



IOC
Révélons votre différence



Bubbles, Foam and Gushing ...the ‘shameful disease’

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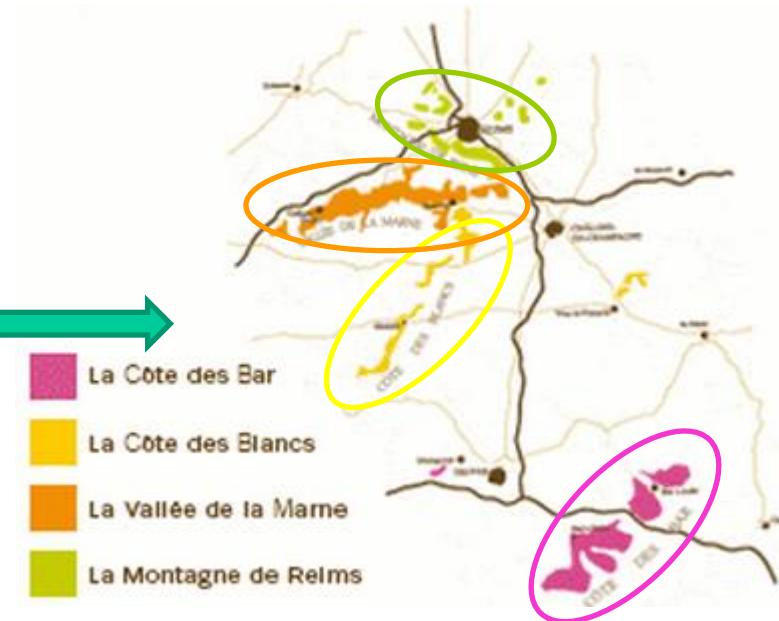
*Ontario Sparkling Wine Symposium
Brock University / 6 may 2014*



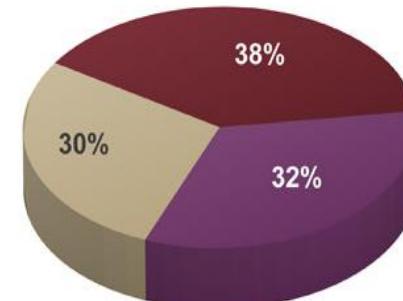
Champagne!

A few words on the Champagne area





■ Les cépages Champenois



Pinot noir



Meunier



Chardonnay

after Comité Champagne

HARVEST (2013)

349 000 000

349 millions de bouteilles

Rendement = 12 008 kg/hectare

4 630
vignerons expéditeurs

43
coopératives qui commercialisent

360
maisons



after Comité Champagne

Turnover (2013):

- 4.4B€
- 2.3B€ exportation

How can we explain the Champagne success ?



Why bubbles and foam must be
important for us?

Little academic exercice:

- same engine,
- same security level,
- same options...



Appearance is of first importance!

What car do you prefer?...



Why bubbles & foam are important for the enologist...

« ...l'information traitée la plus rapidement par le cerveau et qui parvient en premier à la conscience est l'information visuelle. ... Lorsque les autres représentations sensorielles, fournies par la langue, le toucher ou l'ouïe parviennent à la conscience, elles confirment ou contredisent les attentes induites par l'information visuelle. » after Mc Léod.

Bubbles & foam ... high marketing values

war
been
the
shed

new
ottle
is.

77 CHAMPAGNE

Price dive in bubbly war

Drinks International, said: "There was an awful lot of over-optimism at that time. "But many brands – even the well-known ones – didn't do as well as they thought they would. "That is why you are seeing such

half the normal price of \$13.99. Own-brand Blane de Noir is on sale at \$11.99. But Asda customers can snap up Mumm Cordon Rouge – normally \$12.49 – for just \$7 until June 24.

Corking

POUR EN SAVOIR PLUS

Comment vous faire mousser

Vos adorables hôtesses et vos guides plus que compétents ayant parfois tendance à prétendre

se contentent de vider des petites bouteilles dans les grandes.

■ Diane Lac mancione

FIZZICAL THERAPY

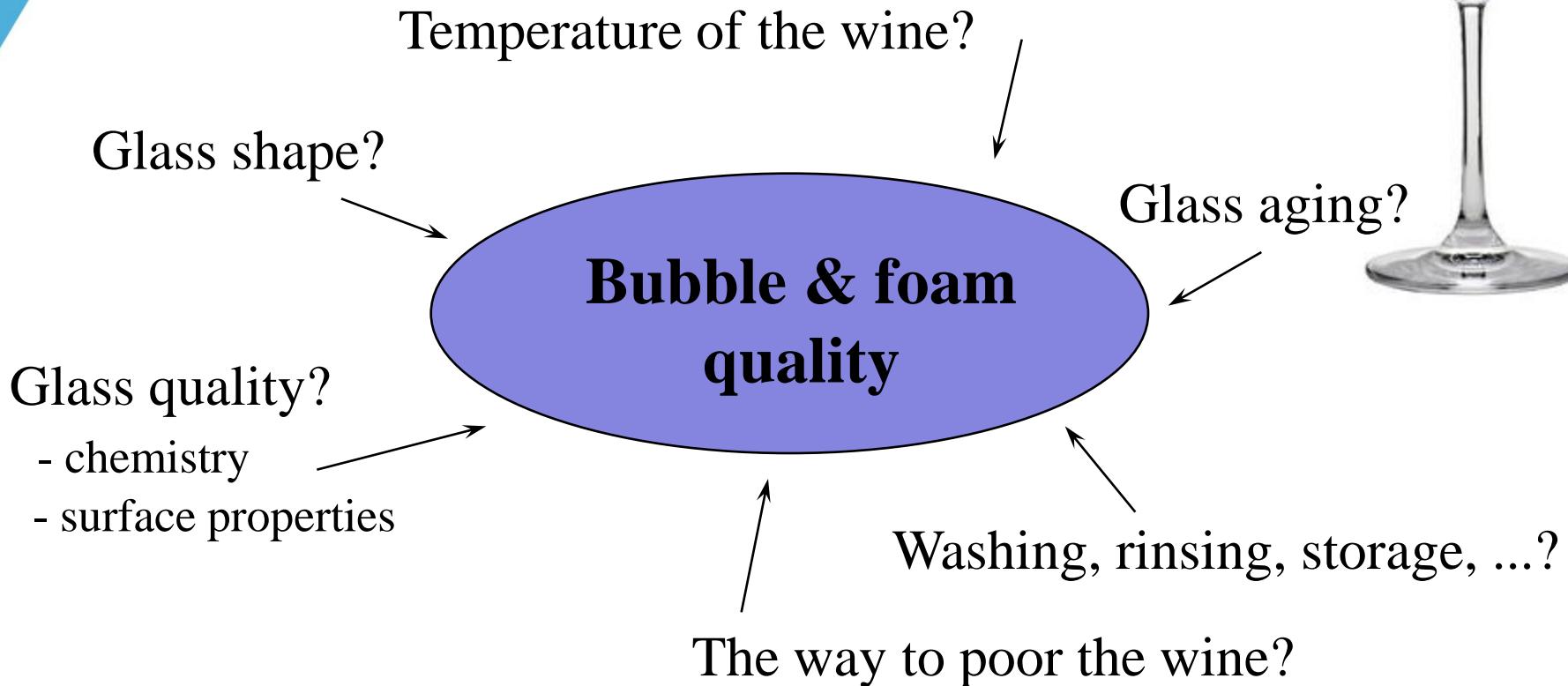
With the battle of the discounts on sparkling wines continuing in stores, only "aspirational" Champagne and value-for-money cavas are holding on to their market share. As Giles Fallowfield reports, in the middle ground it is mainly the brands which are likely to survive

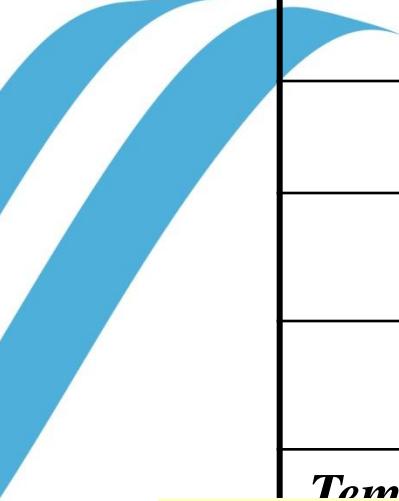


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How to protect bubbles and foam quality?





