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Age Verification of 10-yr and 20-yr Matured Port Wines using Radiocarbon

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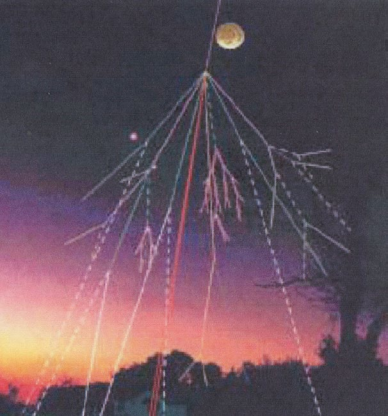
- Contents:**
- ^{14}C (Radiocarbon) and food
 - Fortified wines, such as Port wine
 - Harvest year determination using ^{14}C and the 'bomb peak'
 - Results for 10 and 20 years old port wines
 - Conclusions and outlook



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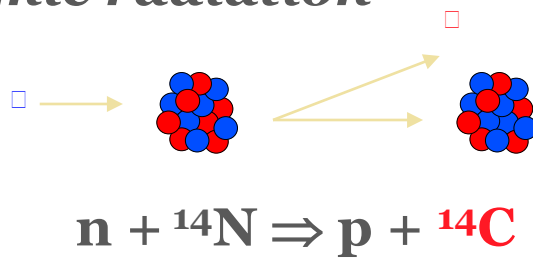
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cosmic radiation

¹⁴C ('radiocarbon')



*natural nuclear reaction
in the atmosphere*

¹² CO ₂	¹³ CO ₂	¹⁴ C CO ₂	Carbon isotopes
99%	10 ⁻²	10 ⁻¹²	
stable	stable	radioactive	

¹⁴C production
atmosphere

photosynthesis

*equilibrium
biosphere*



foodchain



But: synthetic products do not contain any ¹⁴C !

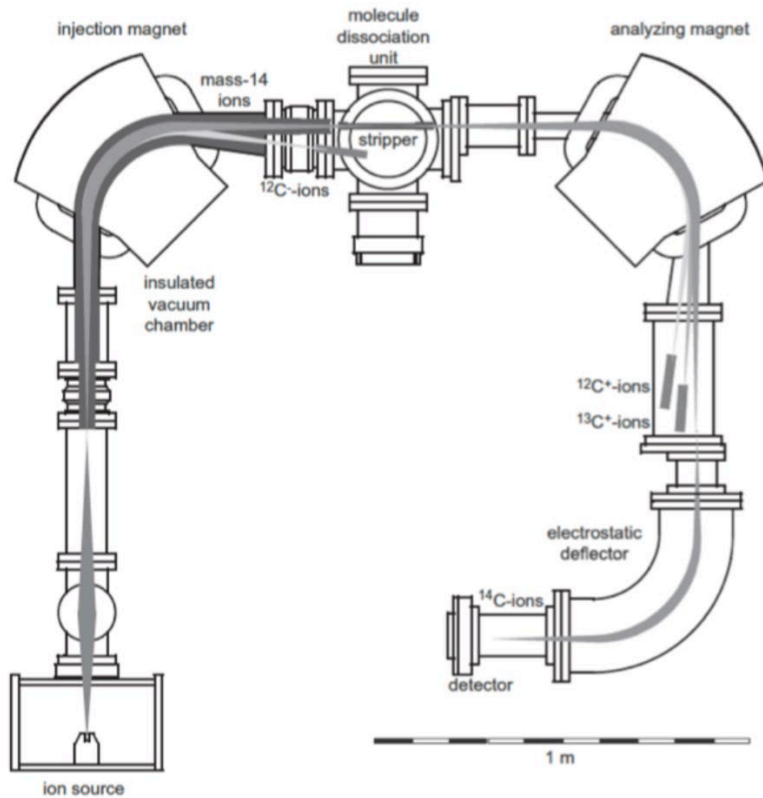


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Very low abundances: Accelerator Mass Spectrometer (AMS) needed



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Port Wine



Cherished and well-protected product

Several quality classes, such as the “10 years” and “20 years” matured tawny port wines



However: Dutch research journalists* found prices for some brands of these 10 and 20 years old port wines suspiciously low: is their age real??

