



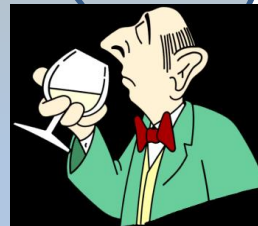
The elusive nature of minerality in white wine

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Minerality?



Dominique Valentin; Jordi Ballester; Dominique Peyron
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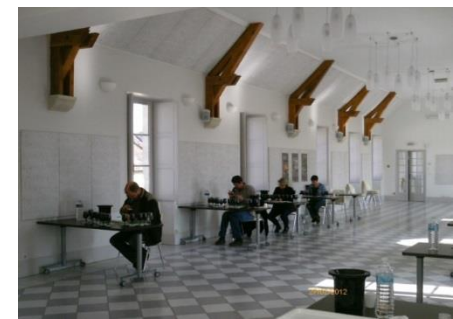
Jason Breitmeyer; Rob Sherlock; Brett Robinson
Philippe Darriet



Minerality?

i.e., what do we experience in wine that evokes geological metaphors?

- Flinty; silex
- Smoky
- Chalky; calcareous
- Matchstick; gun flint; struck match
- Oyster shell; iodine; fossils
- Earthy
- Wet stones; stony
- Pencil lead; graphite



Minerality in wine

- Fashionable notion
 - Increasingly reported as a wine descriptor
- Positive concept
 - Associated with cool climate wines
 - Associated with higher-priced wines
- Good for marketing
 - Links with the concept of *terroir* or provenance



However, geologists & plant scientists tell us that it is unlikely that we are tasting directly the vineyard rocks & soil (Maltman, 2013)



So, is perceived
minerality all in the
mind?

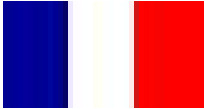

Have we been seduced by
smart marketing?



émotions minérales

Depuis 1975, à Chablis en Bourgogne, les structures travail des vigneronnes associées sous l'étendard de La Châblisienne donne naissance à des vins que le temps ne cesse de magnifier. Issus d'une fantastique mosaïque de "climats", ils révèlent de pures émotions minérales...

“All in the mind?”

- Are we *sensing* specific characters in wine that evoke geological metaphors?
 - **Data-driven perception** based on the phenomenological properties of the wine
- Or, is minerality primarily a mental construction?
 - **Top-down** or knowledge-based perception
- And is our experience of perceived minerality in wine shared by others?
 - Within a culture?  
 - Across cultures?
- Influence of wine composition?



Qs arising from industry, media, & anecdotal reports

- Can minerality be smelled, or is it a palate sensation only?
- How is perceived minerality related to:
 - Acidity?
 - Relative absence of varietal flavour?
 - Reductive characteristics?
- What other wine characteristics associate with or drive perception of mineral character?



How did we go about it?

(Parr et al., FQAP, 2015)