Parameters	Impacts
<i>Glass shape</i>	+/-
<i>Glass chemistry</i>	0
<i>Liquid pouring</i>	> ou <
<i>Temperature (wine/glass)</i>	< 0



'Bubbles & foam ... fragile objects.' P-G de Gennes



<i>Glass age</i>	?
<i>Glass story</i>	
<i>washing</i>	0 si bon rinçage
<i>(liquid of...) Rinsing</i>	$\ll 0$
<i>drying</i>	dispersion
<i>Storage</i>	< 0



Bubbles & foam ... not so simple to understand...

By principle: to have foam you need bubbles...



A lot of bubbles ...
and no foam...



A lot of foam...
and no bubbles...

Bubbles & foam ... not so simple to understand...



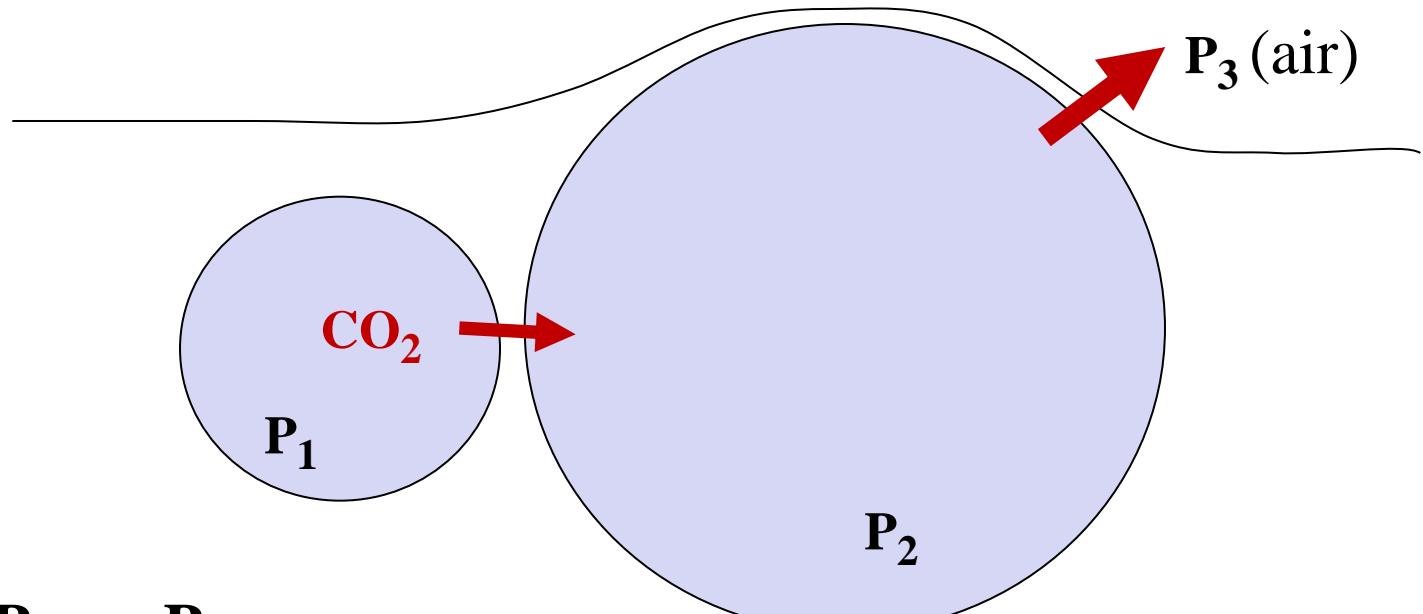
Parameters	Beer	Sparkling wine	Impact on foam
Ethanol (% Vol)	5	13	5 % is a good content for foam stabilisation
CO ₂ amount (g/L)	3	10	The quantity of gas governs the foam formation
Protein conc. (eq. mg/L BSA)	0,5	0,05	The quantity of protein governs the foam stability
Polysac. (g/L)	> 5	0,1	The quantity of polysac. helps to stabilise the foam

Figures are indicating values

Why the sparkling wine collar is so unstable?

3 mechanisms explain the rapid bubble collapse at the wine surface:

1 - disproportionation (Ostwald ripening)

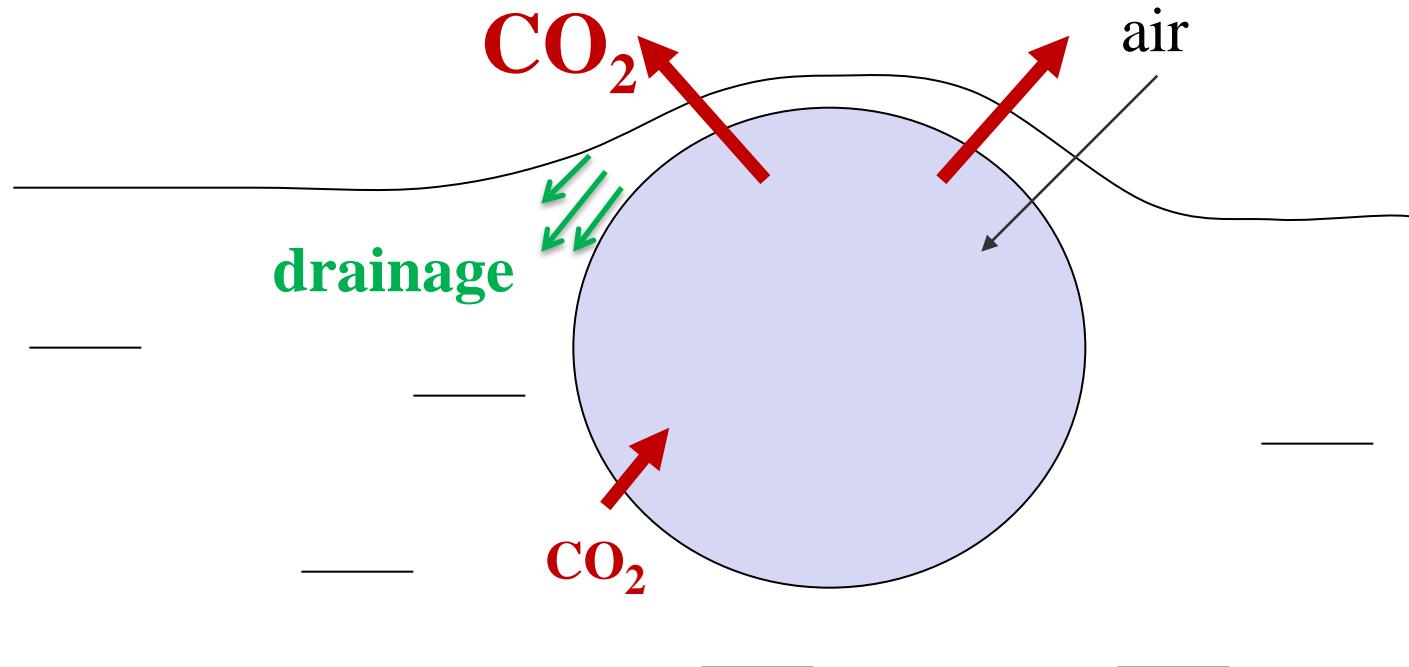


$$P_1 > P_2 \gg P_3$$

Why the sparkling wine collar is so unstable?

3 mechanisms explain the rapid bubble collapse at the wine surface:

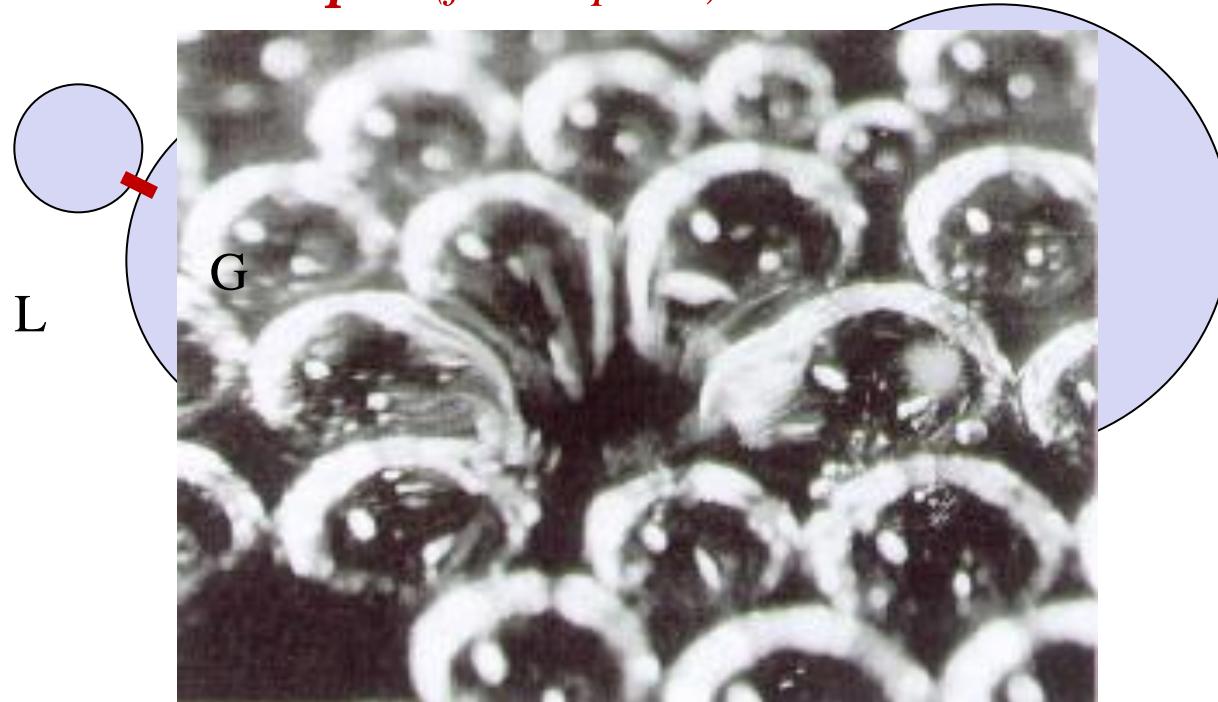
2 - drainage



Why the sparkling wine collar is so unstable?

3 mechanisms explain the rapid bubble collapse at the wine surface:

3 - collapse (*film rupture*)



G. Liger-Belair, B. Robillard, M.
Vignes-Adler et P. Jeandet.

CR Acad. Sci. Paris, 2001.



**Bubbles & foam: we begin to understand
the foam stability of sparkling wines...
... more or less ...**



But things are not all rosy with bubbles ...

Gushing ...

Definition:

Gushing can be considered as a disequilibrium between foam formation and foam collapse.

2 extreme cases:

1/ Foam formation is relatively low but if this foam is very stable, this last one will be pushed out of the bottle due to the bubble formation (in this present case, gushing intensity is relatively low).

2/ At the opposite, foam stability is low, but bubbles formation is intense: in this case, the liquid can be directly ejected out of the bottle. (gushing intensity is high)

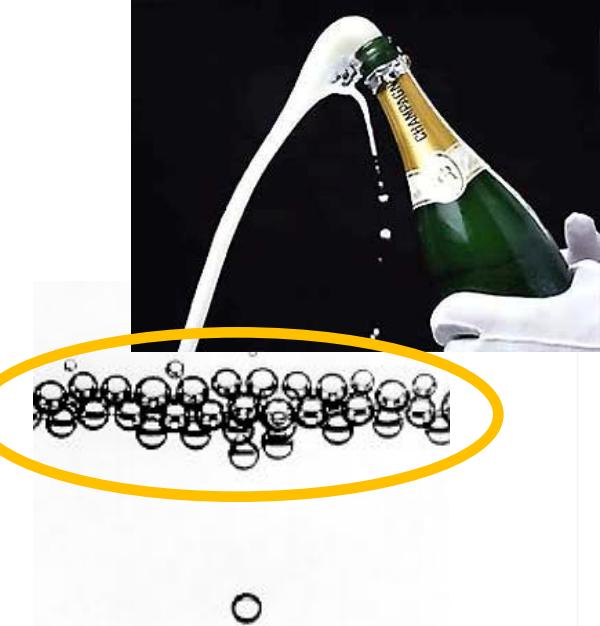
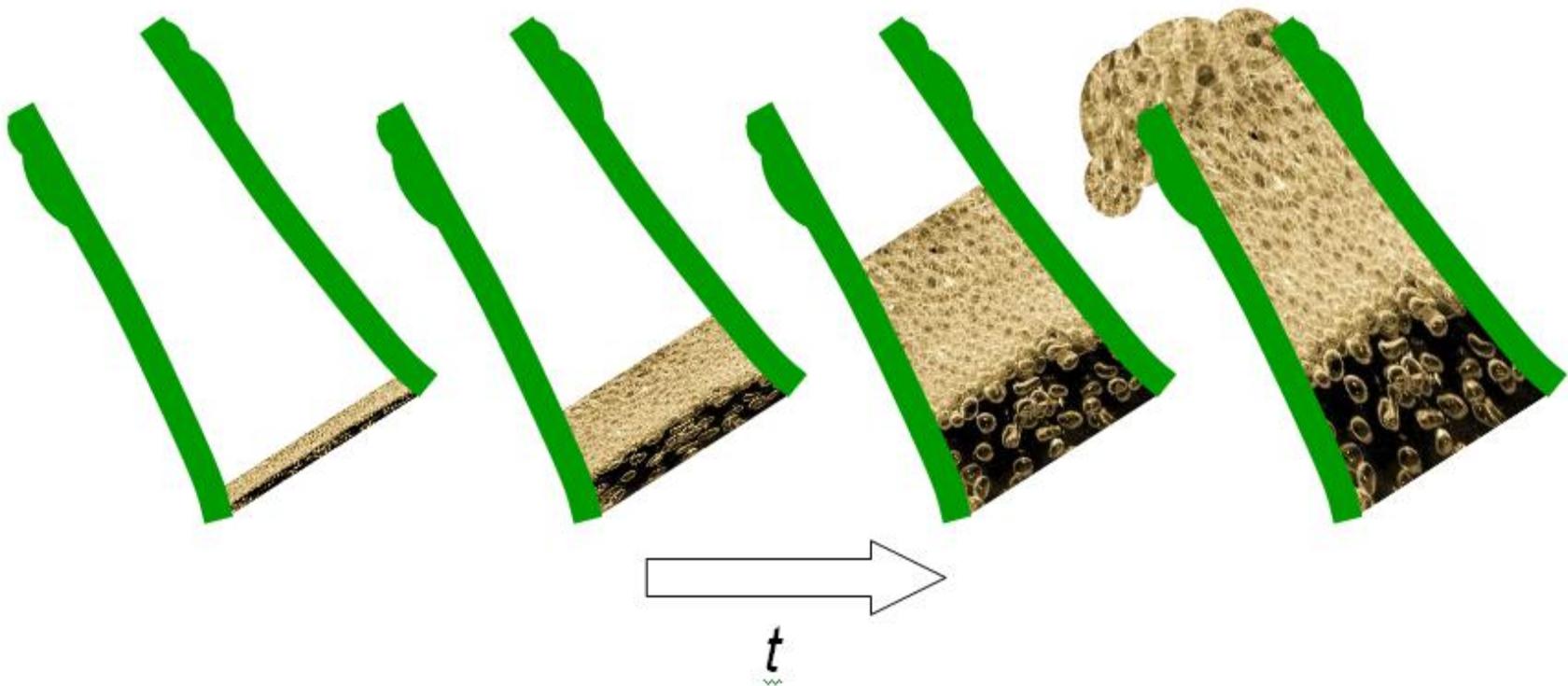