Question to us: is it possible to check this using ^{14}C ?

**Eelco van Wieringen and Twan Kroon, bureau publieke werken*



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Typical fortified wine production (Sherry, Port, Madeira..)

1. Harvest the grapes
2. Start wine making process as for normal wine
3. When alcohol levels have reached $\approx 6\%$, stop the fermentation process by adding pure ethanol (from wine!) up to 20%
4. Let the mixture mature for NN years
5. Add a bit of ethanol to compensate for evaporation over the years
6. Bottle and offer for sale as NN years fortified wine



It is also allowed to mix different batches, as long as the average age is indeed NN (or longer)



Check on “NN” by using ^{14}C for determination of the harvest year

The ethanol fraction is a bit complicated, as there are 2 (3) components
The remaining sugars, however, are from the initial grapes!



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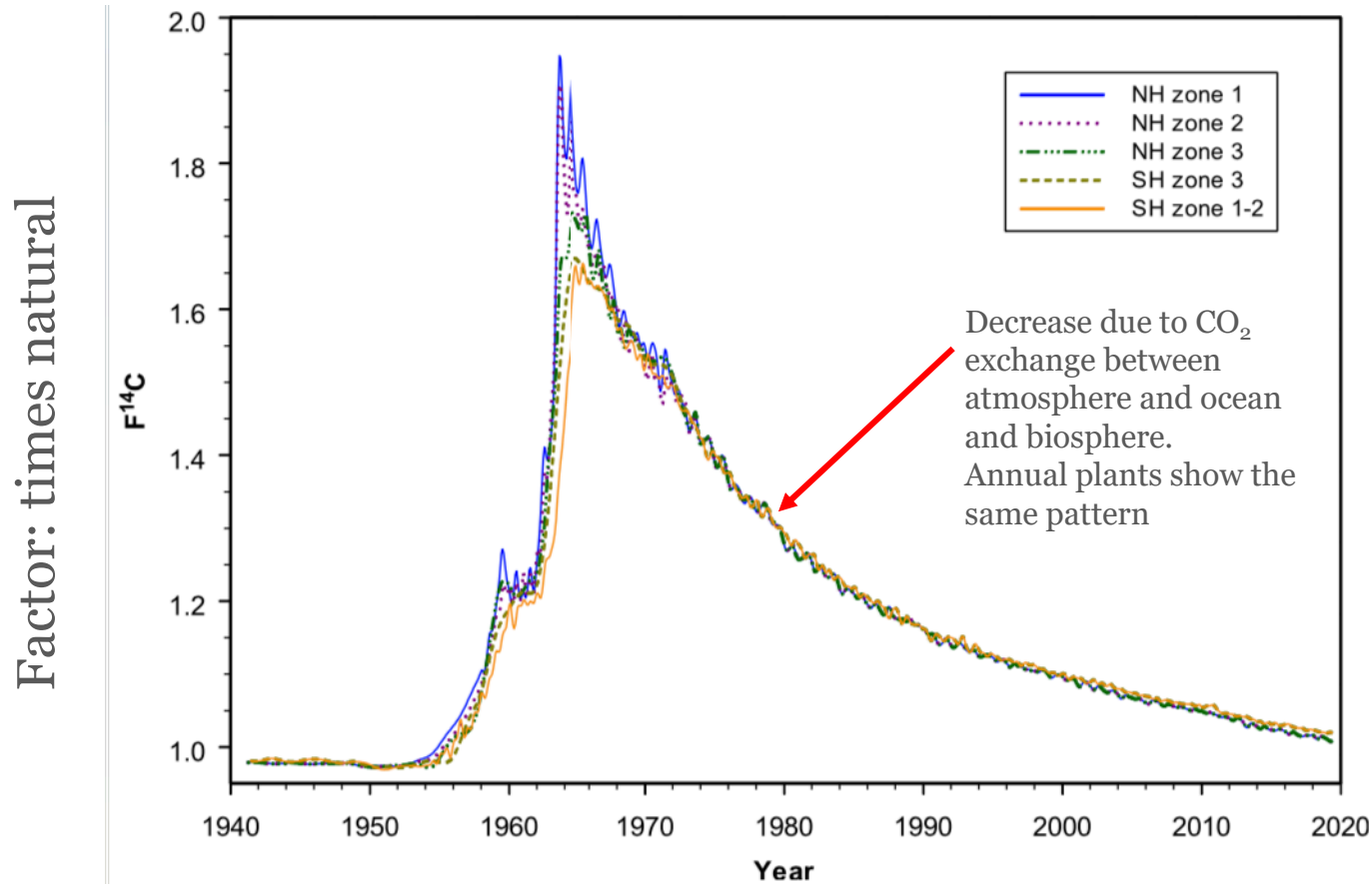
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Harvest year determination: the ‘bomb peak’