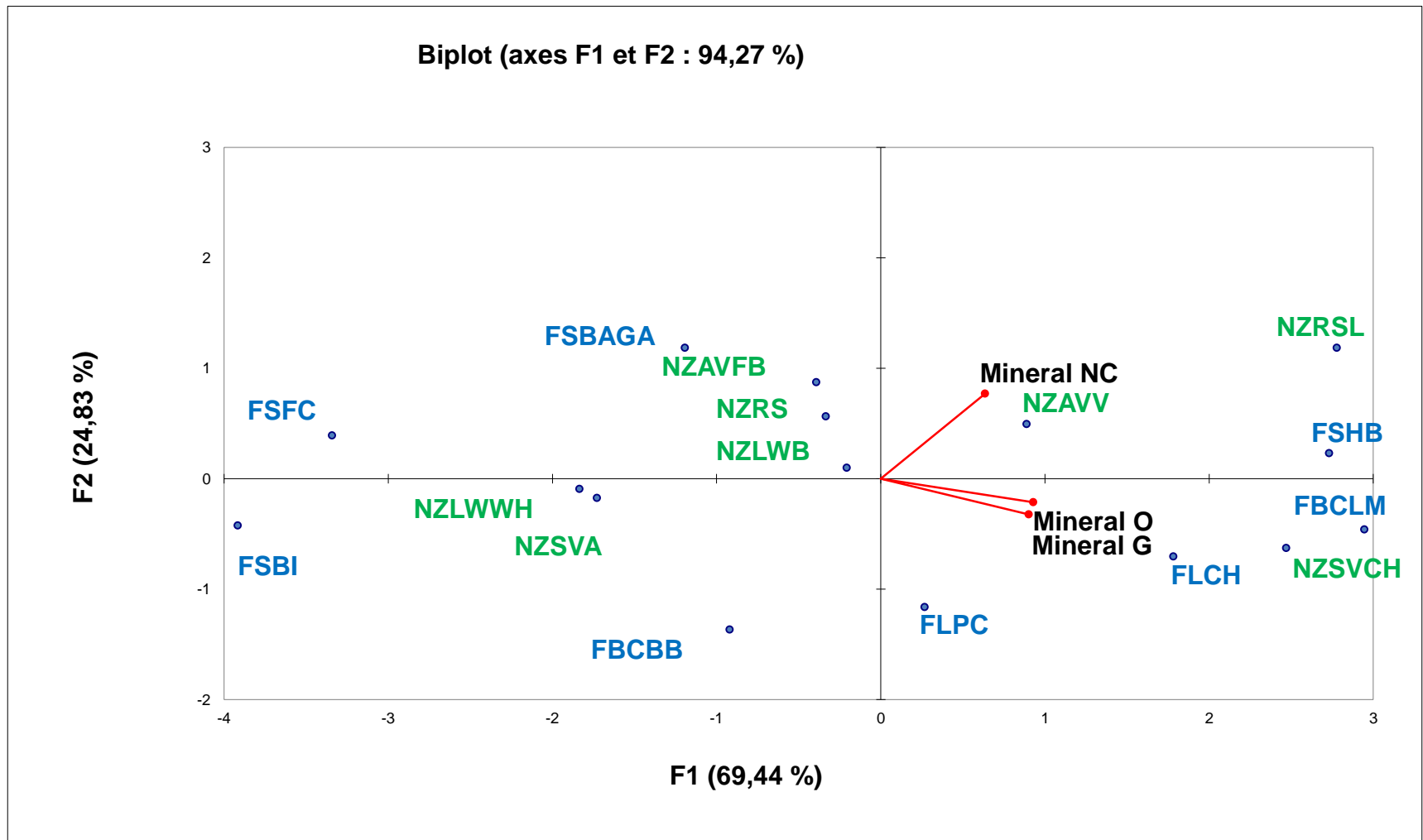


- 32 French & 31 NZ wine professionals evaluated 16 100% Sauvignon wines (8 French; 8 NZ)
 - Via 3 modes of perception
 - Smelling only
 - Full ‘tasting’
 - Palate only: taste & trigeminal (mouthfeel)
- Wines were categorised & described:
 - Varietal characters
 - Mineral characters (flinty; smoky; calcareous)
 - Acidity; freshness
 - Reductive characters (graphite; burnt rubber; sulphide)
 - Overall mineral intensity; complexity; familiarity; liking
- Physico-chemical analyses on the wines



What did we find?