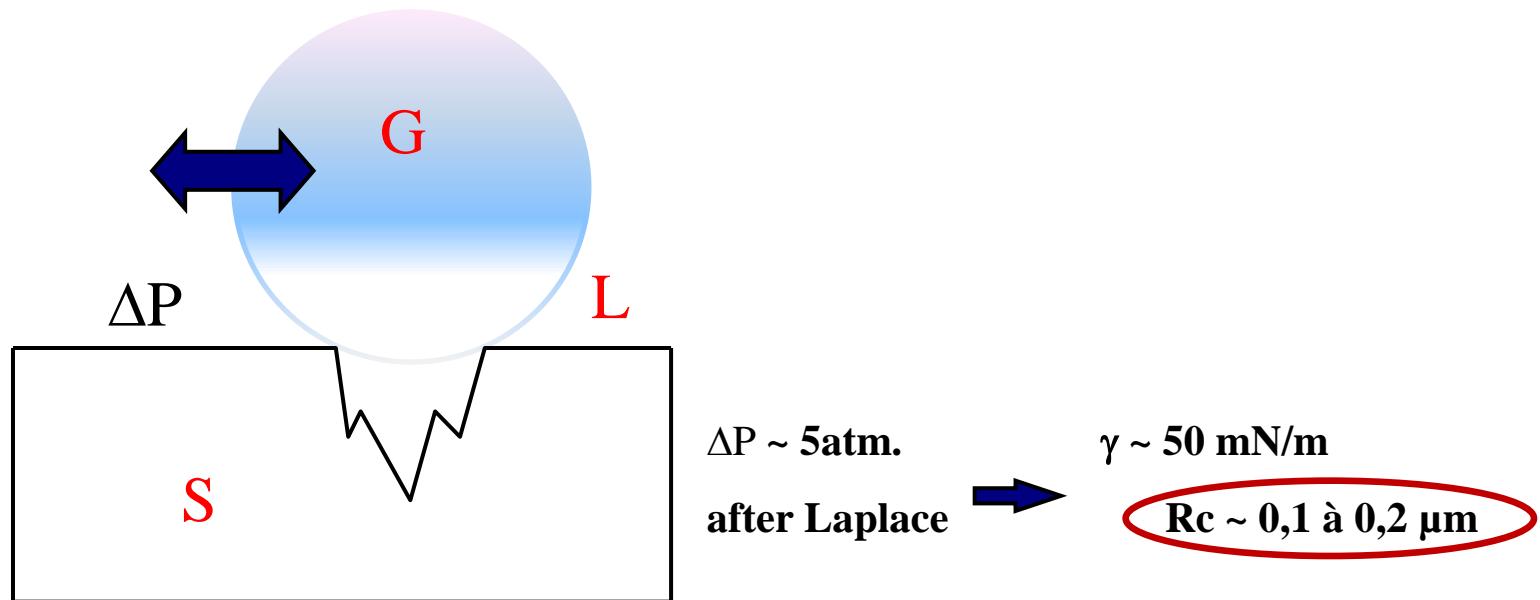
Photo : G. Liger-Belair

Case 1/ : high foam stability



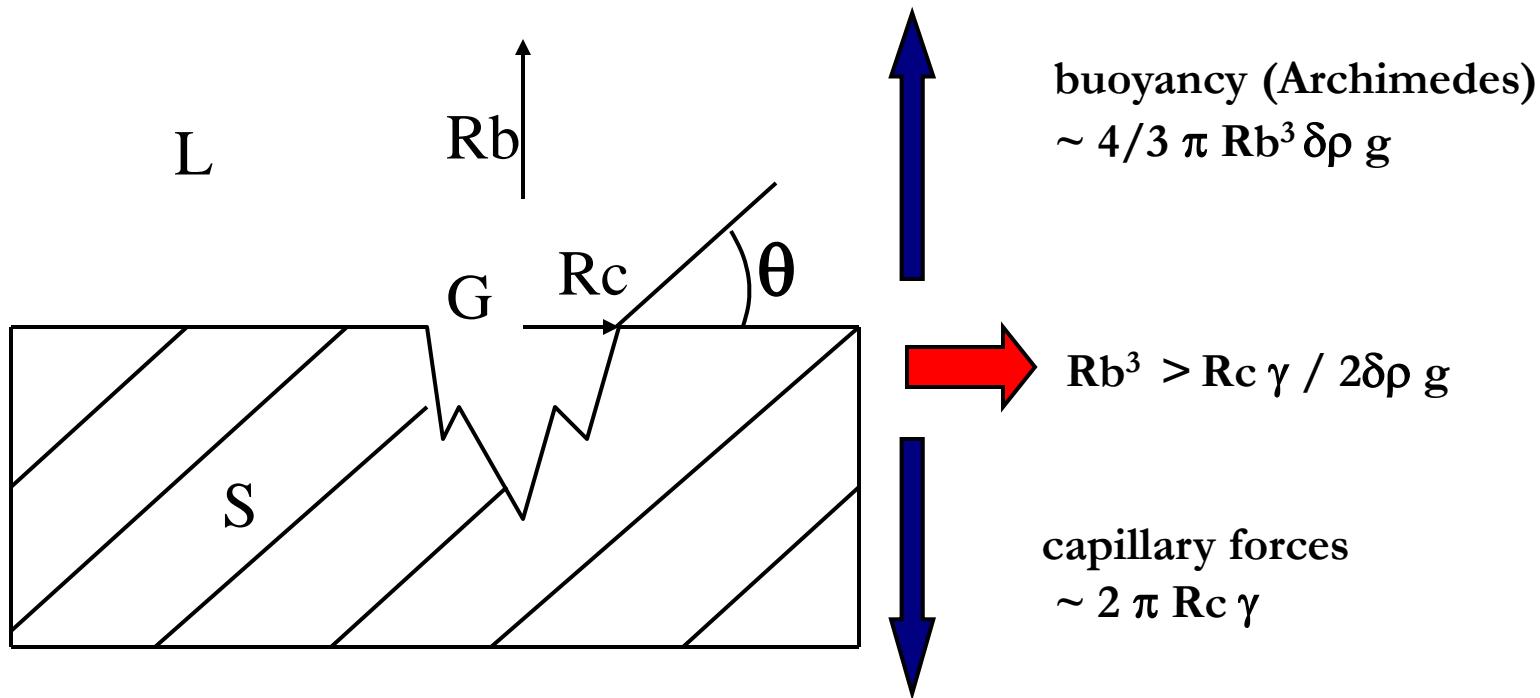
after G. Liger-Belair et al., 2013

Minimum radius for an existing bubble:

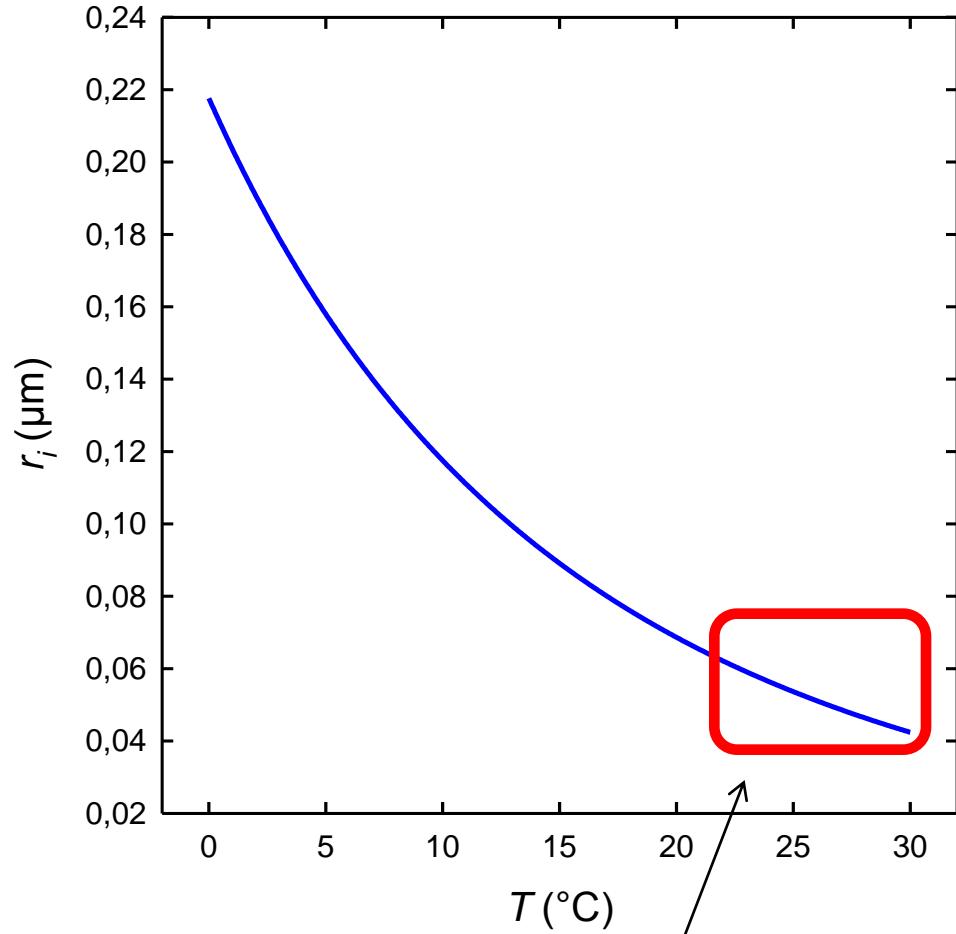


In a sparkling wine bottle more than thousand particles able to create bubble exist... nevertheless, gushing is a problem concerning 10 ... 20 nucleation sites.

