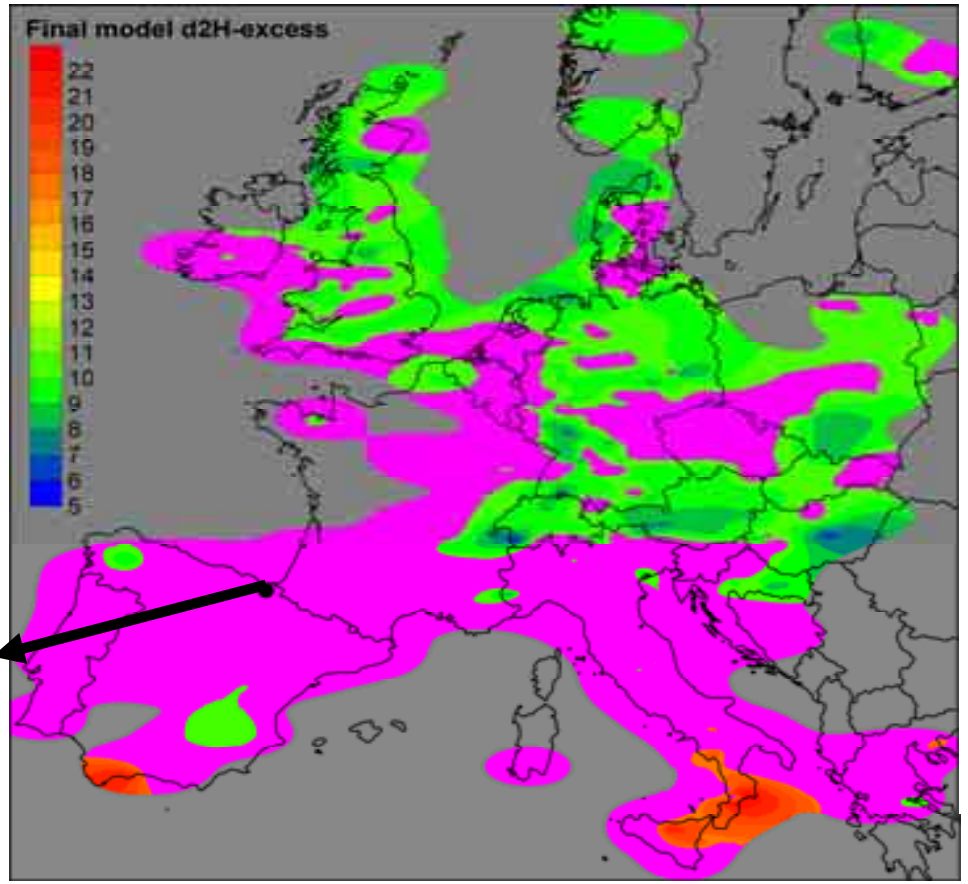


Estimate for Insalus:
δ 18O = -6.9 +/- 1.6 ‰

Specifications for mineral water: ^{2}H-excess

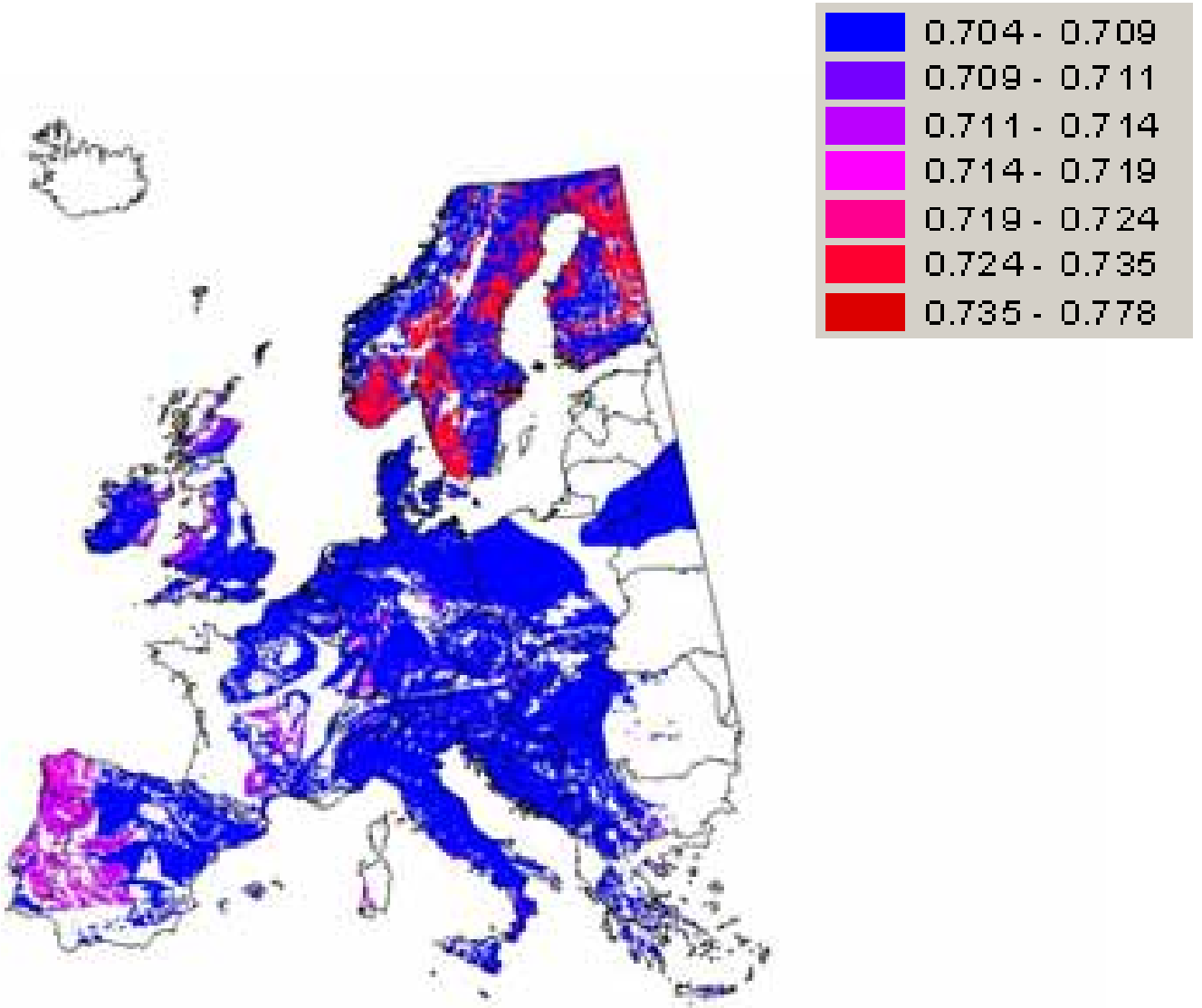