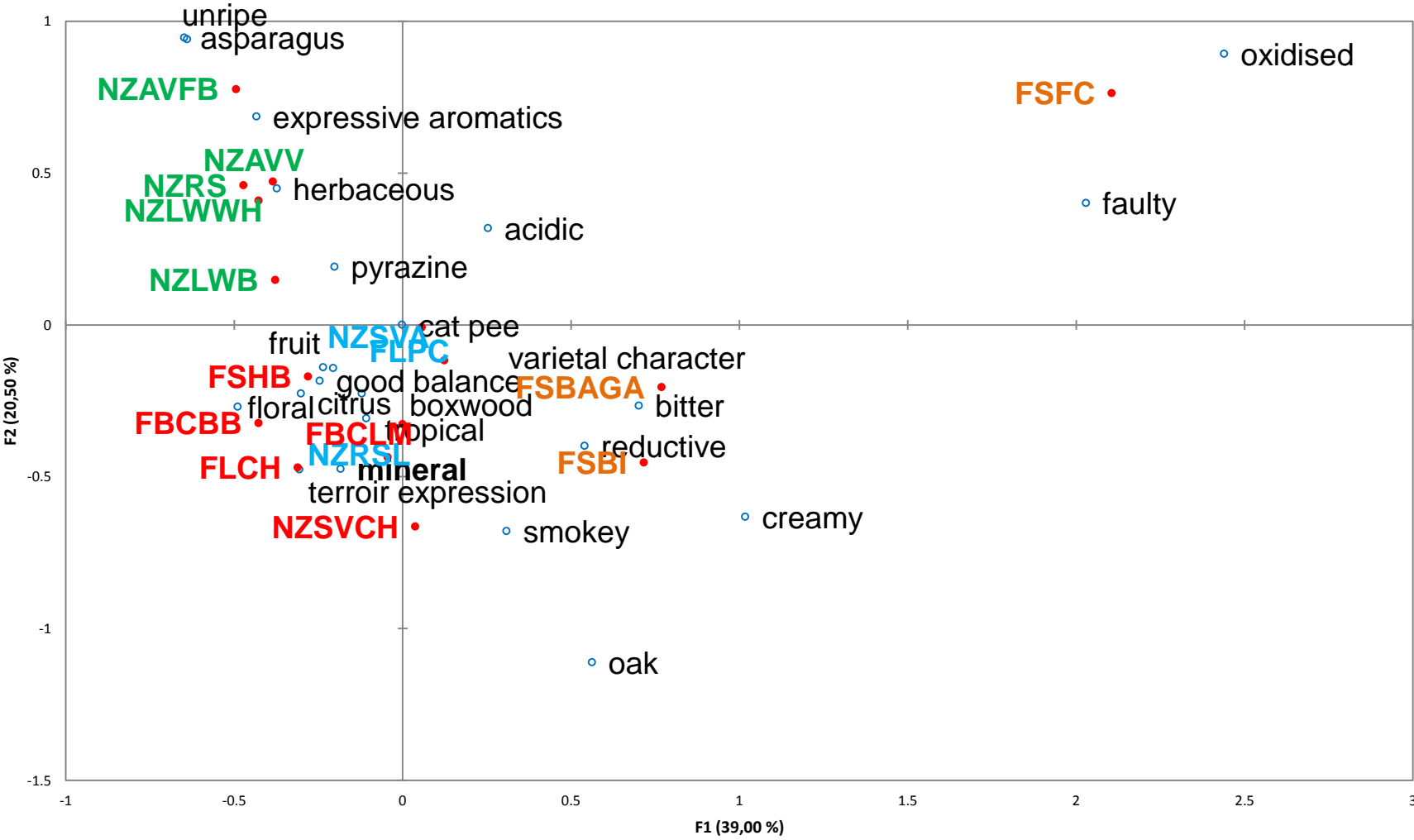
French and NZ wines were judged similarly in terms of overall intensity of mineral character



How were the wines characterised? French Free Sorting

Colours represent MDS clusters

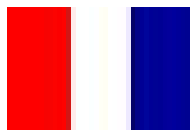
FR axes F1 et F2 : 59,50 %



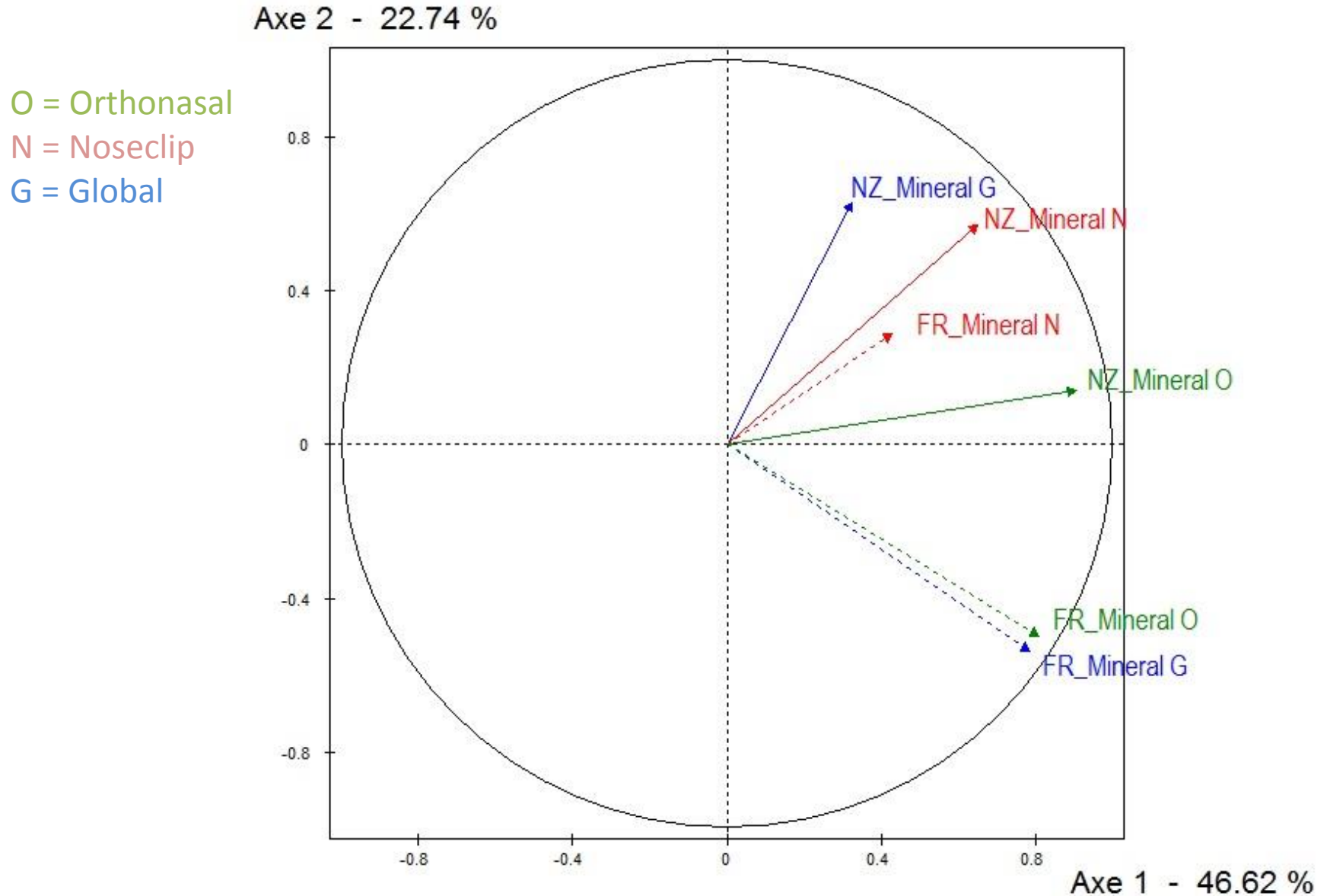


Can *mineral* be smelled?

- Both cultures reported perceiving minerality via each mode of perception; i.e.,
 - Mineral can be smelled and
 - Is a palate experience (taste & mouthfeel)
- French ‘tasters’ relied more on their noses than NZers in their full-tasting judgments of minerality, NZers relying equally on olfaction (smelling) and palate phenomena



PCA: Mineral intensity judgements in the 3 conditions





So, which wine
attributes predicted
perceived minerality
in Sauvignon wine?

And was there much
consensus across cultures?



Regression of *Mineral* by other descriptors: **Nose only**

Multiple Linear Regression: alpha < 0.05

Predictors	<i>t</i>	<i>p</i>	Predictors	<i>t</i>	<i>p</i>
French 'tasters'			N Z 'tasters'		
Citrus	5.29	< 0.0001	Citrus	3.78	< 0.001
Passionfruit	-4.64	< 0.0001	Passionfruit	-3.37	< 0.001
Chalky/calc	6.75	< 0.0001	Chalky/calc	5.94	< 0.0001
Flint/smo	9.75	< 0.0001	Flint/smo	7.23	< 0.0001
Lead/graph	2.62	<.01	Lead/graph	4.51	< 0.0001
Liking	3.10	< 0.01	Liking	3.01	< 0.01
Fresh/zingy	2.51	< 0.05	Concentrat	-2.05	< 0.05
Iodi/oyster	2.09	< 0.05			

Regression of *Mineral* by other descriptors: Full tasting

Multiple Linear Regression: alpha < 0.05

Predictors French 'tasters'	<i>t</i>	<i>p</i>	Predictors N Z 'tasters'	<i>t</i>	<i>p</i>
Citrus	4.22	< 0.0001	Citrus	2.09	< 0.05
Passfruit	-2.12	< 0.05	Green	-2.42	< 0.05
Bitter	2.08	< 0.05	Bitter	2.34	< 0.05
Chalky/calc	2.05	< 0.05	Chalky/calc	4.51	< 0.0001
Flint/smo	4.61	< 0.0001	Astringent	-2.17	< 0.05
Sweet	-6.57	< 0.0001	Fresh/zingy	2.20	< 0.05
Lead/graphite	2.81	<.01	Herbaceous	2.23	< 0.05
Liking	1.98	< 0.05	Conc/Wght	2.48	< 0.05

Regression of *Mineral* by other descriptors: **Palate only**

Multiple Linear Regression: alpha < 0.05

Predictors	<i>t</i>	<i>p</i>	Predictors	<i>t</i>	<i>p</i>
French 'tasters'			N Z 'tasters'		
Fresh/zingy	5.22	< 0.0001	Fresh/zingy	4.00	< 0.0001
Flint/smo	8.53	< 0.0001	Flint/smo	4.44	< 0.0001
Chalky/calc	6.66	< 0.0001	Chalky/calc	6.93	< 0.0001
Sour/acid	-2.26	< 0.05	Sour/acid	-2.26	< 0.05
Sweet	-4.33	< 0.05	Lead/graph	2.02	< 0.05
			Bitter	3.97	< 0.0001
			PalateWght	5.37	< 0.0001

Influence of wine composition?

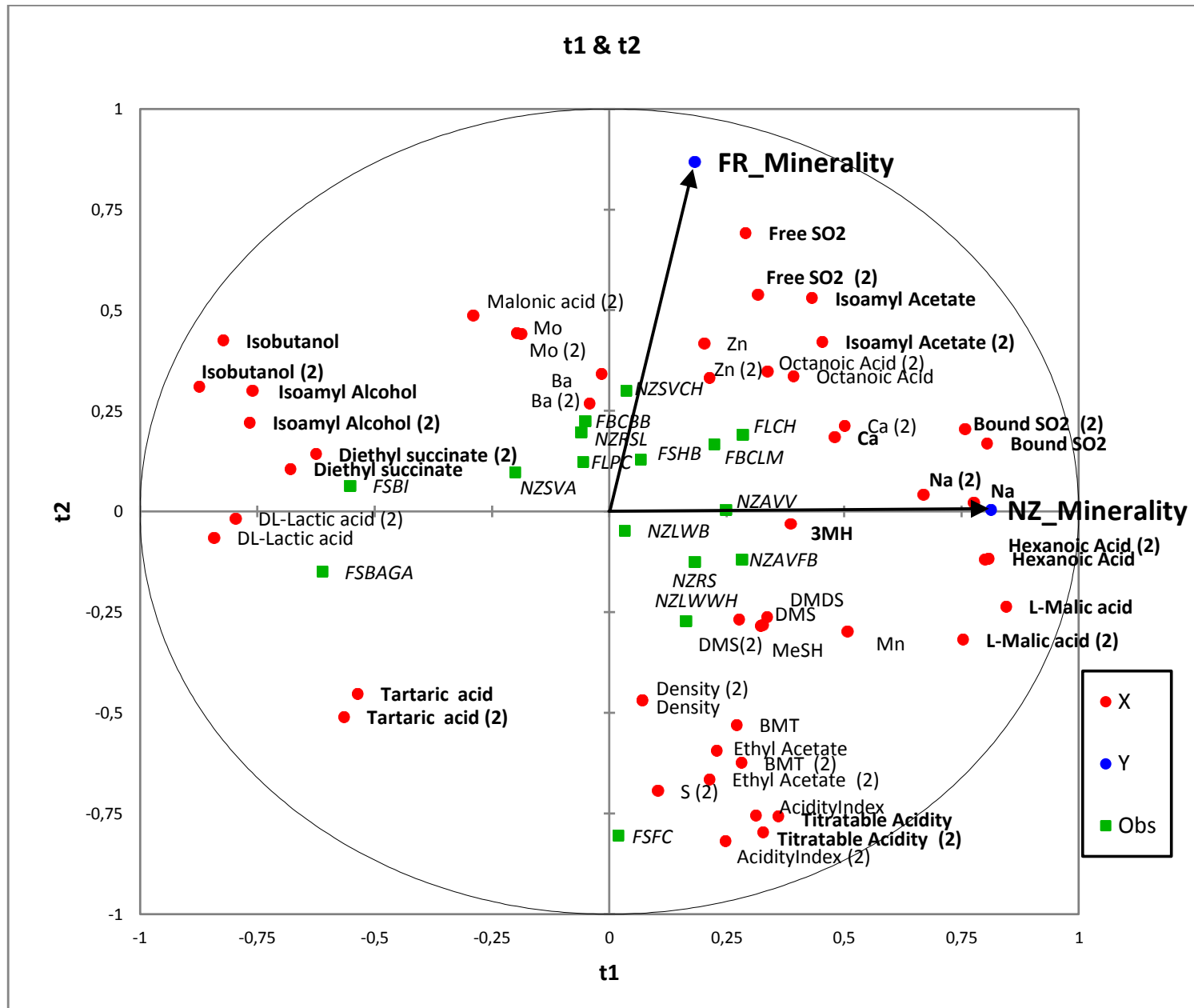
(Parr et al., FRIN, 2016)

- Standard parameters + an acidity index:
 - pH, TA, ethanol, RS, total extract, free & bound SO₂
- Fermentation-derived volatile aroma compounds, volatile organic acids, & IBMP
- Non-volatile organic acids
 - Tartaric, lactic, malic, shikimic, malonic
- Wine elemental composition (ICP-OES):
 - Mg, K, Ca, Na, Rb, Sr, Al, Fe, Mn, Si, La, P, S, Ba, Cu, Mo, Ni, Zn
- Varietal thiols & volatile sulphur compounds associated with pungent aromas

Sulphur compounds

- 3-mercaptohexan-1-ol (3MH) : citrus/grapefruit
- 3-mercaptohexyl acetate (3MHA) : passion fruit
- 4-mercapto-4-methylpentan-2-one (4MMP) :
sweaty/boxwood
- Ethyl-2-sulfanylacetate (E2SA) : “baked beans” note
- Benzenemethanethiol (BMT) : flinty note
- Dimethyl sulfide (quince; truffle)
- Hydrogen sulfide (rotten eggs)
- Méthanethiol (stagnant water; halitosis)
- Ethanethiol (onion; rubber)
- Diéthyl sulfide
- Diméthyl disulfide (quince; asparagus)

PLSR plot: projection of Y variables (*M* perceived minerality scores) on X variables (chemical compounds: in red) and Wines (in green)



Aspects of wine composition associated statistically with perception of mineral character in S. blanc wines

(Parr et al., FRIN, 2016)

Positive predictors		Negative predictors	
French	N Z	French	N Z
Free SO ₂	Bound SO ₂	Tartaric acid	Isoamyl alcohol (fusel; solvent)
Isoamyl acetate (fruity)	Hexanoic acid (fatty; waxy; barnyard)	Titratable acidity	Diethyl succinate (fruity; wine-like)
	Malic acid		Isobutanol (fusel; solvent)
	Na		
	Ca		

Implications

Not just smart marketing

- Perceived *minerality* in Sauvignon wine appears based on data-driven input (wine attributes)
- Characters driving perceived minerality in Sauvignon
 - *Citrus* notes and *fresh/zingy* character (acid?)
 - Absence of *passion fruit* & *green* characters



Caution needed in how the term *mineral* is used

- Much between-judge variability in judging intensity of mineral character in wine
- Wine varietal differences may influence how minerality is perceived in any particular wine
- Wine composition aspects appear complex & require further research



Acknowledgement

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And thank you for your attention

