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# Terroir – it's the rocks that matter

Dr Peter Dry





# Minerality in wine

- ❖ Can you taste it?
- ❖ What is the source?
- ❖ Is it related to the rocks/geology?
- ❖ Or the soil?



Source: Fairburn, W. et al. (2010)  
Geological Map of McLaren Vale Wine Region.  
Govt of SA

# Minerality



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- soils with rocks/stones appear to elicit allusions of minerality in wine



# For example



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“...But what separates Beechworth from so many other regions, ....., is minerality. It’s there, you can see it, with minerals glistening in the sun—slate and shale and great boulders of granite.....

While some disagree, you can taste minerality and it’s there in the wines”

*Jeni Port The Age Feb 2012*



Source: <http://www.google.com.au/search?q=beechworth+pics...>





## And the Granite Belt (Qld)



Source: <http://www.google.com.au/search?q=granite+belt+pics...>

# The use of 'minerality' as a descriptor has exploded (Maltman 2013)



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- ❖ One article in Decanter July 2012:  
'mineral', 'minerally' or 'minerality' used 116 times in a few pages
- ❖ Wine Spectator: 'minerality' now used more frequently than 'oaky' or 'fruity' or 'floral'
  - Even reference to a specific mineral or rock  
e.g. slaty, flinty, .....

More.....



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“...schist - the geological equivalent of Viennetta icecream ... comes in green, brown and black, all stuffed full of tasty minerals”

Sunday Wines Club newsletter UK quoted in Andrew Jefford's Decanter blog 4/6/2013

# Even in Australia



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“...but unlike clay, (the) Kurradjong (Formation) is composed of big chunks of rock stuff, each of which has a **flavour**”

Philip White Drinkster blog May 2013



Source: Fairburn, W. et al. (2010)

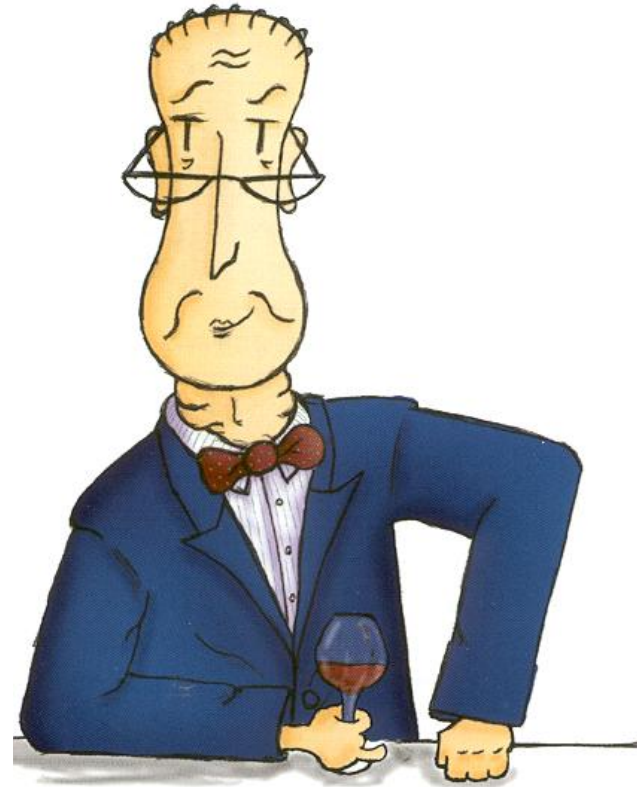


# But is there a direct link between the rocks and wine 'flavours'?



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- If the wine writers think that there is a link, then it must be so