^{2}H excess= δ^{2}H-8 * δ^{18}O

In pink: specification
Area for Insalus water

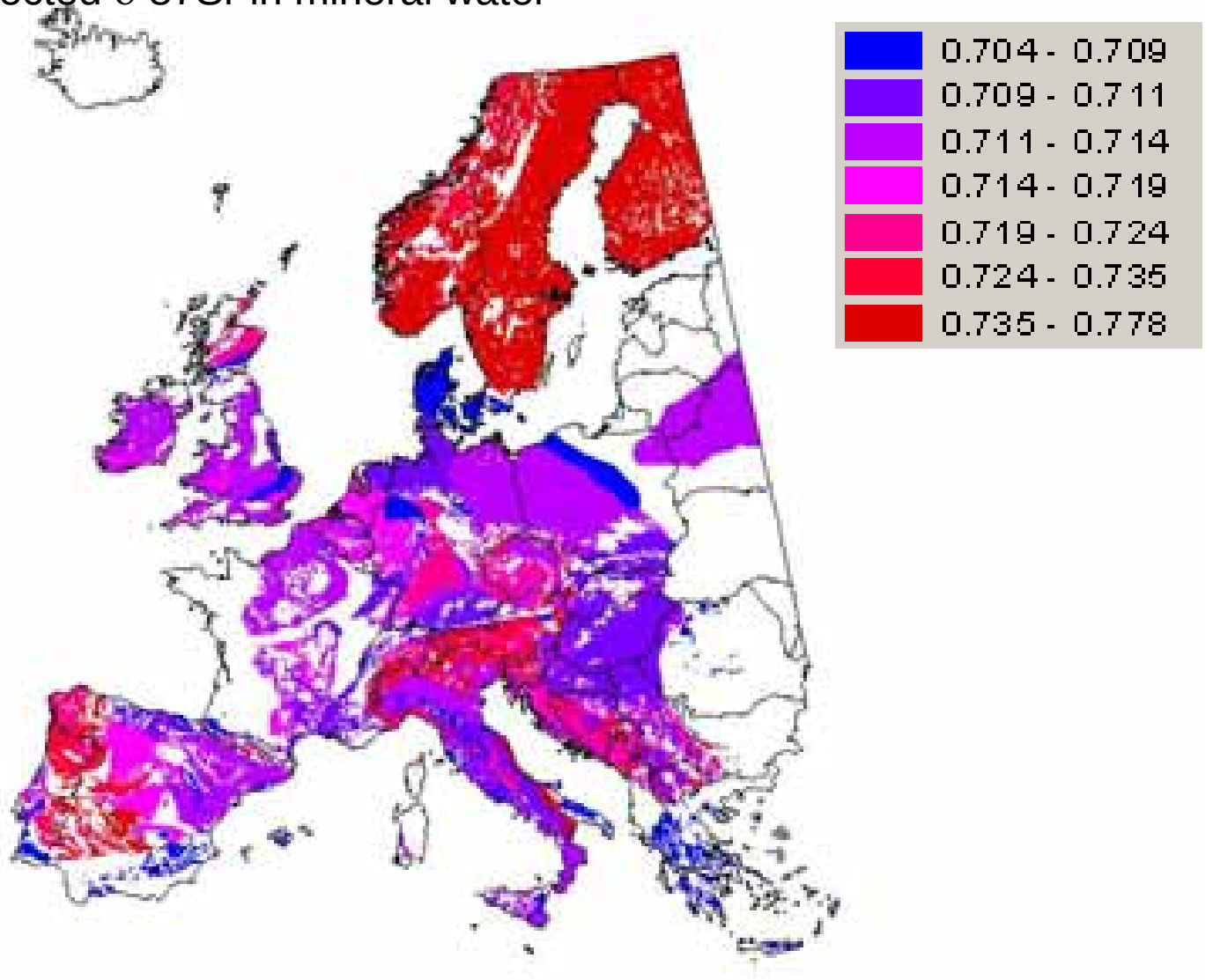


Estimate for Insalus:
^{2}H-ex = 14.2 +/- 3.5

Minimum expected δ 87Sr in mineral water



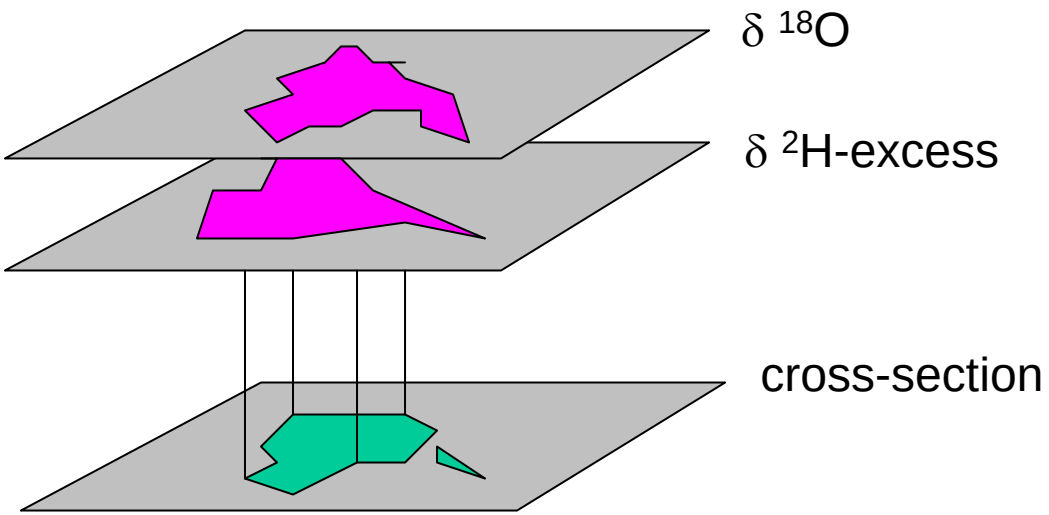
Maximum expected δ 87Sr in mineral water