Above-ground nuclear explosions cause extra production of ^{14}C

After 1963: “ban treaty”

Bomb peak disappears through CO_2 exchange with (mostly) the ocean

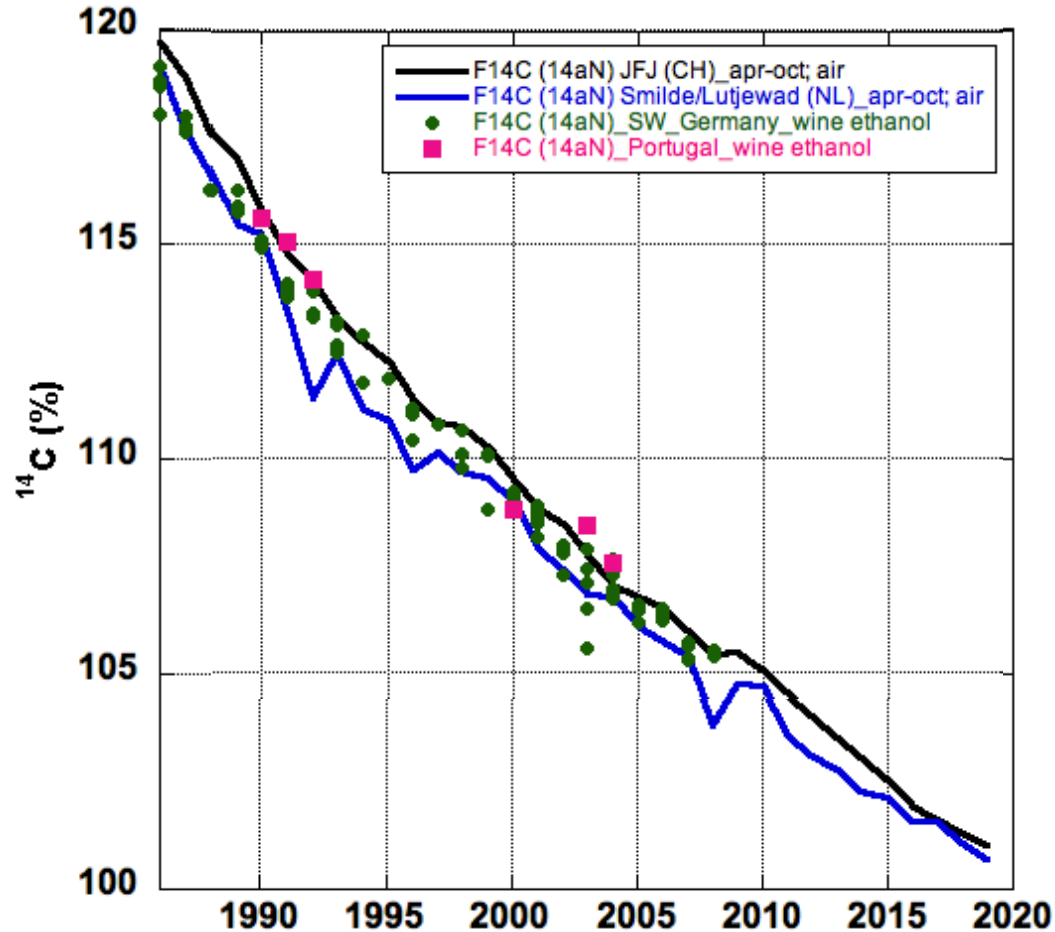


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Like all plants, also grapes, and thus the wine ethanol and sugars, follow nicely



There is some regional and temporal variability -> has to be taken into account



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Our (pilot) study of Port wine age



- 20 bottles of different brand Port wines; 11x 10-yr and 9x 20-yr maturation age
- Measure ^{14}C of both the ethanol and sugar fractions
- Establish minimum and maximum expected ^{14}C values for both fractions, based on:
 - Regional variation of atmospheric $^{14}\text{CO}_2$: the “Reference” values
 - ^{14}C measurement uncertainty
 - For the ethanol fraction: variation in the mix of the 2 (3) compounds
- Validate the method with 4 Vintage Port wines



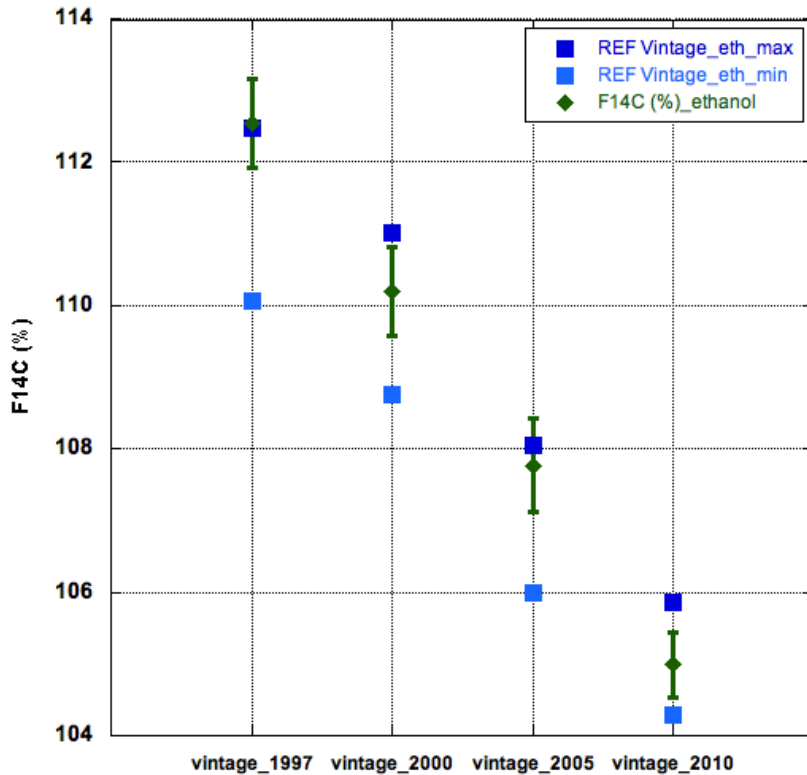
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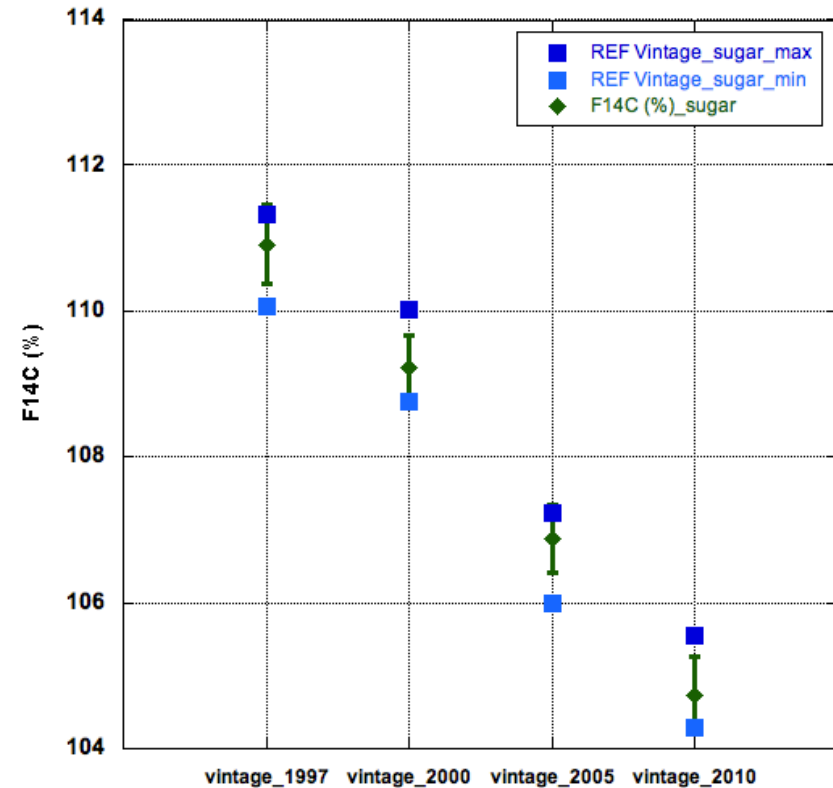
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Validation with Vintage Ports

Vintage_ethanol fraction



Vintage_sugar fraction

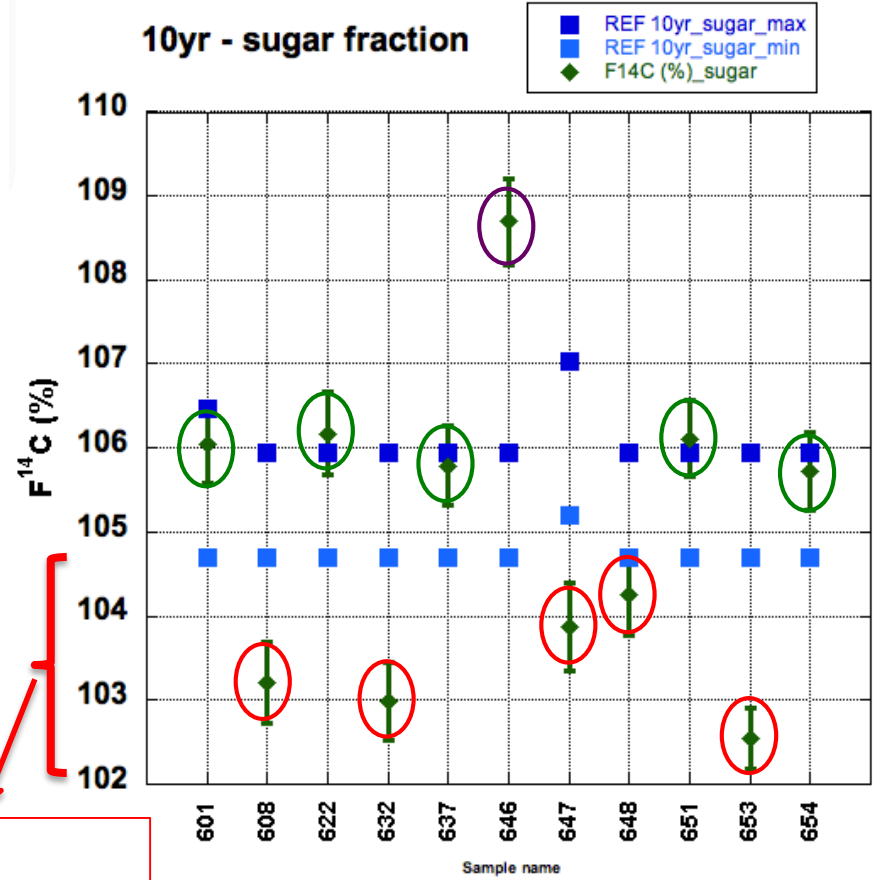
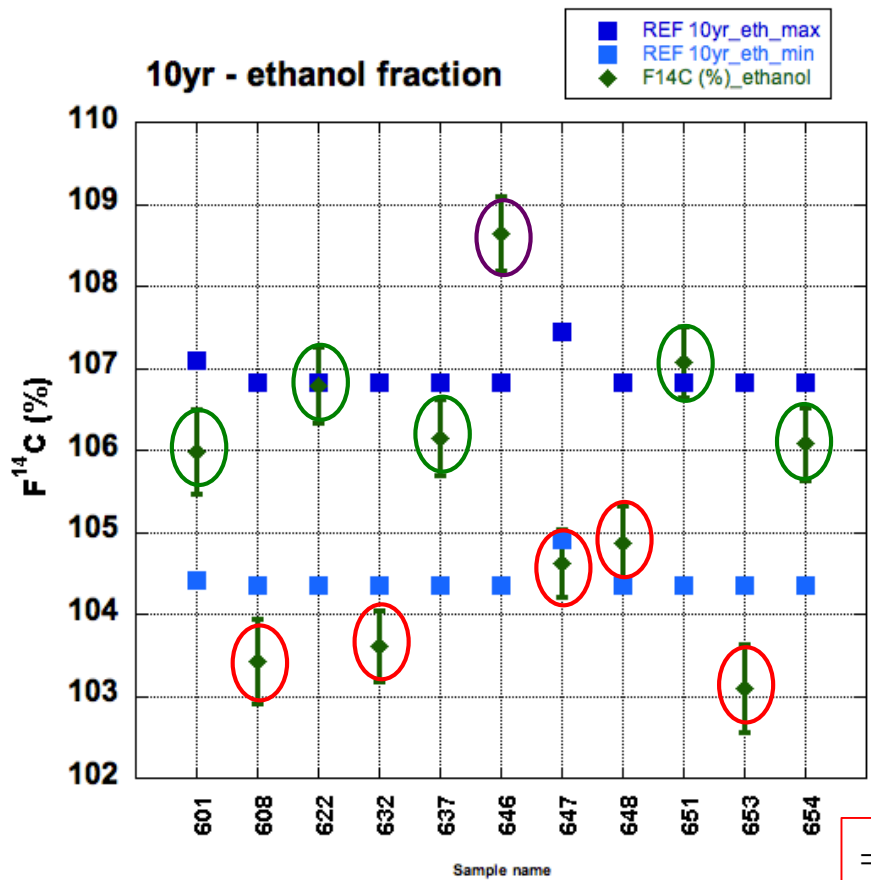


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Results - 10yr old Port wines



= too young!

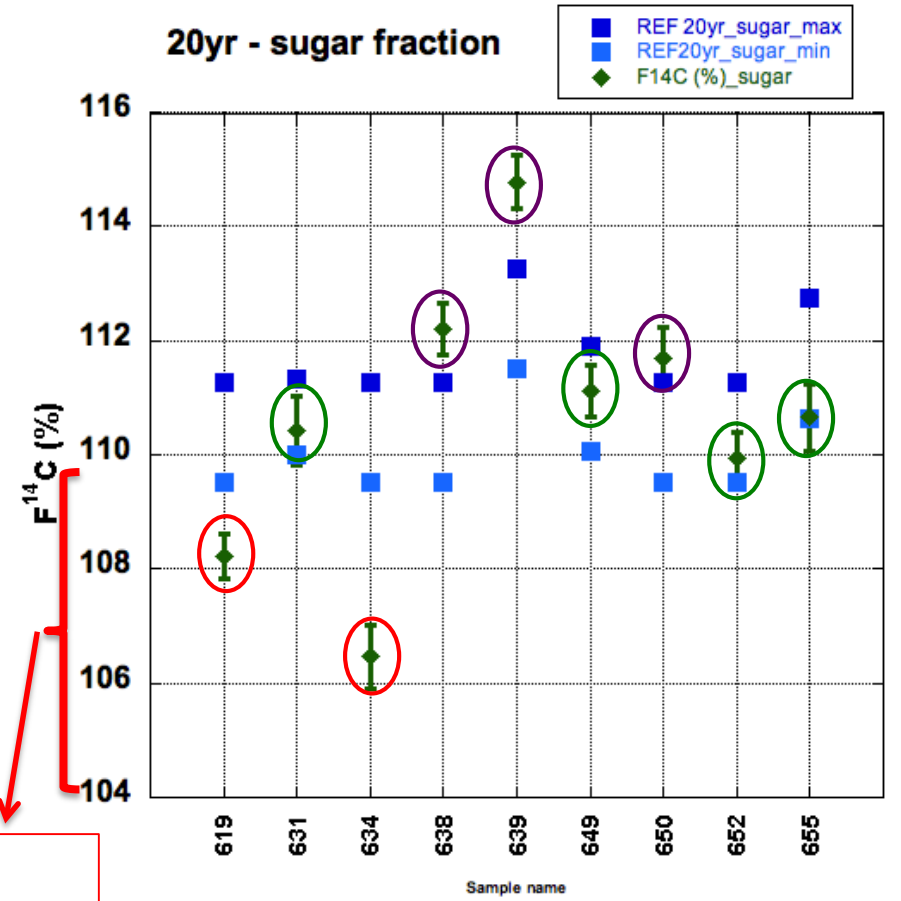
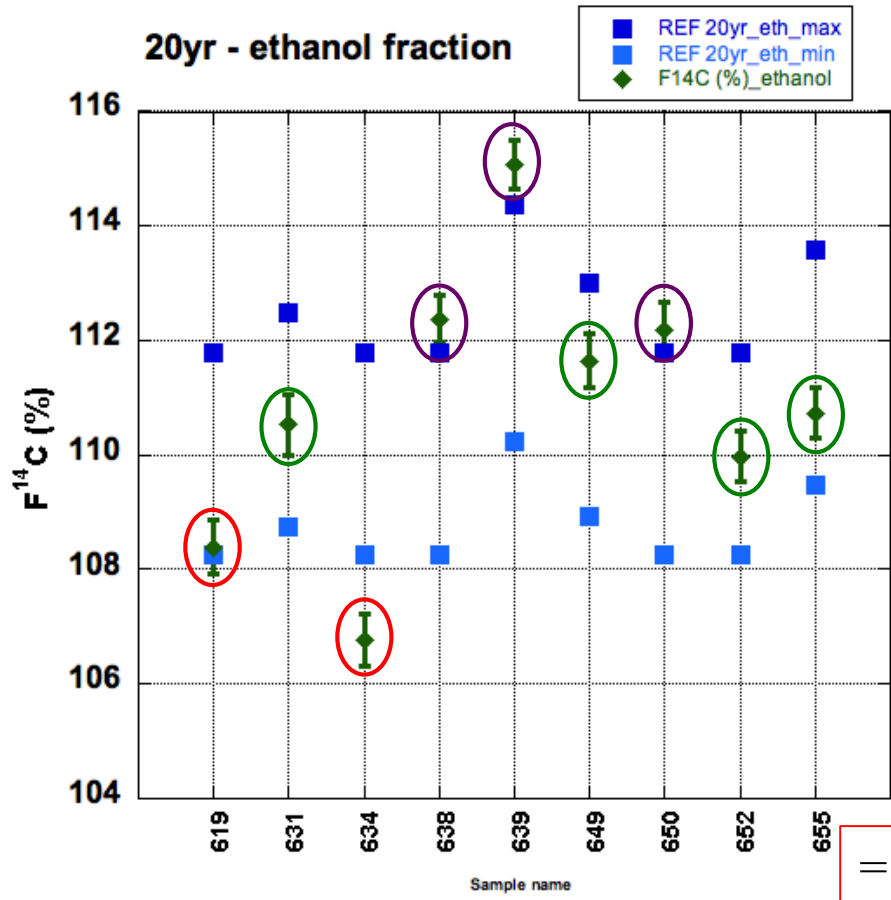


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Results - 20yr old Port wines



= too young!



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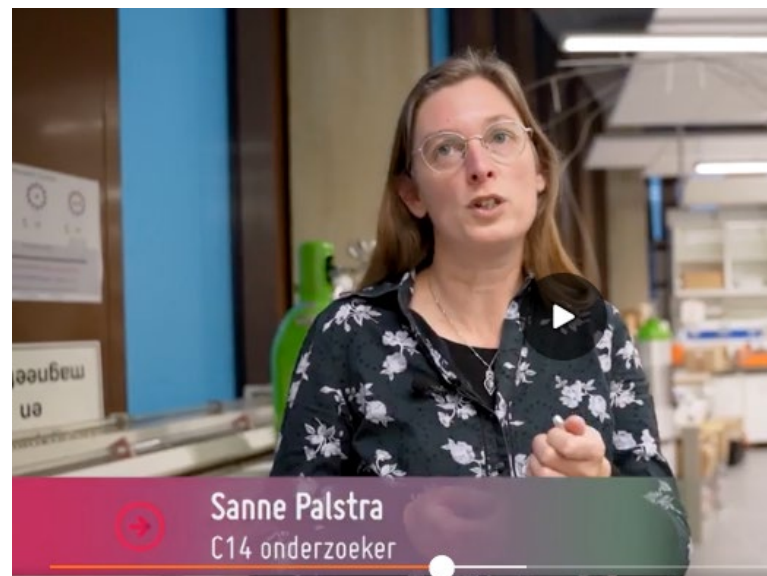
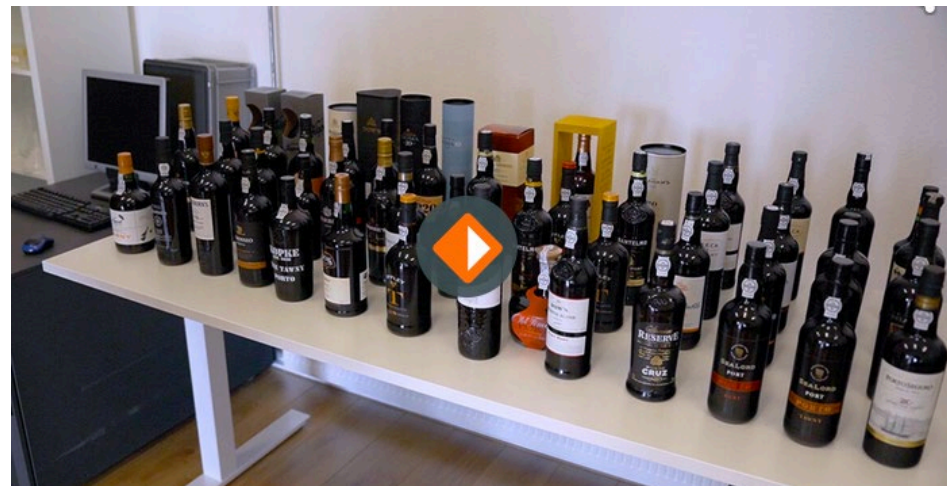
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➔ MELDPUNT



➔ Harro Meijer
hoogleraar fysica



➔ Sanne Palstra
C14 onderzoeker



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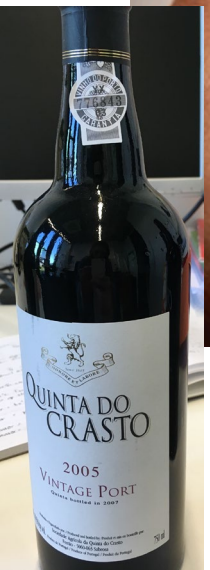
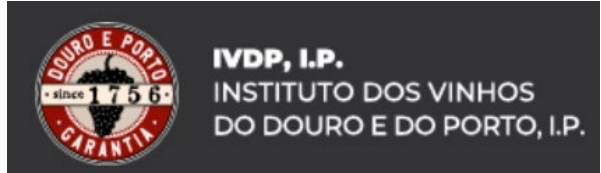
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Vinho do Porto Estudo de carbono-14 a 20 garrafas Tawny 10 anos e 20 anos revela que vinho tinha menos idade em metade dos casos

Comprar velho e beber novo

Port wine is one of the national treasures of Portugal
Vigourously defended by the IVDP



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Conclusions and outlook

Thanks to the 'bomb peak', ^{14}C is well-useable for harvest year determinations

Maturation age verification of port wines is well possible

Science works different from Commerce

Research journalists also have their own agenda, but...

...without them this possible fraud would not have been brought to light

IVDP is interested in the method, collaboration at hand



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Thank you for your attention!