# Geology = terroir in some circles



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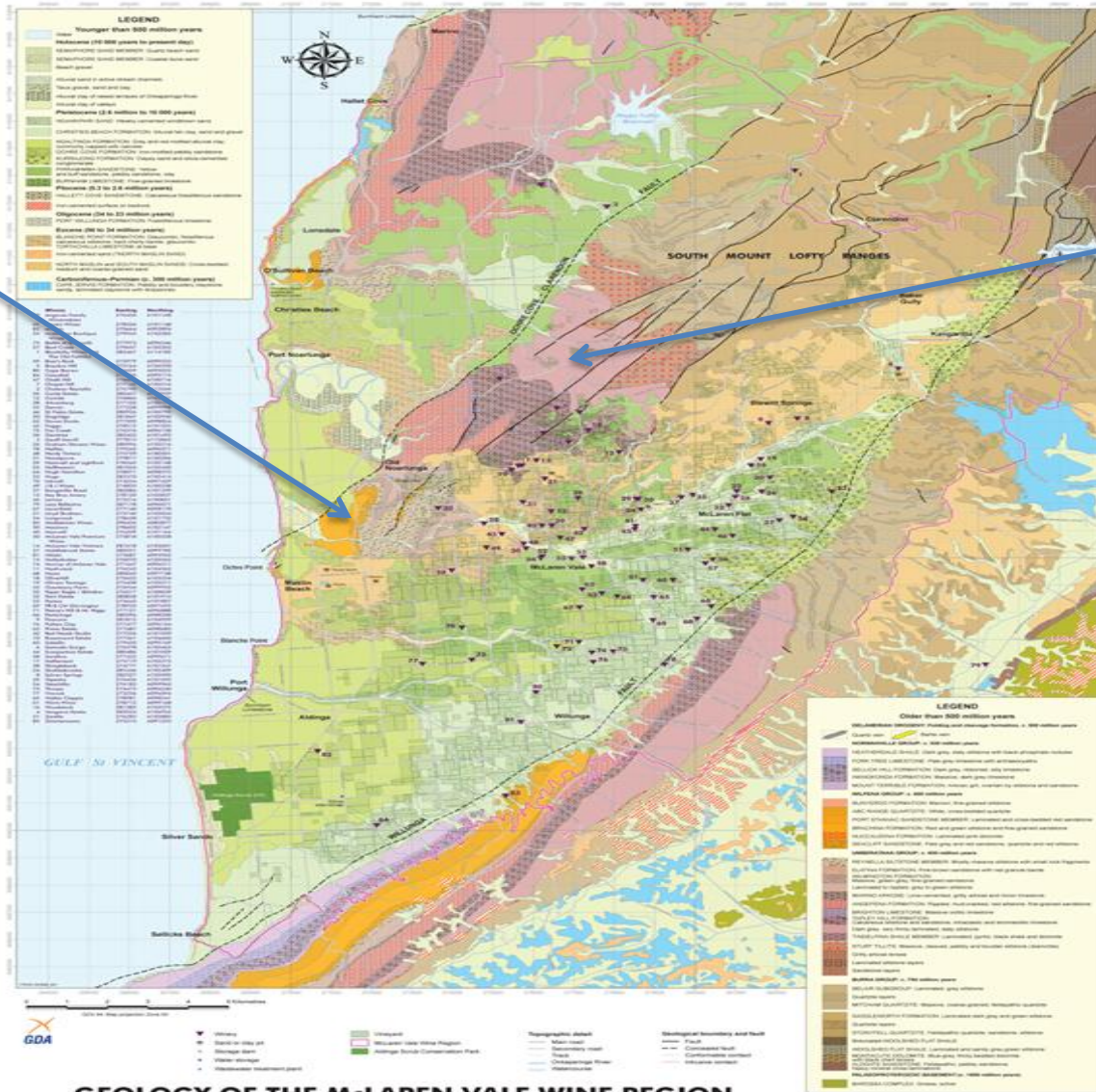
- Geology is being used to map ‘terroir’
- As a marketing tool it is useful for implanting images of terroir distinctiveness



# The McLaren Vale geological map

Wine A

Wine B



# The McLaren Vale **geological** map



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Some quotes from McLaren Vale growers and winemakers after its release:

- ❖ *“For winemakers, we can look at the geology and say that’s why this block has never done well”*
- ❖ *“The (geological) map reveals where the best viticultural ground is”*
- ❖ *“The map could spell doom for some grapegrowers. Sections of the map shown to produce poor quality grapes could drop in value”*

Are these statements justified?

# Geological influence as a fantasy of the taster?



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“...the roots of (this vineyard) are now well into the siltstones (750 m years old), and the deeper they creep, the more these wines **reek of the slate**”

*Philip White in Greenock Creek Wines Newsletter Sept 2011*





❖ Let's accept for sake of argument that it is possible that there is a direct link

# Trace minerals and wine 'flavour'



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- ❖ “...the ferruginous whiff (of the wine) is a consequence of the ironstone (in the vineyard soil)”
  - Philip White (Drinkster blog)



Source: Fairburn, W. et al. (2010)

# Trace minerals and wine 'flavour'



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- ❖ How could trace minerals get from rocks to fruit and directly influence flavour?
- ❖ What are the assumptions necessary?



1. That there is some chemical compound in the 'rocks' that can influence flavour
  - Geological minerals are complex chemical compounds that are mainly tasteless
  - Insoluble
  - To be accessible to vine roots, these elements have to 'detached' from crystal lattices and go into solution as ions e.g.  $\text{Ca}^{++}$
  - Depends on chemical environment, pH, temperature, water, time.....



## 2. Need deep roots in contact with rocks

- Majority of vine roots are in surface soil
- Only access water (and thus minerals) in deep layers when topsoil has dried out





3. Mineral ions need to get into roots for transport to fruit
  - Vine roots can only take up ions in solution
  - Membranes only allow certain ions to be taken up
    - Ions have to be 'loaded' into xylem



## 4. That it is possible for minerals to get to fruit during ripening

- Not all ions taken up by roots will end up in fruit
- Distributed in different proportions around vine
- Different ratios of mineral nutrients reach skins, seeds and pulp
- Mineral ions mainly transported in transpiration stream (in xylem)
  - **AFTER VERAISON, MOST WATER → FRUIT VIA PHLOEM**



5. Particular mineral ion (tasteless) has to become complexed with an organic aromatic compound
  - so that the apparent flavour of the mineral can be expressed

# The reality



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- Inorganic chemical profile of grape berry bears only distant and indirect relationship with vineyard geochemistry (Maltman 2013)



- This disconnect is magnified during vinification
  - Fermentation can remove mineral nutrients such as Cu, Zn, while adding others e.g. Al, Ca, Fe
  - Fining removes more - and others added if bentonite etc used
  - Stabilisation and ageing can add Cu, Fe etc whereas others removed along with tartrate precipitation

Therefore, proportions of minerals in wine bear **little relationship** with geological minerals in vineyard.