Specifications for mineral water: δ ^{18}O & δ ^{2}H-excess:

$$S_{\min wat}(Insalus) = -8.5 < \delta^{18}O < -5.3 \;\&\; -17.7 < \delta^{2}H - excess < -10.8$$

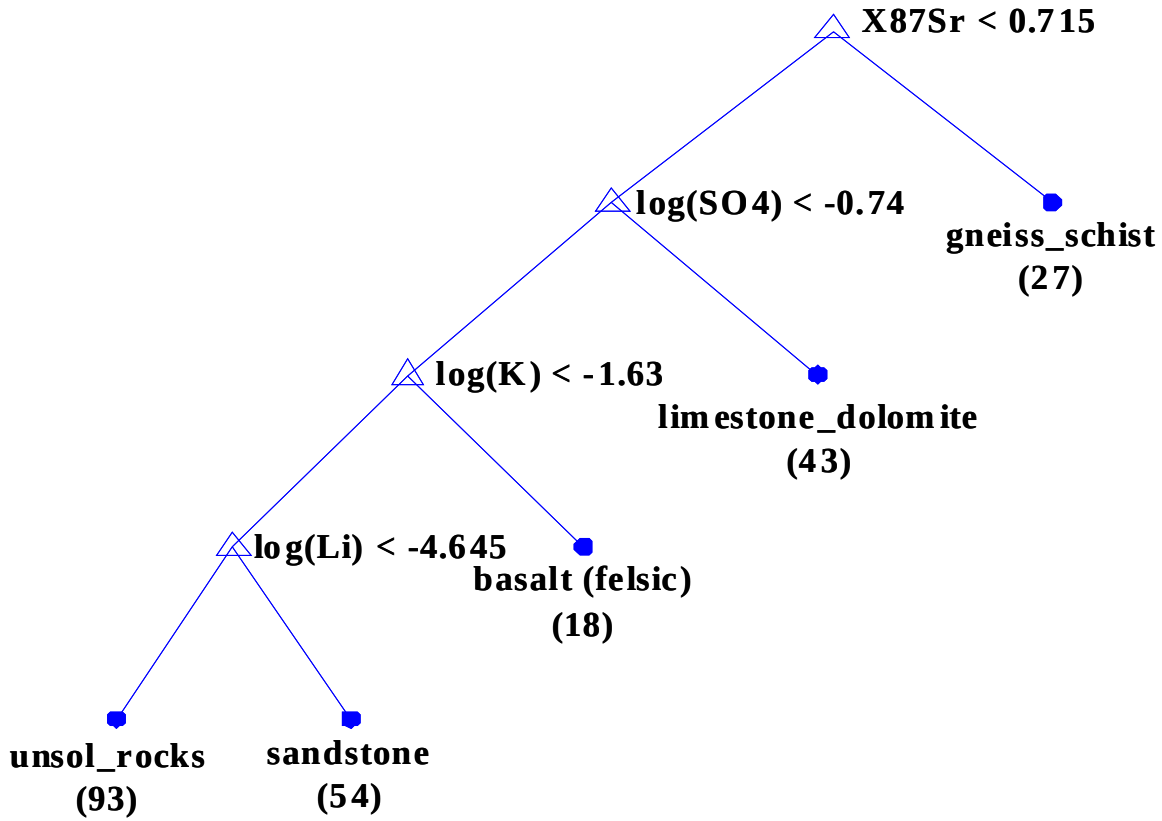
Combination of ranges applies to an area, which is the cross-section of BOTH specification areas:



CART specification relating TE to geology

CART produced from a study of mineral water mineral and TE profile vs lithology

(unvalidated)



Mineral water challenge

Can we discriminate Aqua Insalus mineral water from 18 other water samples using the predictive approach ?