Bubbles are detached when gravity forces > capillary forces

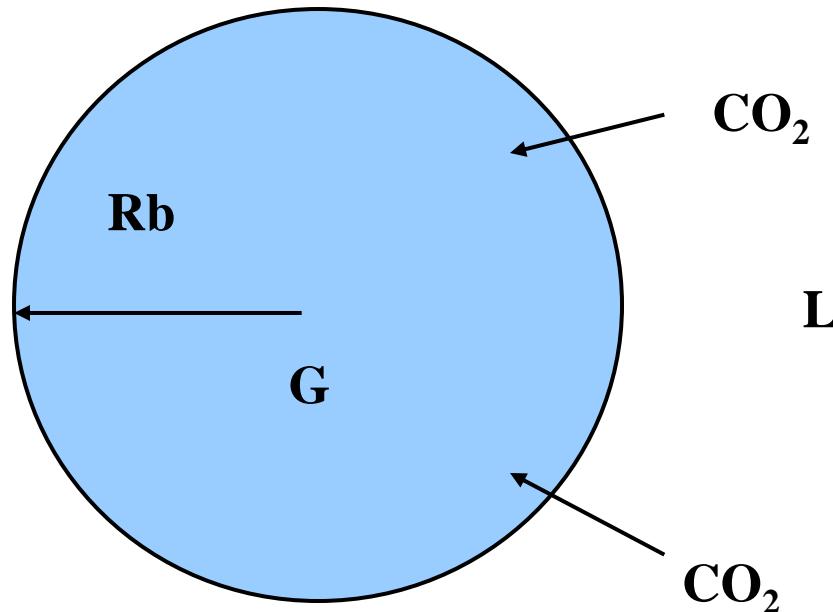


Bubble size able to grow up after bottle opening is highly dependent of the wine temperature.



Increase of the probability to create bubbles

bubble growth kinetics are governed by the CO₂ content

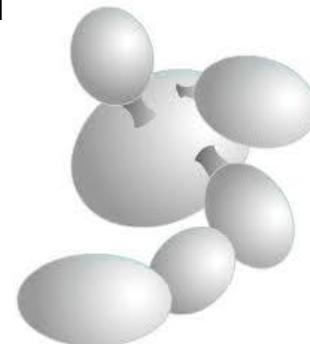
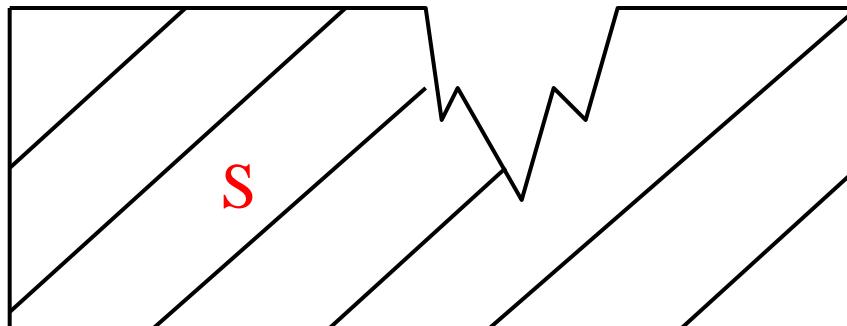


$$dR_b/dt = k \cdot \Delta P$$

with $\Delta P = P_{iCO_2 l} - P_{iCO_2 g}$

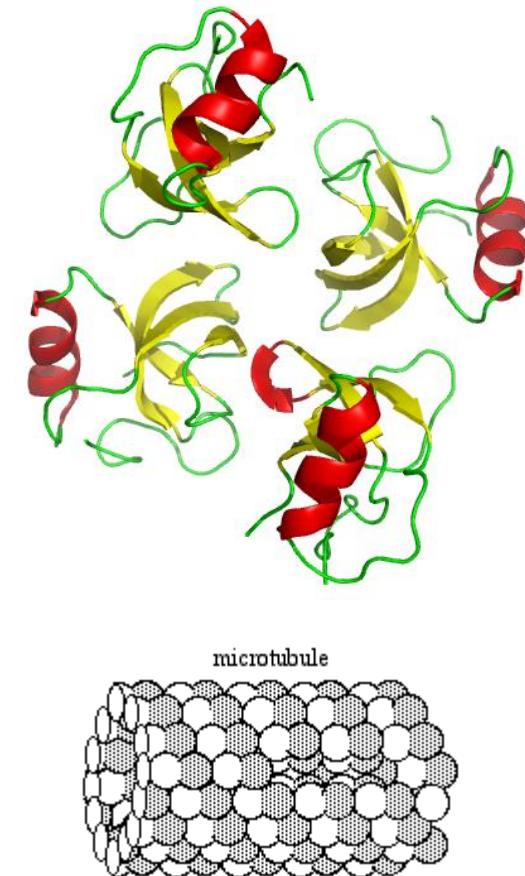
- *During disgorging step, CO₂ is released from 0,5 to 1,5g/L de (initially close to 11,5g/L if ‘tirage’ at 24g/L). This explains why the risk of gushing is less at the ‘consumer step’ compare disgorging step.*
- *One solution adopted by some clients is to add ~ 20g/L of sugar for tirage)*

**Particles (mineral or organic) are always described to generate the gushing phenomena ...
However ...**

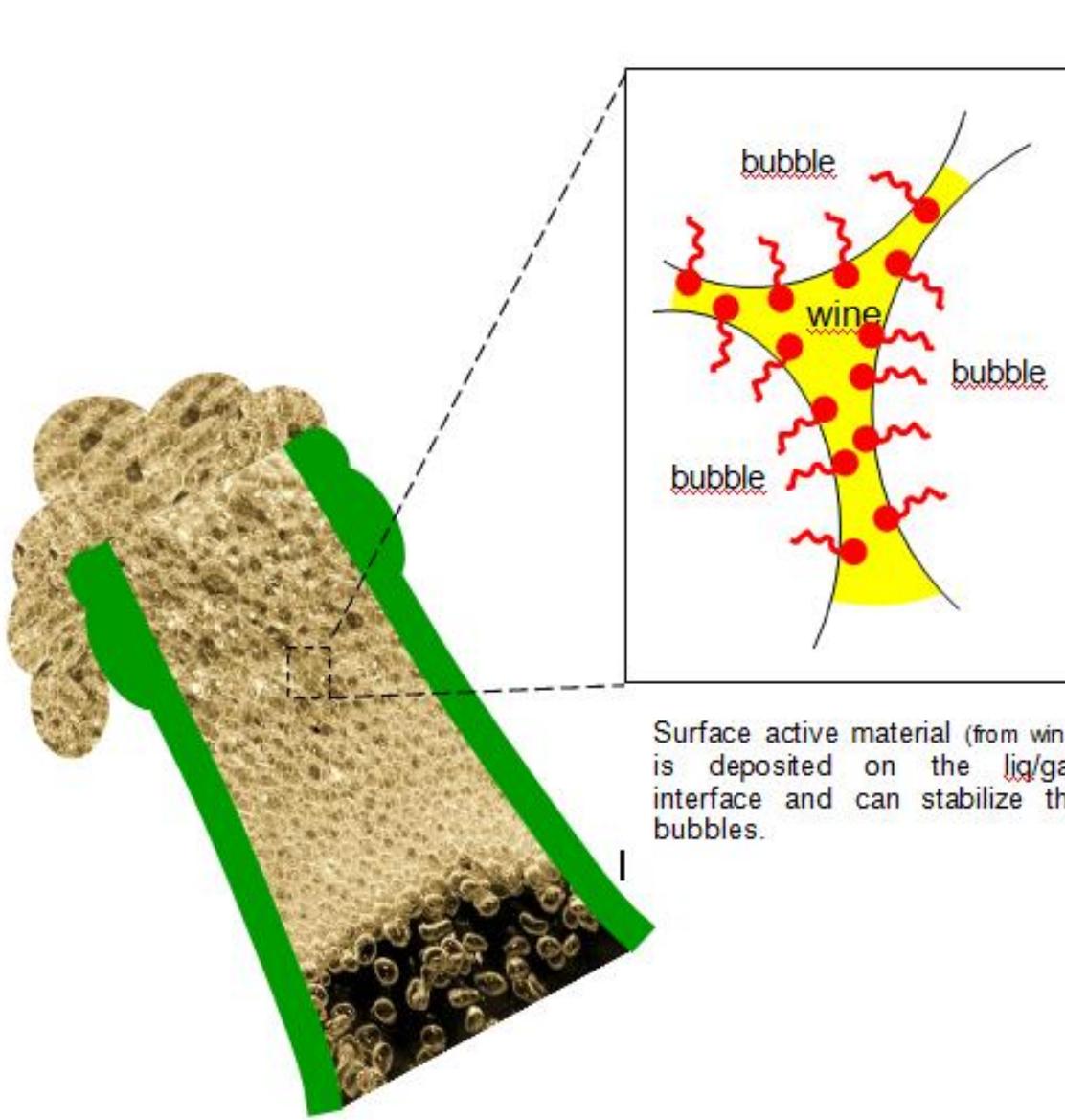


Hydrophobins ... (?)