# Tiny quantities of minerals in wine

- Total inorganic content of wine = 0.15 to 0.4%
- Can't taste minerals in wine
- Cannot taste rocks – they don't volatilize

# So what is wrong with an emphasis on soil and geology?



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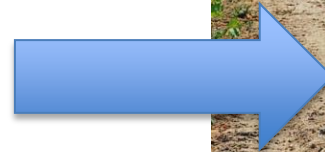
- ❖ It ignores the profound effect of the other factors and their interactions
- ❖ “A terroir is a unique and delimited geographical area for which there is a collective knowledge of the interaction between the **physical** and **biological environment** and **applied viticultural practices.**”

# Factors that may influence terroir



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- ❖ Climate
- ❖ Geology
- ❖ Geomorphology
- ❖ Soil
- ❖ Human influence
  - Selection of sites
  - Practices e.g. irrigation



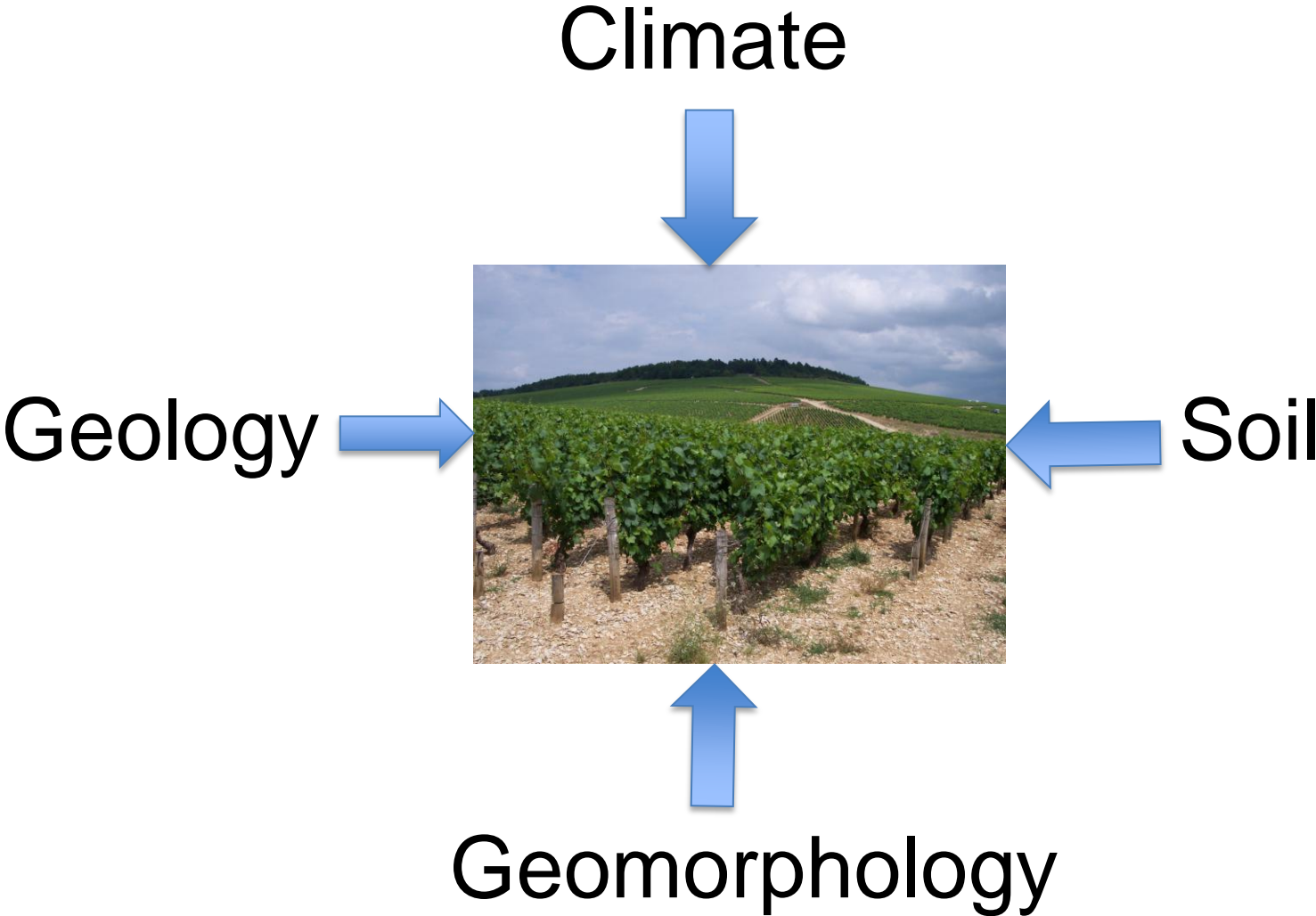


# Interactions are important

- ❖ Therefore, it is pointless to try to explain terroir in terms of a single factor
  - e.g. **climate** or **geology** or **soil** or .....
  
- ❖ But that hasn't stopped some people trying



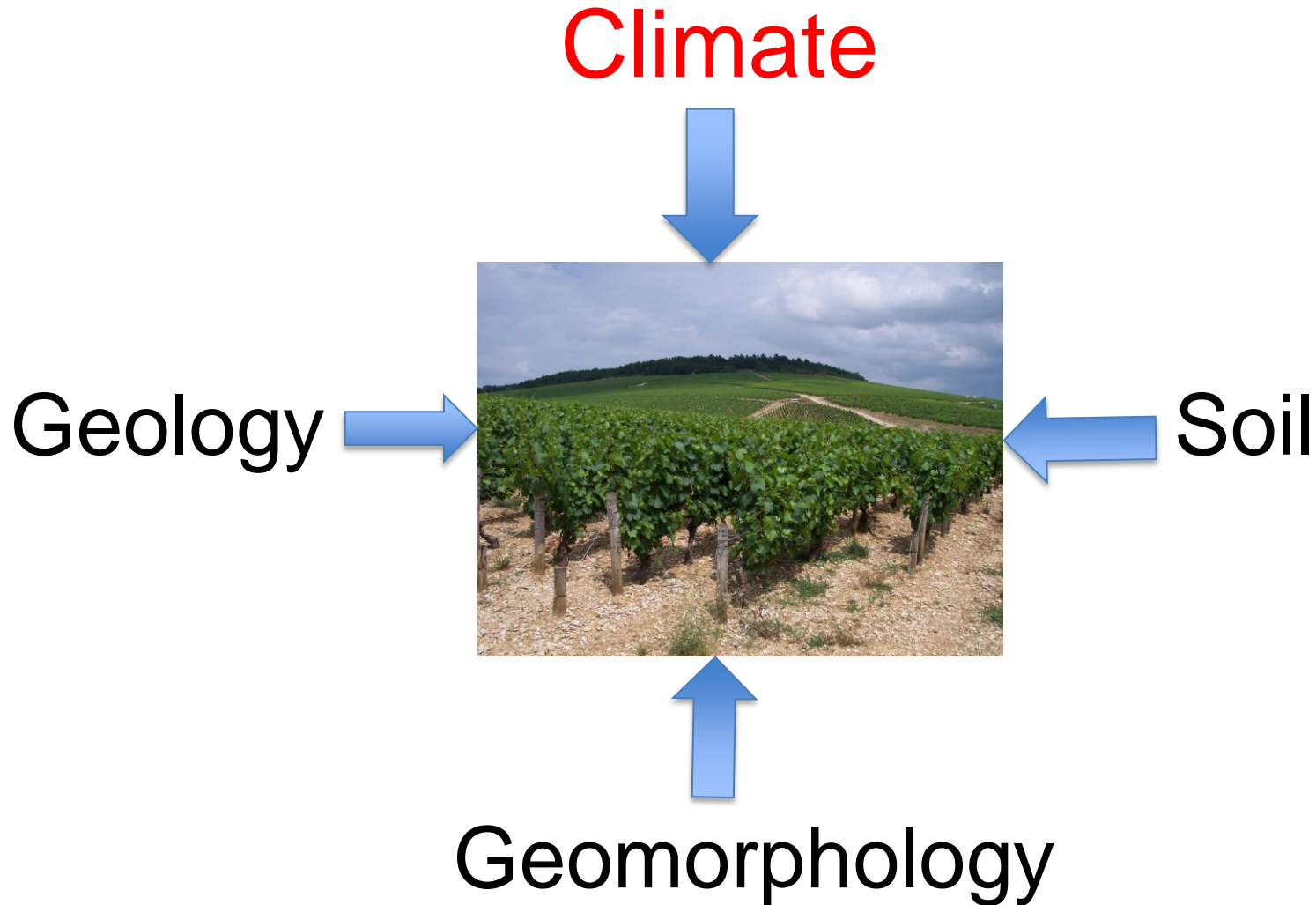
# Contribution of each factor to terroir







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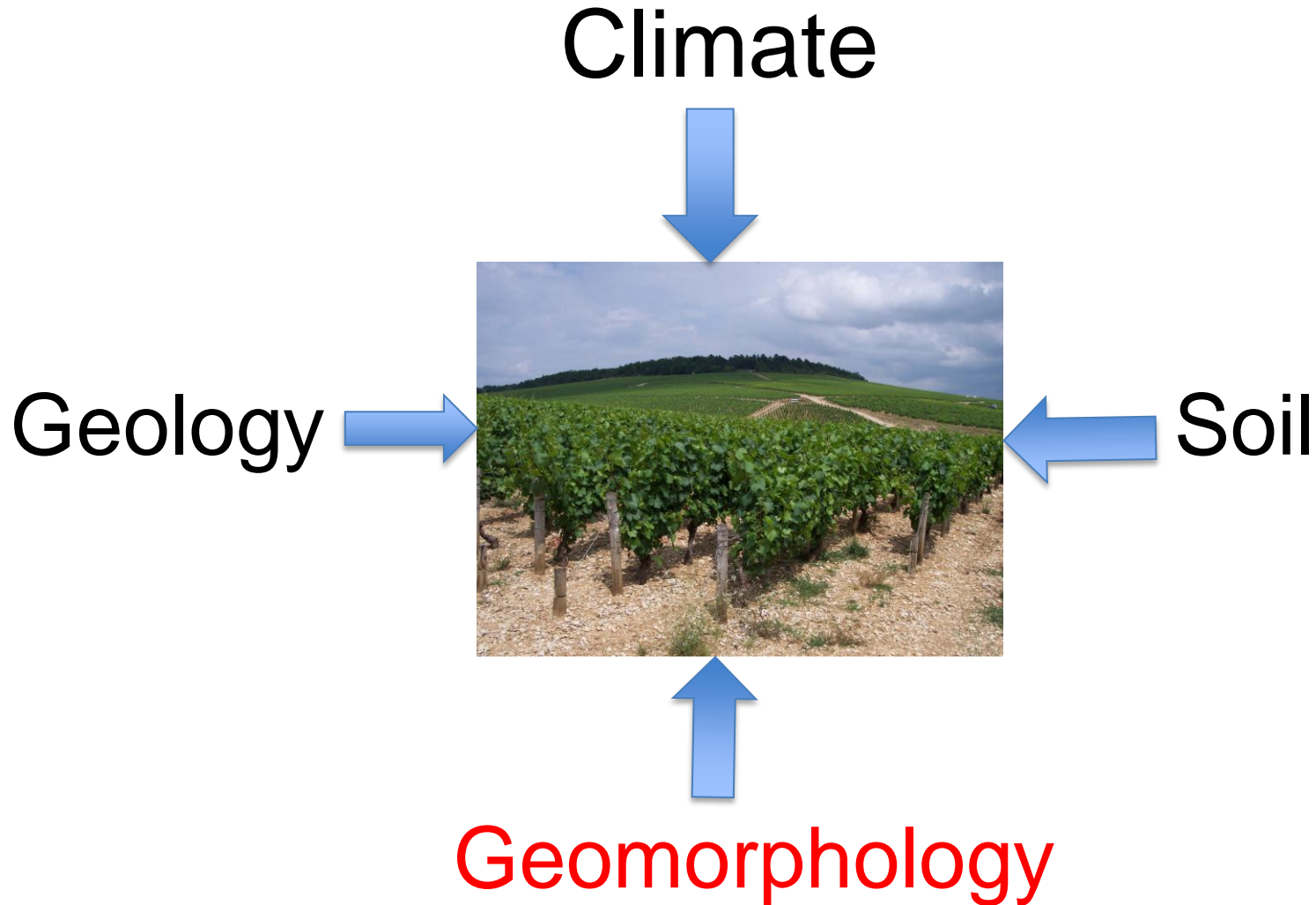


- ❖ Macroclimate and **mesoclimate** have great influence on growth, fruit composition and wine style/quality
  - particularly in regions with complex geomorphology
  - or with maritime influence
- ❖ Affected by
  - Altitude
  - Cold air drainage
  - Large water bodies
  - Sea breezes

Mesoclimate = site climate



# Contribution of each factor to terroir



- ❖ ‘Topography’
  - Influenced by geology



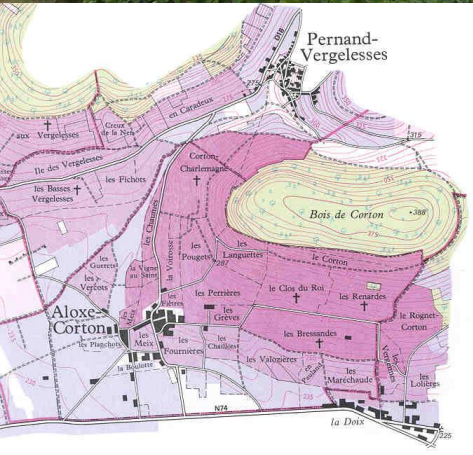
## Indirect effect on terroir via

- ❖ Altitude
- ❖ Slope
  - Erosion and soil depth
  - Radiation interception and thermal load
  - Air drainage
- ❖ Aspect





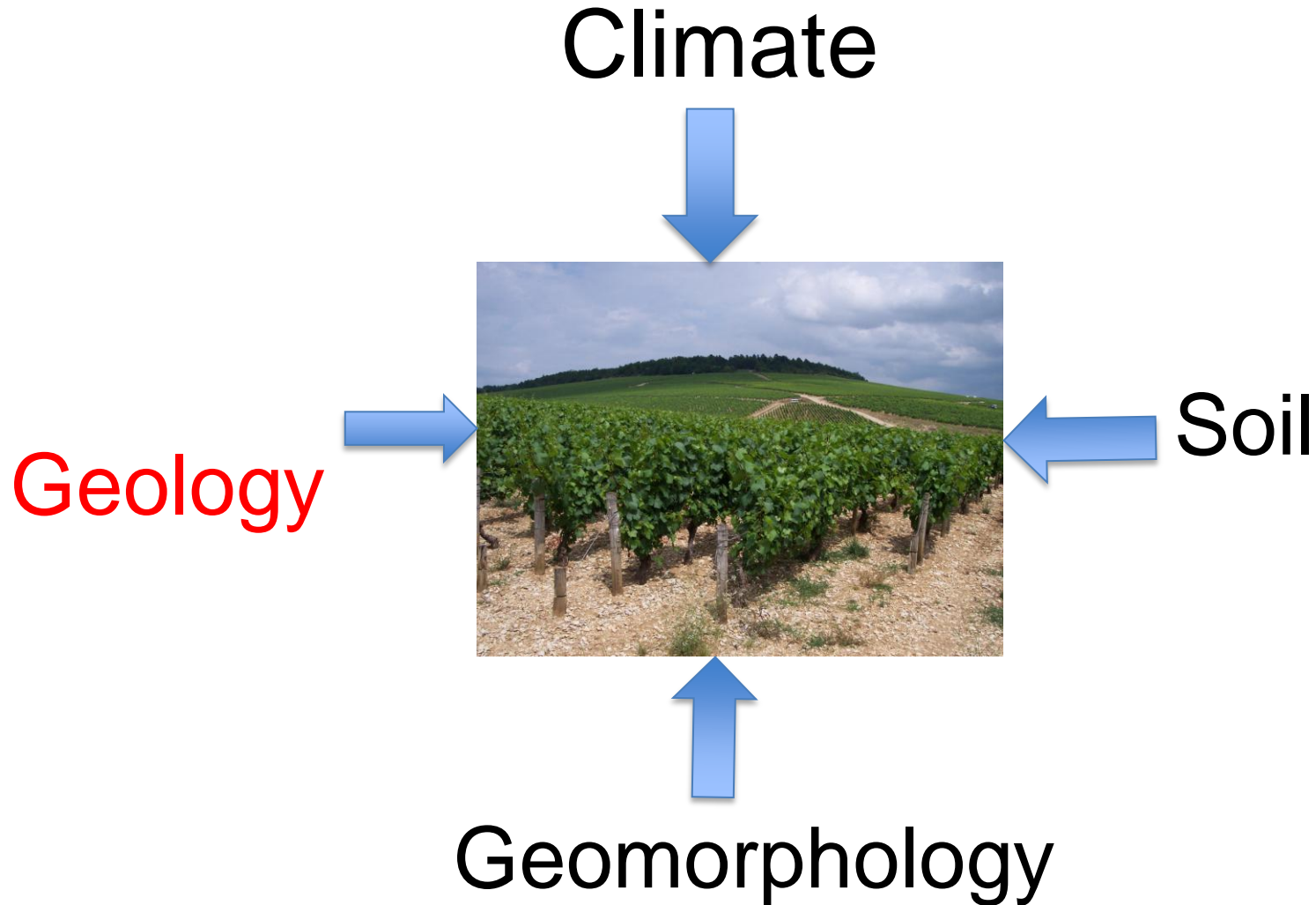
# Corton (Burgundy)







# Contribution of each factor to terroir



# There is no such thing as a 'perfect' geology for wine



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- ❖ High quality wines are produced on a wide variety of geological materials
- ❖ Schists: Douro, Mosel
- ❖ Chalk, limestone etc: Champagne, Chablis, St Emilion, Burgundy, Rioja, Barolo, Coonawarra
- ❖ Clay: Napa Valley, parts of Pomerol
- ❖ Sand: parts of Margaret River, McLaren Vale, Barossa
- ❖ Granite: Beaujolais





- ❖ Role is likely to be indirect
- ❖ Influence on:
  - soil type
  - root depth
  - geomorphology
    - e.g. slope
  - drainage

# Role of geology is often misinterpreted



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## ❖ Example: Chablis

- ❖ Best wines said to come from vineyards on Kimmeridgian limestone
- ❖ Lesser wines from Portlandian limestone



# Role of geology is often misinterpreted



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Kimmeridgian: all south-facing sunny slopes  
Portlandian: all cool and windy plateaux



# The influence of geology – another myth



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- ❖ “It is humbling as a winemaker to be making wine on a block that is 650 million years old”
  - Quote by a McLaren Vale winemaker, Adelaide Advertiser 28/7/12
- ❖ Can you make good wine from 2 million year old geology?





# Contribution of each factor to terroir

Climate



Geology



Soil

Is it the physical or chemical characteristics that  
are important?

# Soil: chemical composition



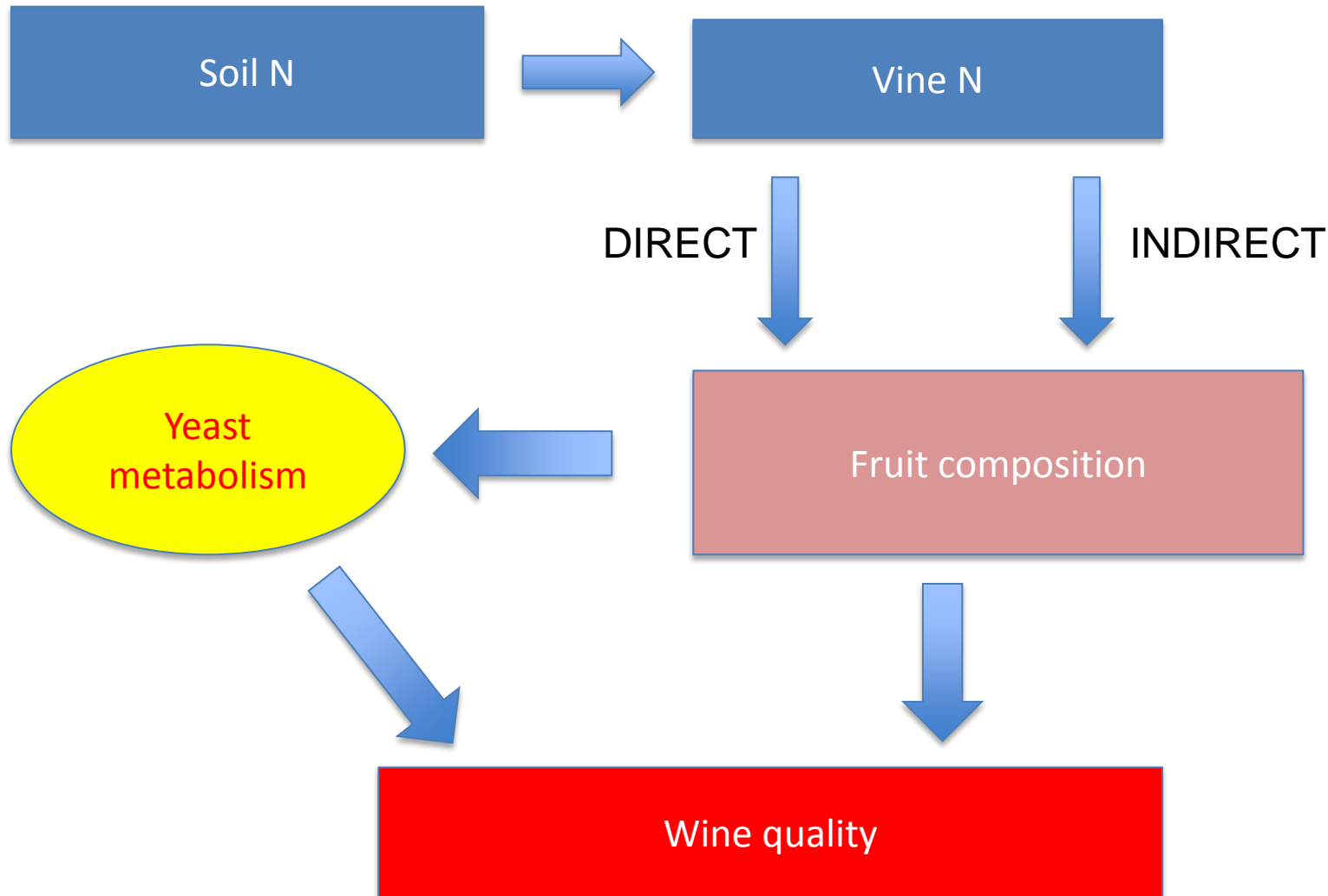
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- Many studies
- With exception of deficiencies of mineral nutrients or excess NaCl,
  - no correlation between wine typicity and soil content of any nutritive element **with exception of N**

# Nitrogen effect on fruit composition and wine quality



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# Soil **physical properties** are very important in terroir expression



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- Supported by much experience and research
- Likely effect on wine quality/typicity is **indirect**
  - → Waterholding capacity
  - → Cation Exchange Capacity
  - → Root penetration
  - → Rootzone temperature
  - → Drainage and susceptibility to waterlogging



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# Soil temperature

- Affects canopy microclimate via:
  - Roots → cytokinins → vegetative growth
  - Heat re-radiated from soil affects air temperature
    - partic. at night
  
- Effects depend on slope and aspect
  - greatest early/late in season and at high latitudes

# Soil **physical properties** are very important in terroir expression



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# Soil Water Status



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Affects wine typicity in many ways

- → amount of vegetative growth
  - → canopy size/density
    - → canopy microclimate
    - → bunch exposure, proportion of shaded leaves
- → timing of cessation of shoot growth
  - → diversion of resources to shoots and roots etc
- → direct effect of root-produced hormones on secondary metabolite production

# Gravel soils of St Emilion (France)



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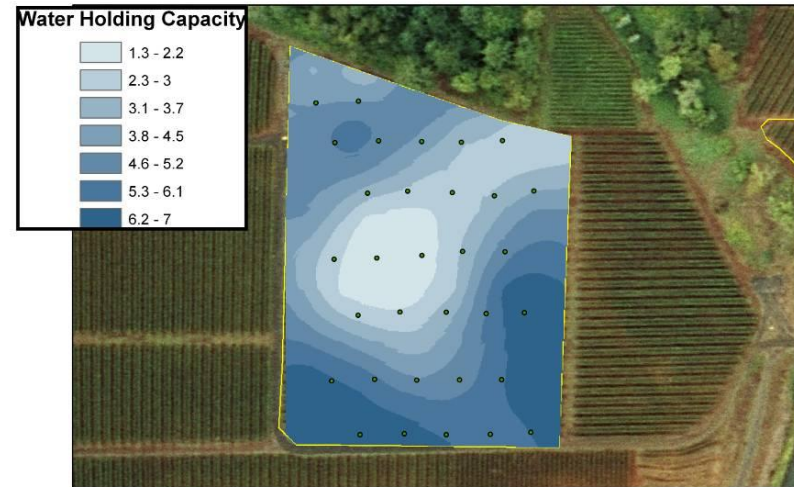
Van Leeuwen et al. (2004) *Am J Enol Vitic* 55, 207-217



# Terroir study: Pinot Noir, Oregon



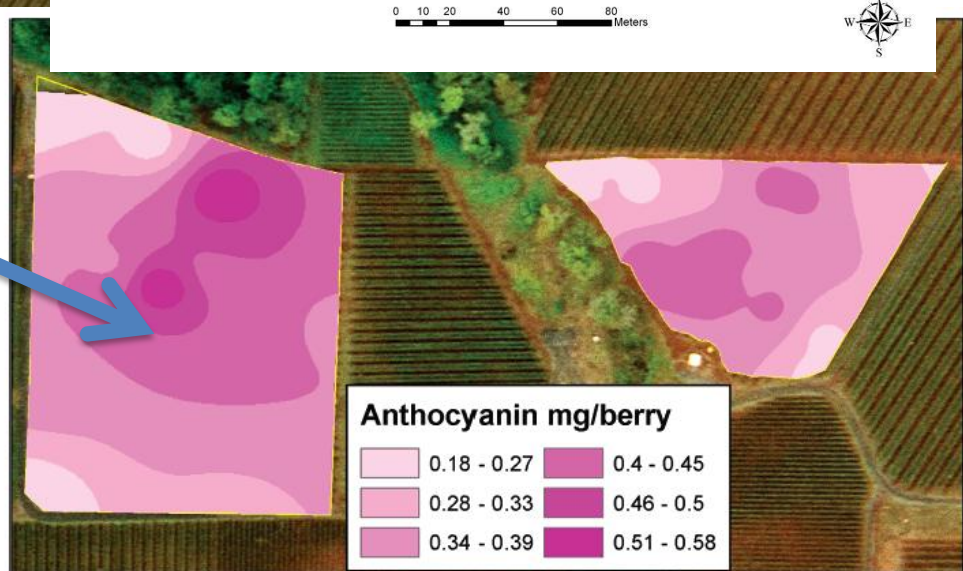
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0 10 20 40 60 80 Meters



What is the link?



0 10 20 40 60 80 Meters



Cortell, J. et al. (2005) J Agric Food Chem 53, 5798-5808



# Gimblett gravels of Hawkes Bay



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# Coonawarra



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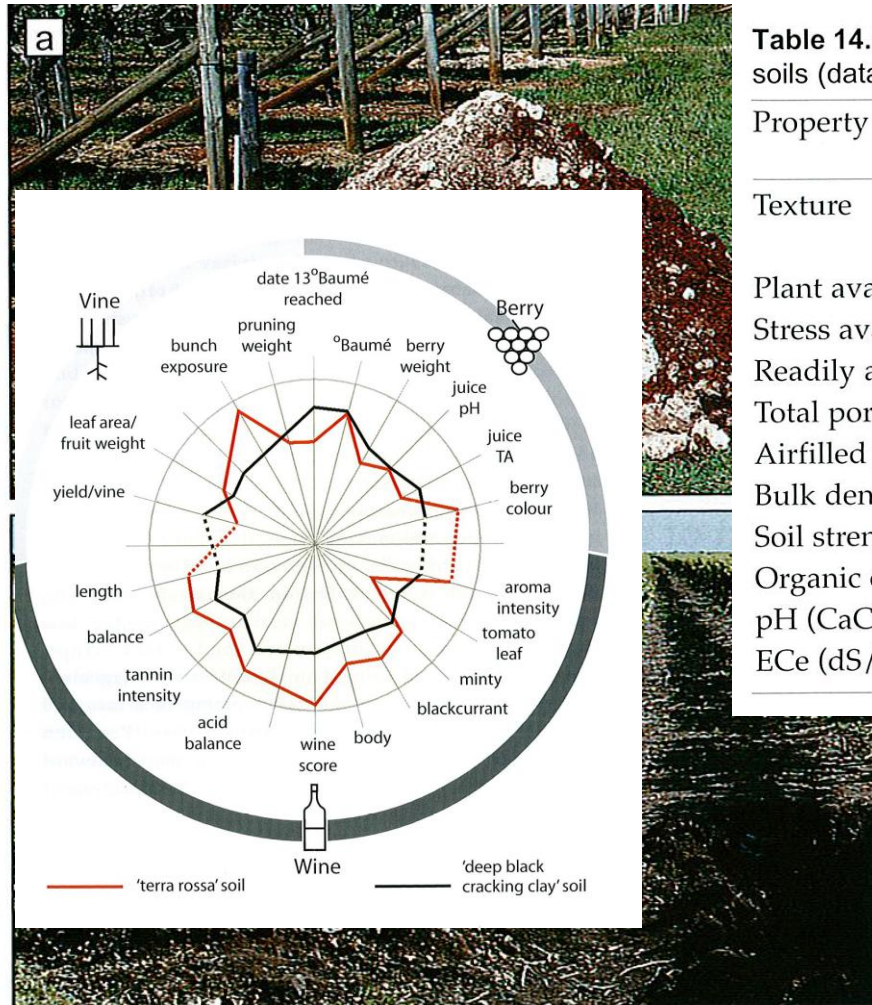




# Coonwarra: why does red soil → better wine than black?



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**Table 14.1** Properties of the terra rossa and the deep black cracking clay soils (data sourced from Proffitt et al. 2000).

| Property                          | Terra rossa soil         | Black cracking clay soil   |
|-----------------------------------|--------------------------|----------------------------|
| Texture                           | Clay loam/<br>loamy clay | Medium clay/<br>heavy clay |
| Plant available water (mm)        | 63                       | 96                         |
| Stress available water (mm)       | 41                       | 64                         |
| Readily available water (mm)      | 25                       | 40                         |
| Total porosity (%)                | 52                       | 49                         |
| Airfilled porosity @ 10kPa (%)    | 19                       | 11                         |
| Bulk density (g/cm <sup>3</sup> ) | 1.3                      | 1.4                        |
| Soil strength @ 10kPa (MPa)       | 1.7                      | 2.9                        |
| Organic carbon (%)                | 1.6                      | 1.6                        |
| pH (CaCl <sub>2</sub> )           | 7.1                      | 6.6                        |
| ECe (dS/m)                        | 1.5                      | 0.6                        |

Source of figures: Iland et al. (2011)  
The Grapevine

**Figure 14.4** (a) The 'terra rossa' soil and (b) the 'deep black cracking clay' soil (photographs P.G. Iland).

# Summary



- The rocks do matter in terroir expression
- But not necessarily in a direct way
  - Role in physical properties of soil
    - Particularly soil water status
  - And influence on geomorphology etc
- Terroir: many interacting factors
  - Invalid to focus on just one factor such as geology
  - Beware the geological maps



- Minerality of wine is unlikely to be related to soil nutrient status
  - N is the only soil nutrient that seems to have a significant impact on wine quality
- Soil and rocks and a presumed direct association with flavour – does it really help to sell more wine?

# Is it OK to use minerality in a metaphorical sense?



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- Yes - so long as we do it in same way as truffles, cats pee, sweaty saddle, cigar box, chocolate ....
- *“the problem with wielding these metaphors is that if I describe a wine as slatey - whose vine is growing in slate – the metaphor is quickly gobbled up by the literal image and the trusting reader assumes a direct line of transmission”*

Andrew Jefford Decanter Blog June 2013

# Further reading



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Maltman, A. Minerality in wine: a geological perspective

(as submitted to Journal of Wine Sc)

<http://cadair.aber.ac.uk/dspace/handle/2160/1270>



Chateauneuf du Pape