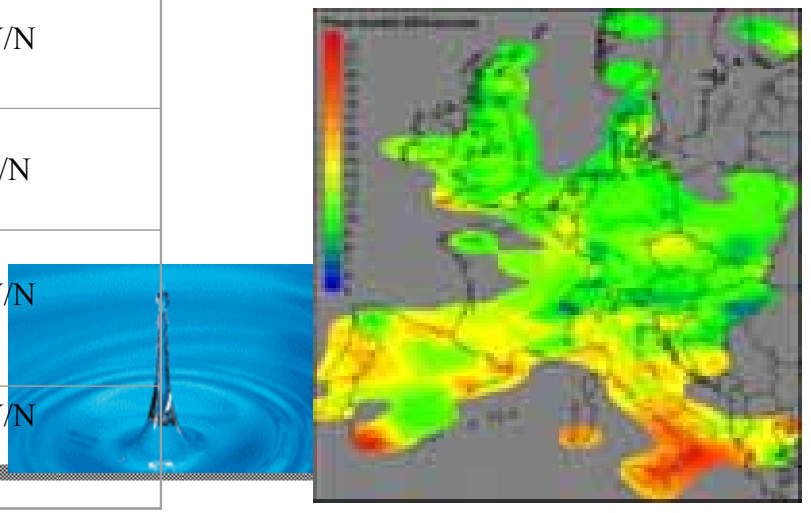
Mineral Water Challenge

- Specifications for Insalus water produced from SPM's
- 20 "mineral" water samples sent to participants as blind samples-overseen by FSA
- Analysis by ICP-MS and IRMS
- Data analysis to see which samples comply (with spec).

Specification for Insalus water

Produced by Grishja van de Veer (Geochem) & Susanne Voerkilius (Hydroisotop)

Parameter	Specification	Result	Compliance
CART	multivariate	?	Y/N
^{87}Sr	0.704-0.714	?	Y/N
$^{18}O\ ^{0}/_{00}$	-5.3--8.5	?	Y/N
^{2}H excess	10.7-17.5	?	Y/N



Blind test revealed

		Climate		Geology		Result
Brand	**Country**	**$\delta^{18}O$**	**$\delta^{2}H$-excess**	**Multivariate Analysis**		
Korpi	Greece					non-compliant
AQUA BONA –SANT.	Spain					non-compliant
AQUAFINA	Spain					non-compliant
Himalayan	India					non-compliant
AQUA INSALUS	Spain					compliant
AQUA INSALUS	Spain					compliant
Spanish tap water	Spain					non-compliant
San Benedetto	Italy					non-compliant
Sainbury's Caledon.	Scotland					non-compliant
Spreequell	Germany					non-compliant
Apollinaris	Germany					non-compliant
M&S Glenpatrick	Ireland					non-compliant
English tap water	York, UK					non-compliant
evian	France					non-compliant
Vittel	France					non-compliant
Vittel	France					non-compliant
Apollinaris	Germany					non-compliant
Korpi	Greece					non-compliant
evian	France					non-compliant
San Benedetto	Italy					non-compliant

Integration into traceability system

Specifications produced without analysis or need of database

Eventually could be generated independently from website

Specification can be checked by any stakeholders in the chain

Parameter	Specification	Result	Ref to method
$\delta^{87}Sr$	[<-x->]	√	TRACE
$\delta^{18}O$	[<-Y->]	√	TRACE
$\delta^{2}H$ excess	[<-z->]	√	TRACE

Conclusions

- First proof of principle of Specification Prediction Models for determining geographical origin
- The specifications provide an objective means for assessing provenance claims
- They can easily be incorporated into a traceability system to provide confidence in provenance claims
- Principle now being applied to honey

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4th TRACE conference

"Lost without TRACE"