- Hydrophobic proteins,
- ~ 300 AA residues,
- agglomeration => superstructure,
- very active to stabilize foam and create gushing (10 ppb scale!),
- origin: *asco-* (*Fusarium*, *Trichoderma* / beer) and *basidiomycetes*,
- in some cases, has been demonstrated to be at the gushing genesis of beer. (after S. Deckers *et al.*, JASBC, 2011, T. Sarlin, Ph D. thesis, 2012).
- *particles* (100nm) attached to the bubbles can be detected on gushing beers when contaminated with HB,

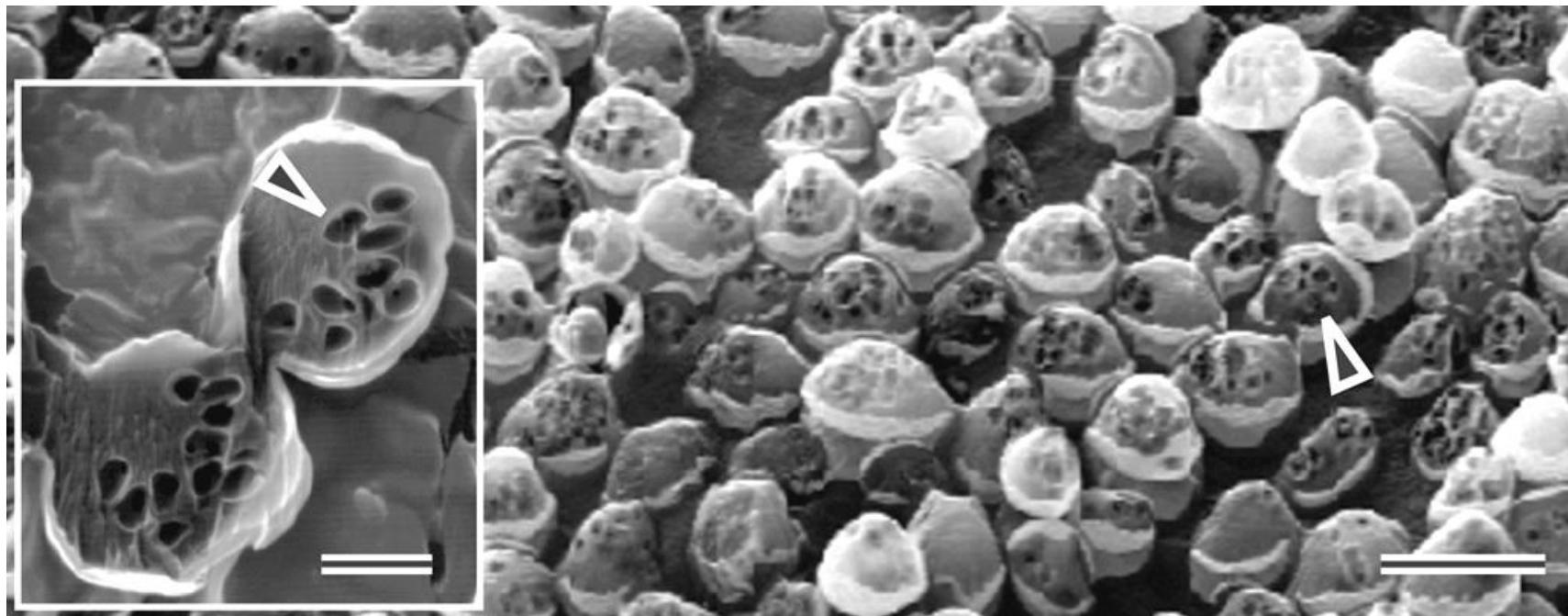


Can we suspect hydrophobins in sparkling wine ?.... (*ascomycetes are described in wine*)



Surface active material (from wine)
is deposited on the liq/gas
interface and can stabilize the
bubbles.

Where	Fq	Reason	Solution
Consumer	rare	Essentially particles (do not forget the cork) + mishandling: shocks, temperature too high,...	0 (except: sugar content at bottling stage is a good way)
In the cellars			
Disgorging step	high	Particles: tartaric stability, riddling problem, MLF in bottle (in fact biological contaminations in correlation with turbidity impact) Contaminants adsorbed on glass wall (?), Too high temperature before disgorging, ...	Diminish the temperature and line speed crowncap-top-hammer Upstream process to manage: tartaric stabil., filtration, Riddling program
Liquor addition (dosage)	medium	Particles from the liquor, (filtration but take care to stable bubbles...), temperature, high sanitary levels required for tubing, nozzle, ...	Efforts on microbiological / biological decontamination
Remploi	rare	Particles and temperature management	Filtration and cleaning



CO₂ bubbles inside yeast during AF.

after Swart *et al.*, 2012.

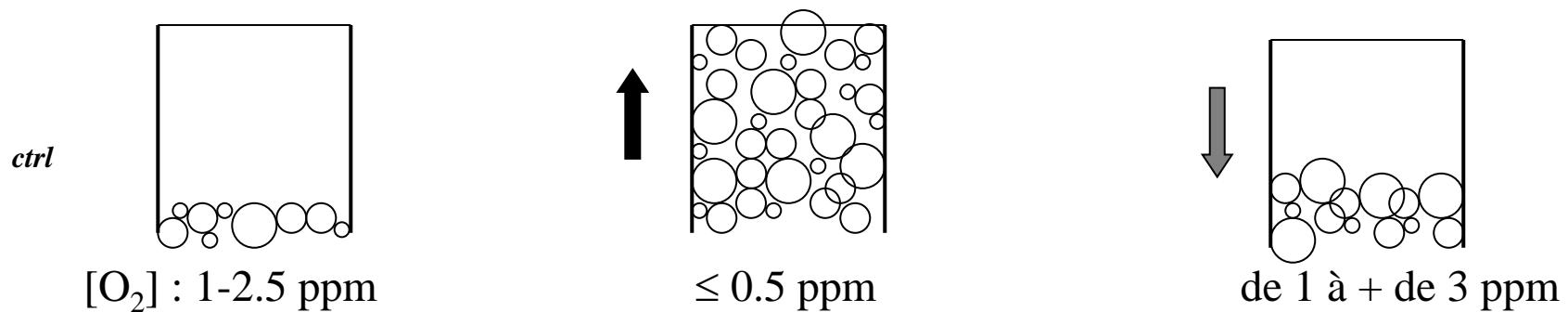
Gushing consequences:

On production sites:

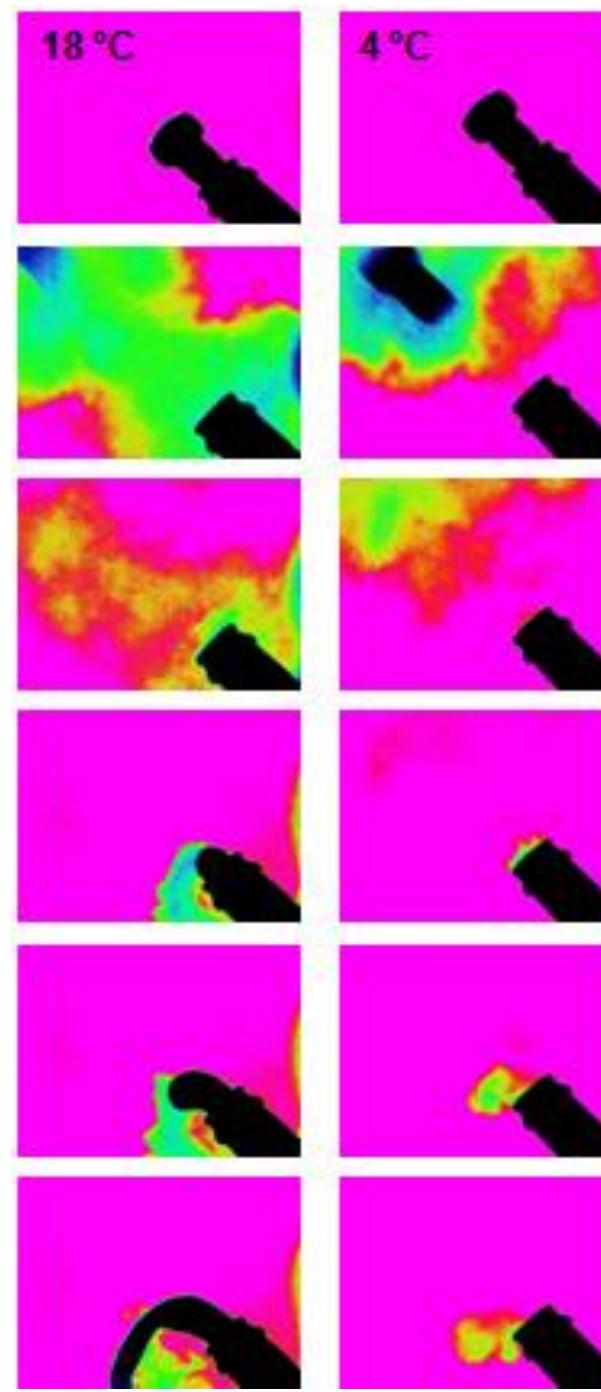
- Decrease of the productivity Impossibility to disgorgé!,
=> *First solution : decrease the temperature* (glycol pumps, mobile fridge, ...),

Quality impact (depending on the gushing moment):

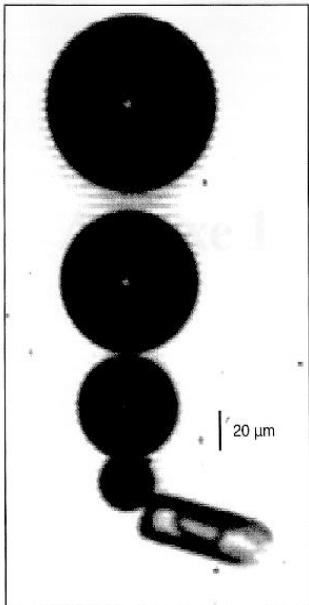
- Sugar heterogeneity (if gushing during/after dosage),
- CO₂ decrease (up to 10% less),
- O₂ heterogeneity (see scheme hereafter / foam in the bottle neck is the main factor impacting the O₂ intake).



after G. Liger-Belair et al., 2011

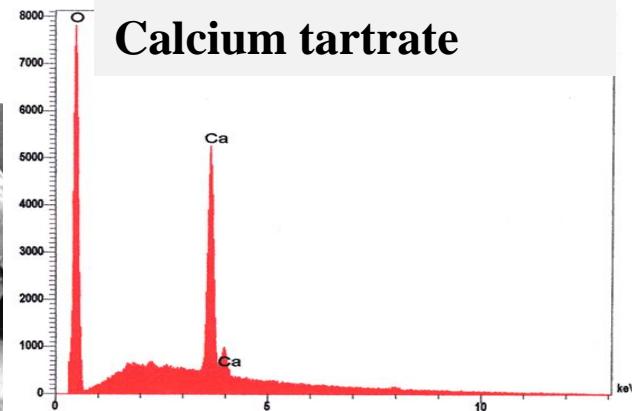
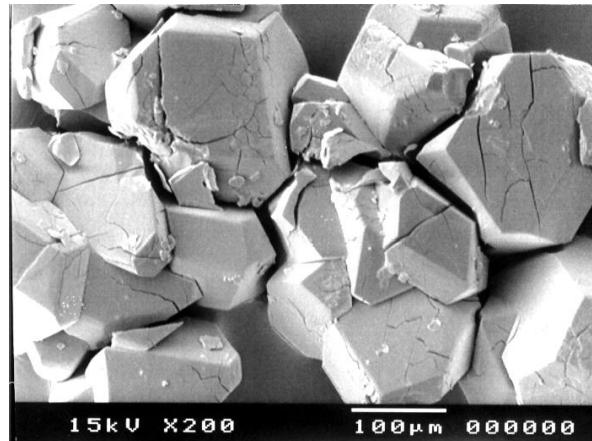


Cellulose fiber

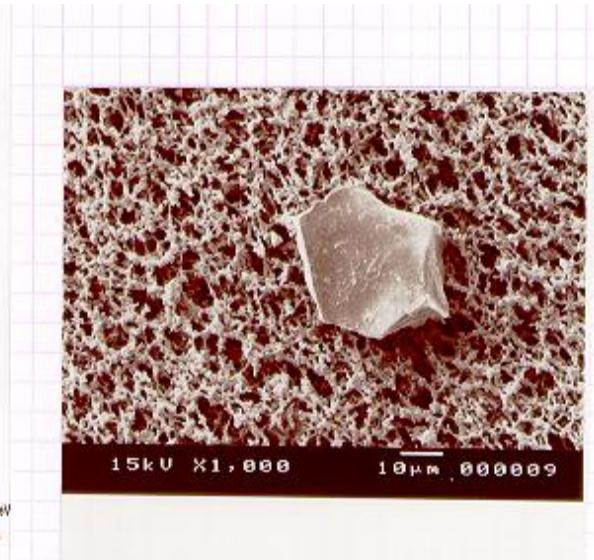
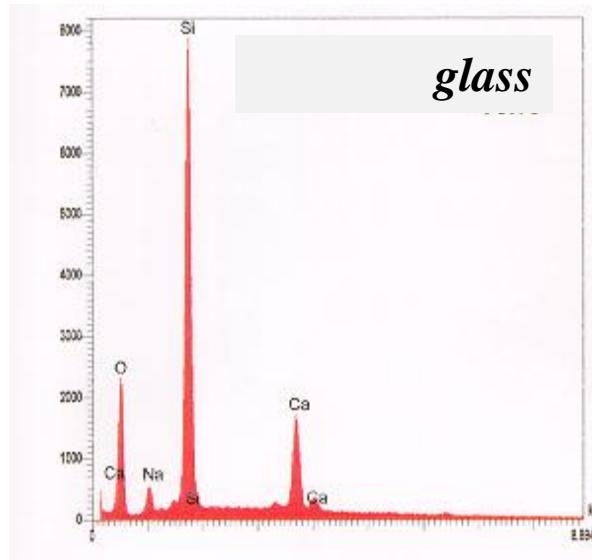


after G. Liger-Belair

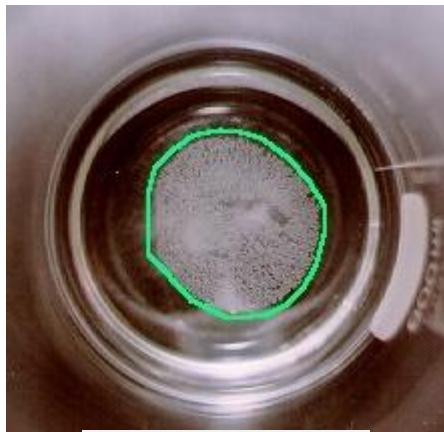
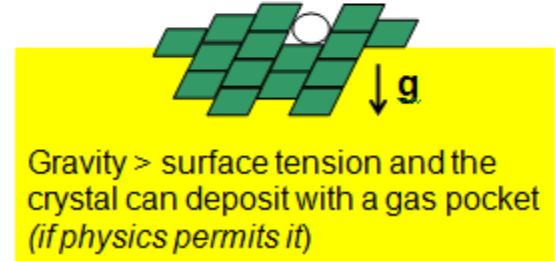
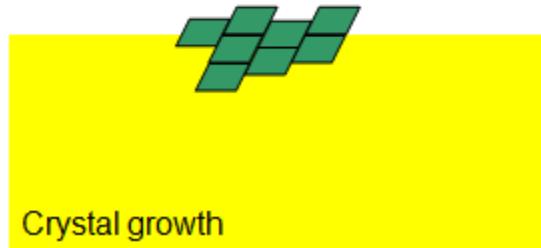
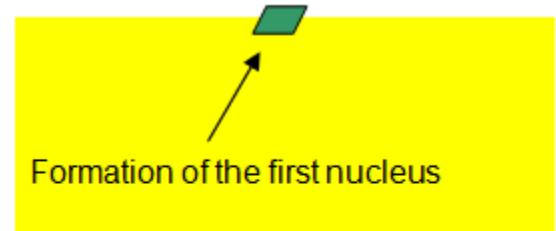
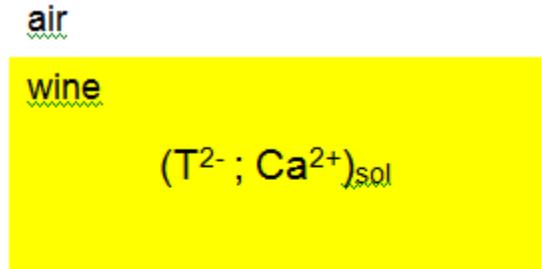
Figure 5: Fibre creuse enfermant une poche de gaz à l'origine d'un train de bulles dans une flûte à champagne (image caméra).



after IOC



Semi-hypothetical
gushing genesis with the
help of crystals...
No clear demonstration at
the moment ...



0% ethanol

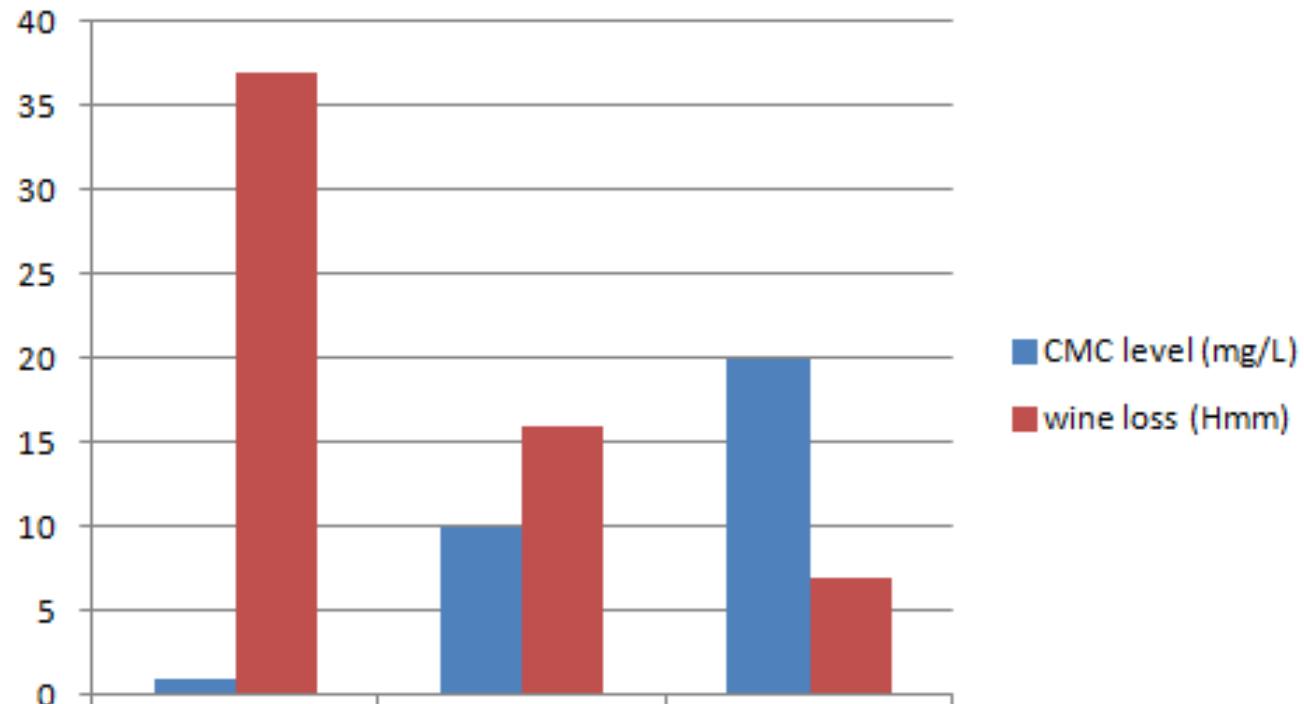


30% ethanol

surface hydrophobicity of CaT
(experiments conducted after M.C.
Fuerstenau method, 1994)

In this example, the wine is *tartarically* unstable because of Ca salt addition.

CMC shows an activity on the inhibition on gushing (positive action on crystallisation on CaT / the wine is stable in regards to KTH).



Using CaT as model, we have never demonstrated a relationship between crystal quantitites and gushing.
The correlation should be more: *surface area / gushing*.

Finally ...

1/ Carbone dioxide level:

- sugar content, temperatures, shocks, ... Solutions which permit to decrease the CO₂ amount is a good way of management. (CO₂ is the driving force of the gushing).

2/ Particles :

- tartaric stabiliaztion (KTH and CaT), filtration before tirage (présence de fibres de cellulose) ou dosage liquor, sanitary management (biological material becomes very hydrophobic after they deposit on tubing and drying), corking quality (consumer).

4/ Bottles...:

- *Some contaminations inside the wall ...*

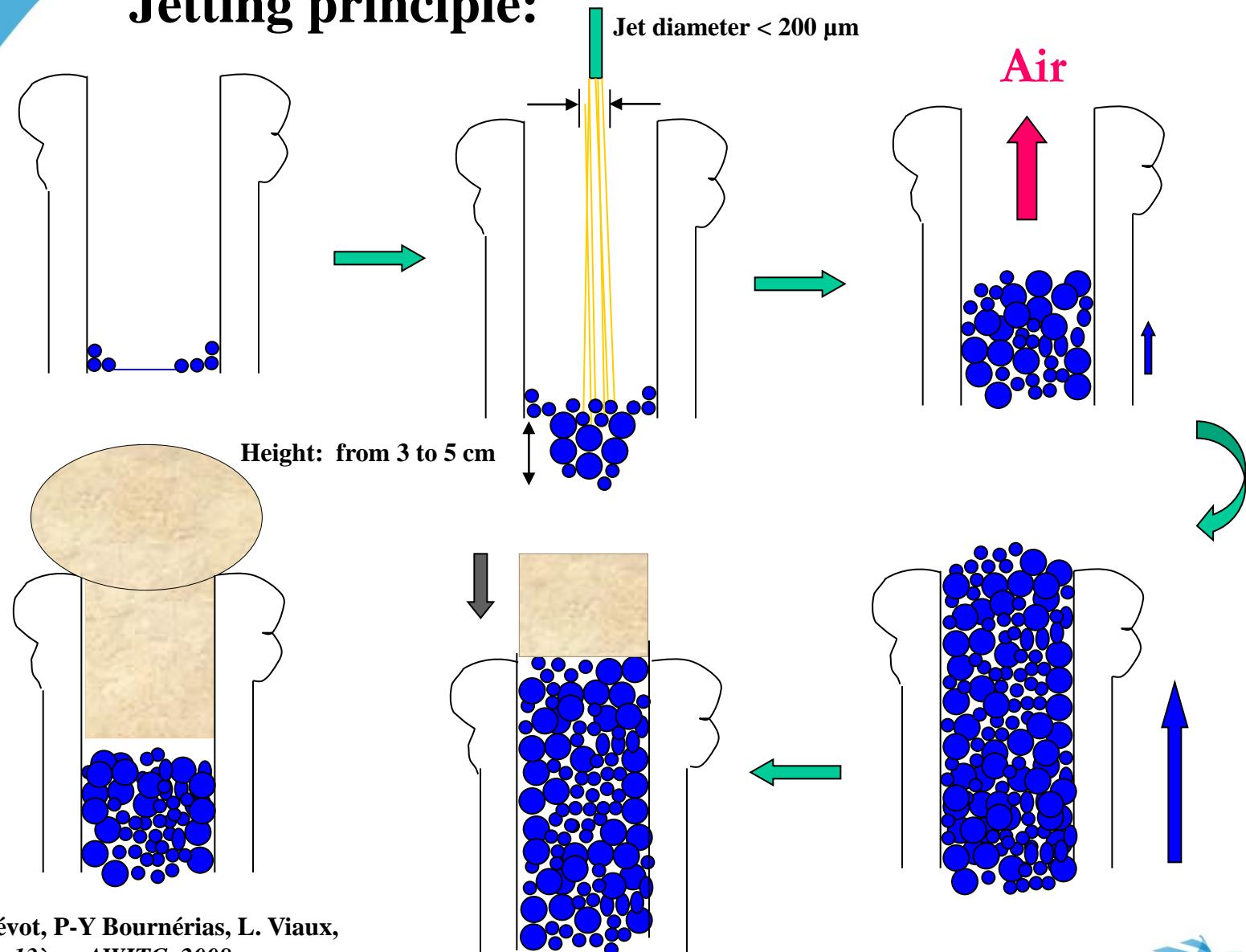
5/ The wine :

- At the moment: no relationship between grape, wine composition and gushing has been established.

Finally: gushing remains a mysterious phenomena not well-understood for sparkling wine and without simple solutions.

... but it can't all be bad in gushing

Jetting principle:



after M. Brévet, P-Y Bournérias, L. Viaux,
B. Robillard, 13ème AWITC, 2008



Thanks for your attention!

... and to:

J-E BARBIER – IOC / Epernay,
D. CHAUDRUC – Champagne Moët & Chandon / Epernay,
Pr G LIGER-BELAIR – Univ. Reims,
Pr G. POLIDORI – Univ. Reims,

Pr Richard ZARE / Stanford University