New approaches

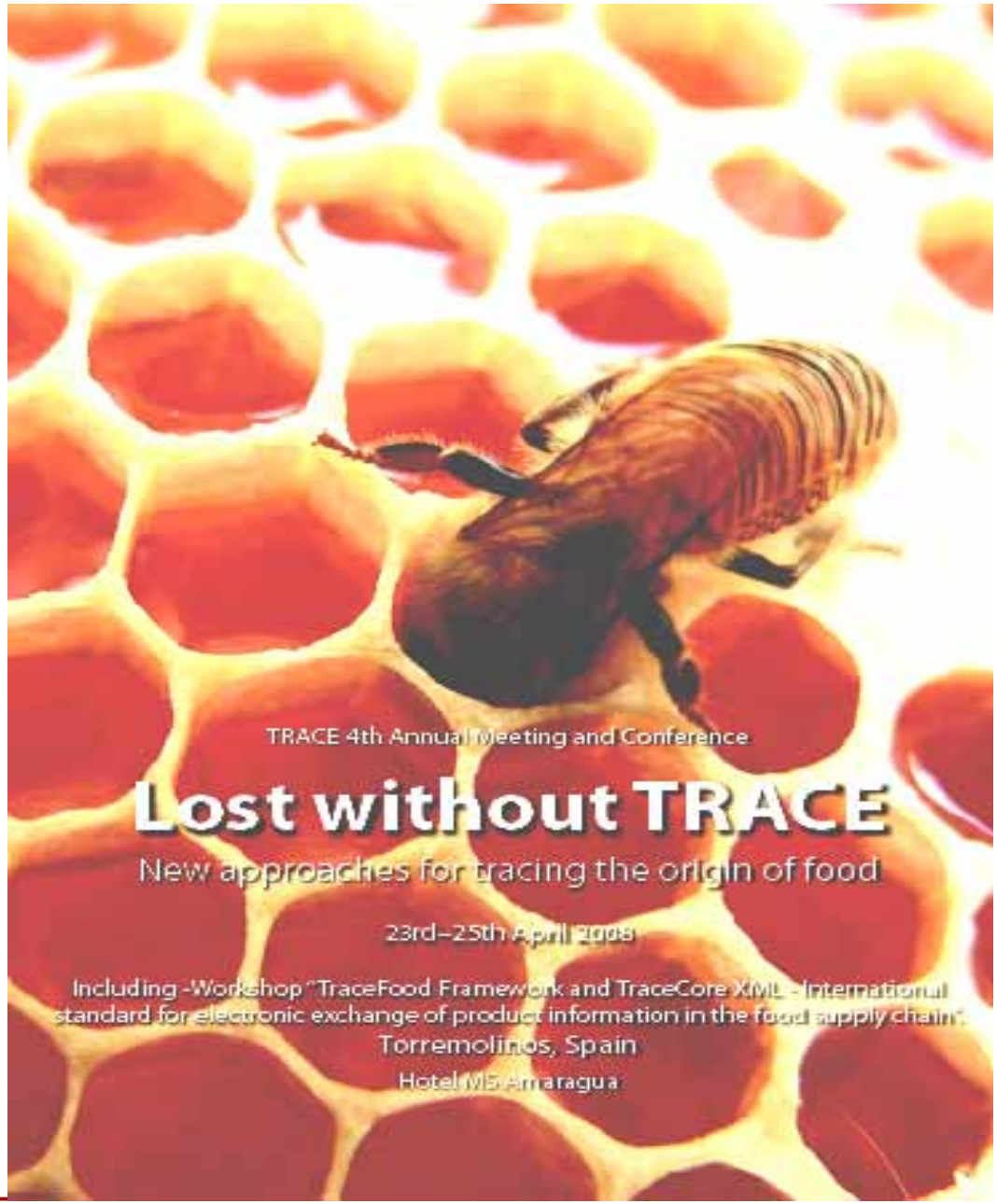
for tracing the origin of

food

23-25 April 2008

Torremolinos, Spain

Register at:
www.trace.eu.org



And acknowledgements to the consortium….: