The Myths of Terroir

Kevin R. Pogue PhD
Department of Geology Whitman College

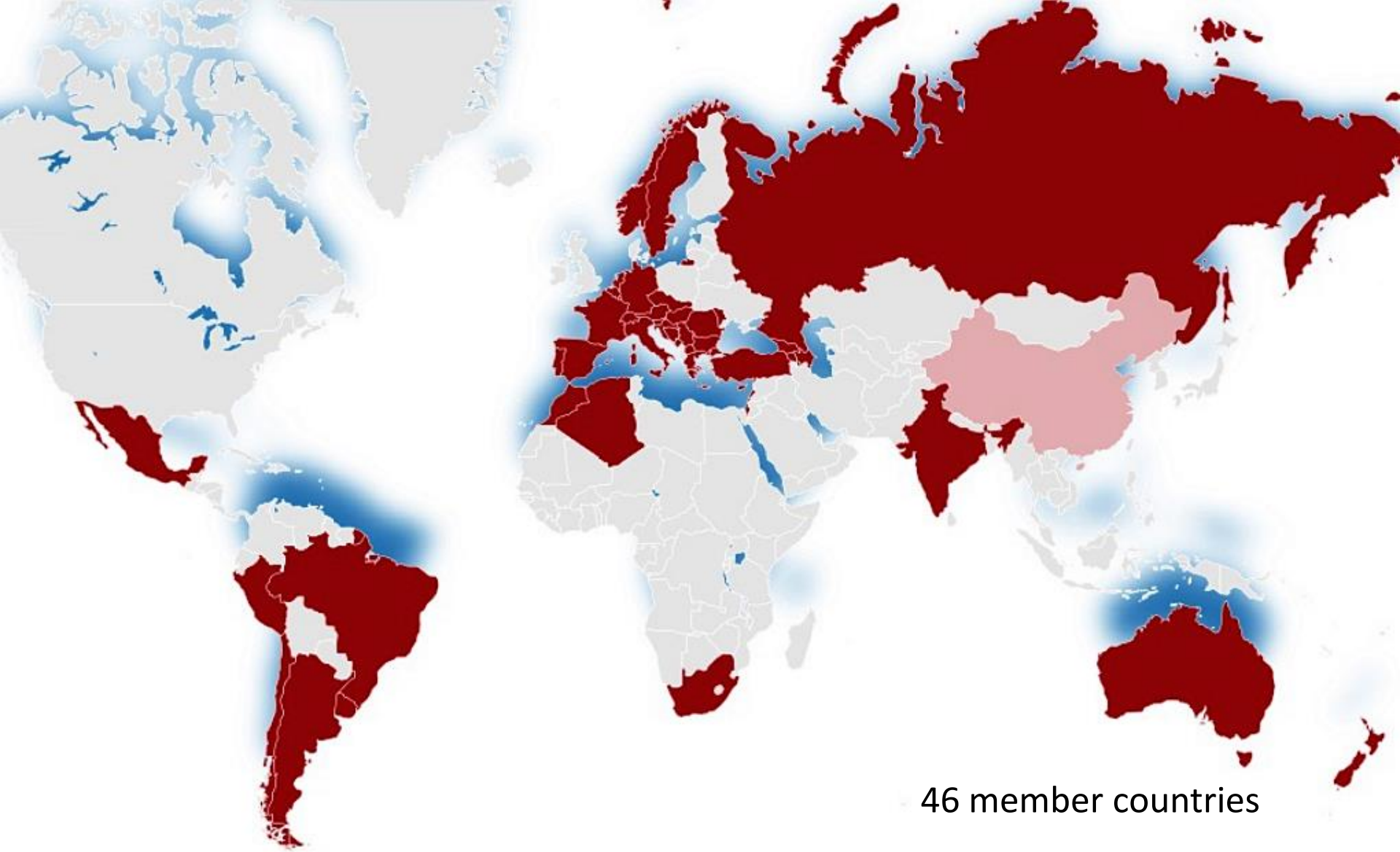
Myth #1

"Terroir is a French concept that is untranslatable."

Corollary: "Since it can't be translated, we can just create our own definitions that serve our purposes, and run with those …"

Resolution OIV/Viti 333/2010 OIV
(Organisation Internationale de la Vigne et du Vin)

"Vitivinicultural terroir is a concept which refers to an area in which collective knowledge of the interactions between the identifiable physical and biological environment and applied vitivinicultural practices develops, providing distinctive characteristics for the products originating from this area. Terroir includes specific soil, topography, climate, landscape characteristics and biodiversity features."



“The OIV is an intergovernmental organization of a scientific and technical nature of recognized competence for its works concerning vines, wine, wine-based beverages, table grapes, raisins and other vine-based products.”

Resolution OIV/Viti 333/2010 OIV
(Organisation Internationale de la Vigne et du Vin)

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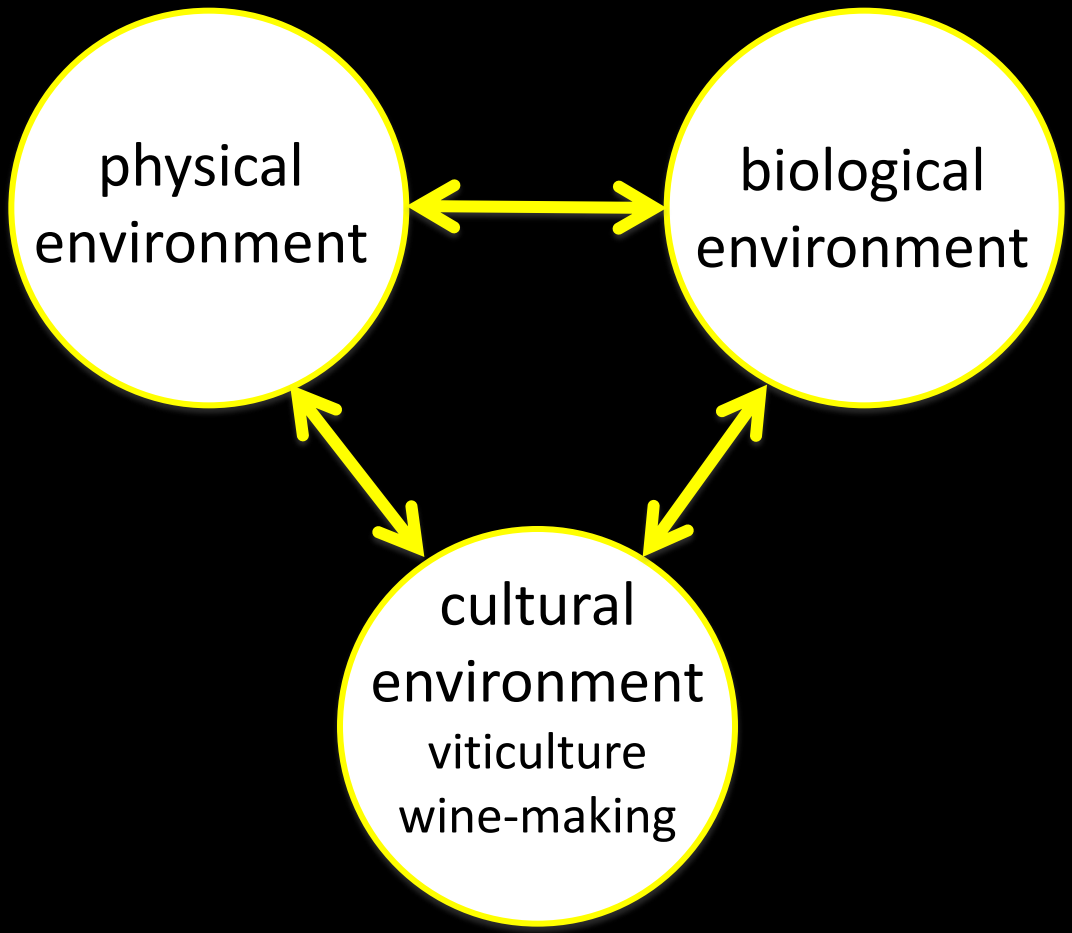
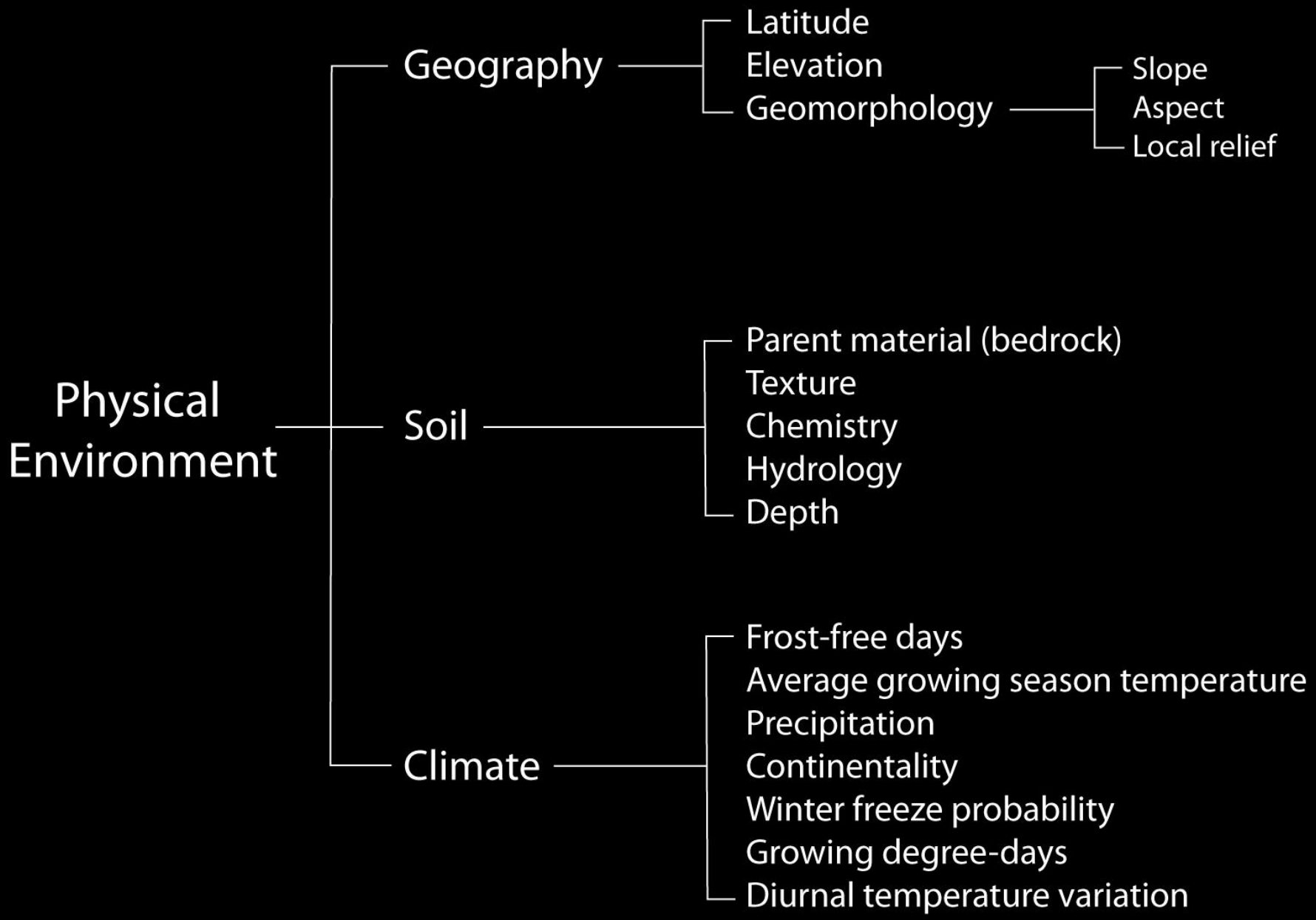
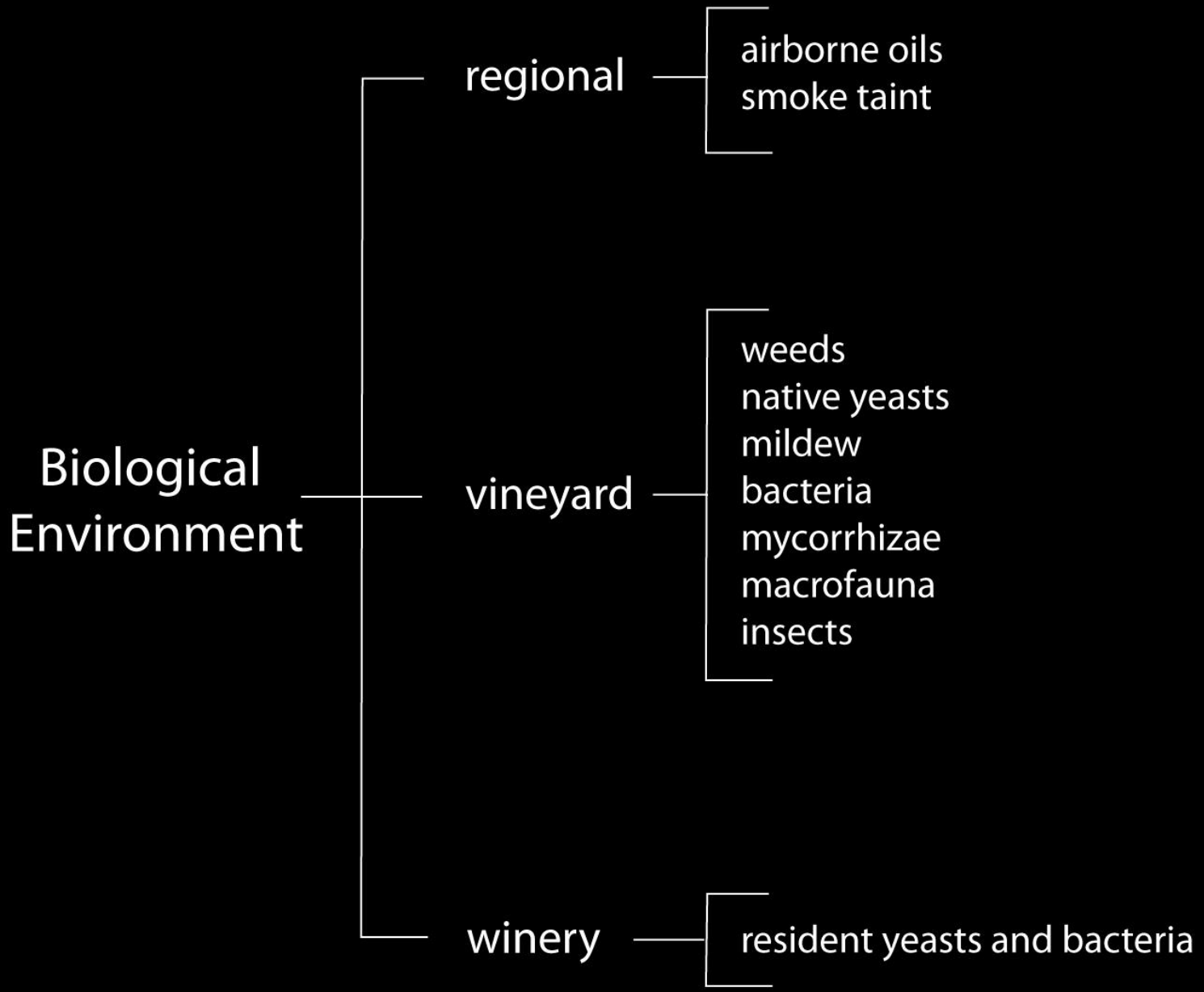
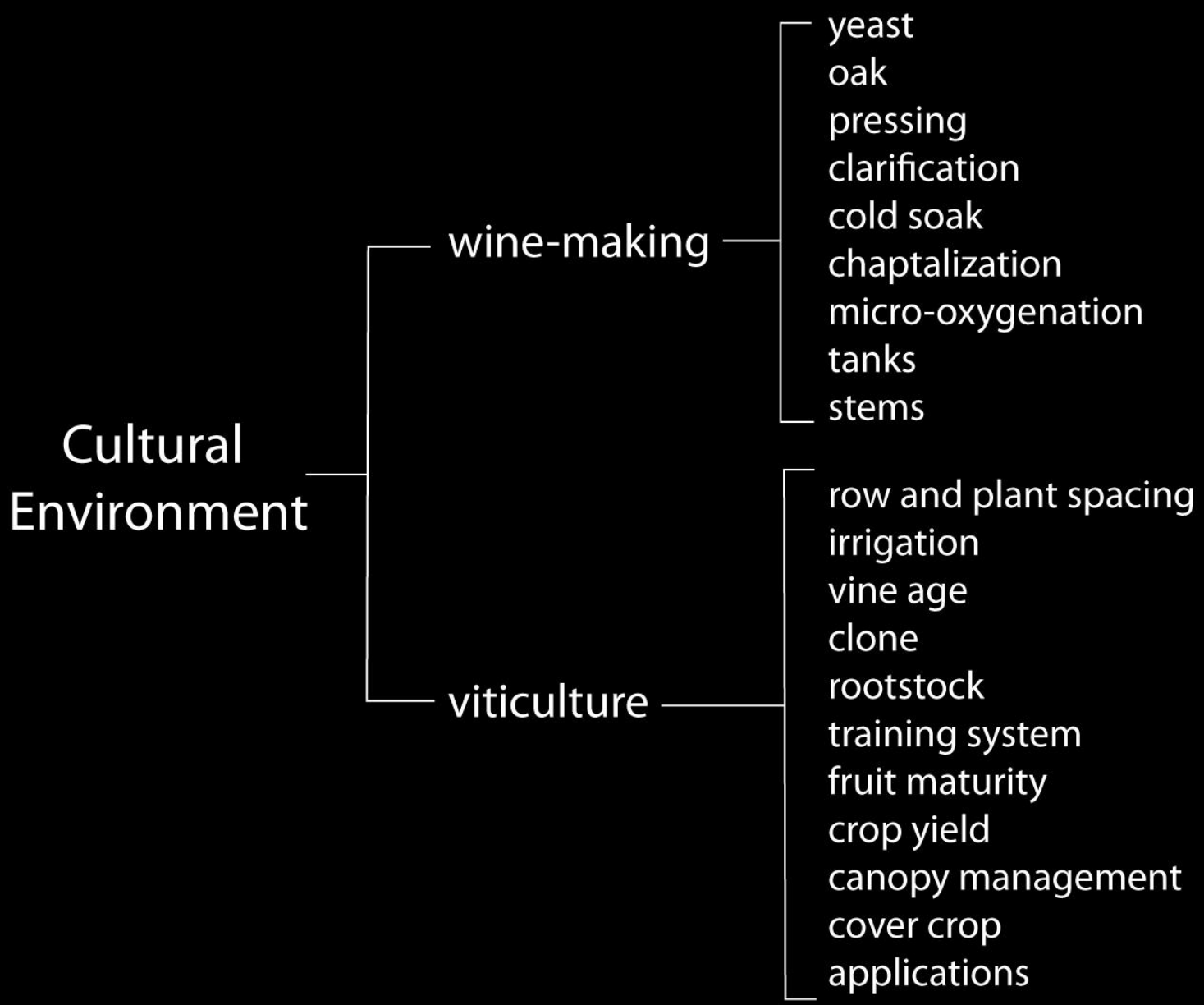


Must be identifiable – demonstrable cause and effect.


Physical Environment
Geography
Latitude
Elevation
Geomorphology
Slope
Aspect
Local relief
Soil
Parent material (bedrock)
Texture
Chemistry
Hydrology
Depth
Climate
Frost-free days
Average growing season temperature
Precipitation
Continentality
Winter freeze probability
Growing degree-days
Diurnal temperature variation


Biological Environment
regional
airborne oils
smoke taint
vineyard
weeds
native yeasts
mildew
bacteria
mycorrhizae
macrofauna
insects
winery
resident yeasts and bacteria


Cultural Environment
wine-making
yeast
oak
pressing
clarification
cold soak
chaptalization
micro-oxygenation
tanks
stems
viticulture
row and plant spacing
irrigation
vine age
clone
rootstock
training system
fruit maturity
crop yield
canopy management
cover crop
applications

The cultural component

The cultural component of terroir as presented in the OIV definition consists of area-wide practices that have evolved from collective knowledge of the impacts of that area's physical and biological environment on viticulture and wine-making.

These traditional practices have become codified within many wine-growing regions in Europe.

In areas with no restrictions on viticultural or wine-making practices, the cultural component of terroir is negligible. Variations in these practices serve primarily to dilute areal signatures of the physical and biological components.

Summary of regulations "L' Appellation d'Origine Controlée", May 15th 1936. Already applicable as of the 1931 vintage.

Geography and soil	5 communes are included: Châteauneuf-du-Pape, Courthézon, Bédarrides, Orange, and Sorgues. Natural delimitation of the area to be planted with vines, only land of Miocene soils, excluding Alluvial (young) soil from the Rhône.
Grape varieties	13 allowed grape varieties: Grenache, Syrah, Mourvèdre, Picpoul, Terret Noir, Counoise, Muscardin, Vaccarèse, Picardan, Cinsault, Clairette, Roussane, and Bourboulenc.
Planting density	2 m vine distance; 2.5 m row distance; maximum of 3,000 vines/ha. Not more than 15% vines missing failure per plot is allowed.
Pruning	Goblet is obliged for all grape varieties except for Syrah. Bilateral cordon de royat or guyot is authorized.
Harvest	Only manual.
Yield	Vines must be 4 years old. Maximum yield of 36 hl/ha - never more than 39 hl/ha.
Irrigation	Only permitted twice a year, in case of drought.
Alcohol degree	12.5° minimum.
Sugar level	225 g/l minimum.
Volatile acids	1 g maximum.
Chaptalization	Not allowed.
Rosé	Not allowed to produce.
Râpé (discarding)	Every year the Râpé percentage is determined by a commission at a minimum of 5%.

Summary of Chateauneuf du Pape AOC Regulations

These regulations help to shape a region-wide cultural terroir.

Source: Harry Karis, The Chateauneuf-du-Pape Wine Book

A critical element of the OIV definition of terroir is that the interaction of the physical, biological, and cultural environment must provide “distinctive characteristics”.

Without this requirement, terroir is simply “vineyard geography”. The links between unique geographies, vines, and unique wine sensory experiences are crucial to the concept.

Every wine is produced in a unique environment, but not all wines have site-derived characteristics that readily distinguish them.

“Everyone can talk, but not everyone has something to say”.

Alice Feiring

Myth #2

"Terroir is a subjective or even metaphysical concept that cannot be scientifically verified."

Corollary #1: "Since it's not science, it's not real."

Corollary #2: *Real* scientists don't study terroir and *real* scientific journals don't publish terroir-related articles or even mention the concept.

Question:

What do we call region-wide variations in measureable characteristics of grapes and wines that are related to measureable yearly variations in that region's physical and biological environment?

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Answer: Vintage variation!

Vintage variation can be thought of as temporal terroir – variations in the characteristics of grapes and wine related to variations over time in the physical and biological environment.

No one, it seems, is in denial of vintage variation, or the fact that it is quite easy to relate variations in parameters such as cluster weight, brix, alcohol, acid, and phenolics to yearly variations in the environment (e.g. date of first frost, GDD, precipitation patterns, incidence of mildew).

Then why deny terroir, which is variation in the characteristics of grapes and wine related to spatial variations in the physical and biological environment?

Over the last 20 years, dozens of scientific articles have focused on the link between wine characteristics and the physical and biological environment of vineyards. Currently, a “hot topic” in terroir research is the uniqueness of the vineyard microbiome and its affects on wine chemistry and sensory components.

Influence of Climate, Soil, and Cultivar on Terroir

Cornelis van Leeuwen,[1,2*] Philippe Friant,[1] Xavier Choné,[1,2]
Olivier Tregoat,[1,2] Stephanos Koundouras,[2] and Denis Dubourdieu[2]

American Journal of Enology and Viticulture, v. 55, 2004.

"The effects of climate, soil, and cultivar were found to be highly significant with regard to vine behavior and berry composition. It is likely that the effects of climate and soil on fruit quality are mediated through their influence on vine water stress."

The role of soil chemistry in wine grape quality and sustainable soil management in vineyards

D.E. Mackenzie and A.G. Christy

Department of Earth and Marine Sciences, The Australian National University, Canberra ACT 0200, Australia (E-mail: *Doug.Mackenzie@ems.anu.edu.au*; *andyc@ems.anu.edu.au*)

Water Science and Technology, v. 51, 2005

"It is evident from our results that soil cation chemistry does indeed have an influence on wine grape composition. Such knowledge has the potential to be used in better tailoring grape varieties to soils..."

Influence of Geographic Origin on the Sensory Characteristics and Wine Composition of *Vitis vinifera* cv. Cabernet Sauvignon Wines from Australia

Anthony L. Robinson,[1] Douglas O. Adams,[2] Paul K. Boss,[3]
Hildegarde Heymann,[2*] Peter S. Solomon,[4] and Robert D. Trengove[1]

American Journal of Enology and Viticulture, v. 63, 2012.

"Results demonstrate the Australian Cabernet Sauvignon wines have common sensory attributes related to geographic origin."

Regional microbial signatures positively correlate with differential wine phenotypes: evidence for a microbial aspect to *terroir*

Sarah Knight[1], Steffen Klaere[1,2], Bruno Fedrizzi[3] & Matthew R Goddard[1,4]

Nature, Scientific Reports, 2015.

"…these data show there is quantifiable microbial aspect to terroir, thus revealing the potential importance of microbial populations on the regional identity of wine…"

Pyrosequencing reveals regional differences in fruit-associated fungal communities

Michael W. Taylor,[1] Peter Tsai,[2] Nicole Anfang,[1]
Howard A. Ross[1,2] and Matthew R. Goddard[1]*
[1]*The School of Biological Sciences and*
[2]*Bioinformatics Institute, University of Auckland,*
Auckland, New Zealand.

Environmental Microbiology, v. 16, 2014.

"…the limited but increasing evidence showing that microbes, which may influence vines, also exhibit regional differentiation, supports the concept that there might be a microbial aspect to terroir."

Geographic delineations of yeast communities and populations associated with vines and wines in New Zealand

Velimir Gayevskiy and Matthew R Goddard
School of Biological Sciences, University of Auckland, Auckland Mail Centre, Auckland, New Zealand

Journal of the International Society of Microbial Ecology v. 6, 2012.

"… if different regions harbor different communities and populations, as we have shown, these may, in part, contribute to the distinctiveness of wines deriving from that areas: that is, there is a microbial aspect to terroir."

Associations among Wine Grape Microbiome, Metabolome, and Fermentation Behavior Suggest Microbial Contribution to Regional Wine Characteristics

Nicholas A. Bokulich,[a,b,c*] Thomas S. Collins,[b,d*] Chad Masarweh,[a] Greg Allen,[e] Hildegarde Heymann,[b] Susan E. Ebeler,[b,d] David A. Mills[a,b,c]

Journal of the American Society for Microbiology, v. 7, 2016.

"We show that grape and wine microbiota exhibit regional patterns that correlate with wine chemical composition, suggesting that the grape microbiome may influence terroir ."

Microbial biogeography of wine grapes is conditioned by cultivar, vintage, and climate

Nicholas A. Bokulich[a,b,c], John H. Thorngate[d], Paul M. Richardson[e], and David A. Mills[a,b,c,1]

Departments of [a]Viticulture and Enology and [b]Food Science and Technology, and [c]Foods for Health Institute, University of California, Davis, CA 95616; [d]Constellation Brands, Inc., Saint Helena, CA 94574; and [e]MicroTrek, Inc., San Francisco, CA 94104

Proceedings of the National Academy of Sciences, 2013.

"…regional, site-specific, and grape variety factors shape the fungal and bacterial consorta inhabiting wine-grape surfaces. Furthermore, these microbial assemblages are correlated to specific climate features.

… these factors shape the unique microbial inputs to regional wine fermentations, posing the existence of nonrandom microbial terroir as a determiong factor in regional variation among wine grapes."

Vineyard soil bacterial diversity and composition revealed by 16S rRNA genes: Differentiation by geographic features

Kayla N. Burns [a], Daniel A. Kluepfel [b], Sarah L. Strauss [b], Nicholas A. Bokulich [a, c, 1], Dario Cantu [a], Kerri L. Steenwerth [b, *]

[a] Department of Viticulture and Enology, University of California, Davis, One Shields Avenue, Davis, CA 95616, USA
[b] USDA-ARS Crops Pathology and Genetics Research Unit, University of California, Davis, One Shields Avenue, Davis, CA 95616, USA
[c] Foods and Health Institute and Department of Food Science and Technology, University of California, Davis, One Shields Avenue, Davis, CA 95616, USA

Soil Biology and Biochemistry, v. 91, 2015.

"We reason that AVA, climate, and topography each affect soil microbial communities through their impacts on soil properties...

"The identification of distinctive microbial communities with AVA lends support to the idea that soil microbial communities of wine grapes form a key in linking wine terroir back to the biotic components of the soil environment."

Vineyard and fermentation studies to elucidate the origin of 1,8-cineole in Australian red wine.

Capone DL[1], Jeffery DW, Sefton MA.

Journal of Agriculture and Food Chemistry, v. 60, 2012.

"Preliminary investigations revealed that the proximity of Eucalyptus trees to grapevines can directly influence the concentration of the aroma compound 1,8-cineole present in the corresponding red wines."

Myth #3

Terroir is mostly (or entirely) about dirt (or rocks).

Corollary: My vineyard's dirt (or bedrock) is not the same as your dirt (or bedrock), so obviously my wine is going to be different from yours.

Terroir is not mostly about anything, it's about the influence on wine of the collective interaction of <u>everything</u> in the physical and biological environment. "Tasting the limestone" may sound romantic, but is no different than saying that you can "taste the 30° slope" or "the 220° aspect" or "the 32 inches of annual precipitation". Limestone doesn't have a flavor, and neither does the 220° aspect. Bedrock type is just one influence of many.

The deep and widespread Schist Rock that lies beneath our Mt McKenzie grapeyard is clearly expressed, along with spice and dark fruits…

Eden Valley Shiraz at its purest.

ALCOHOL 14% BY VOLUME - 750ml

Wine Enthusiast Magazine, March 2017

How does bedrock influence soil and vines?

- If the soil above the bedrock is deep and was transported from somewhere else (alluvial, eolian) the local bedrock may have no influence at all.

- The type of soil that forms from the weathering of a particular type of rock is strongly affected by climate and local topography, so very different types of soil can be derived from identical bedrock.

How does bedrock influence soil and vines?

- Most important for vines are the textural, hydrologic, and thermal properties of soils.

- Soil chemistry, which may be related to bedrock, helps to determine a vineyard's microbiota, which can have an important role in the synthesis of aroma and flavor compounds during fermentation.

Myth #4

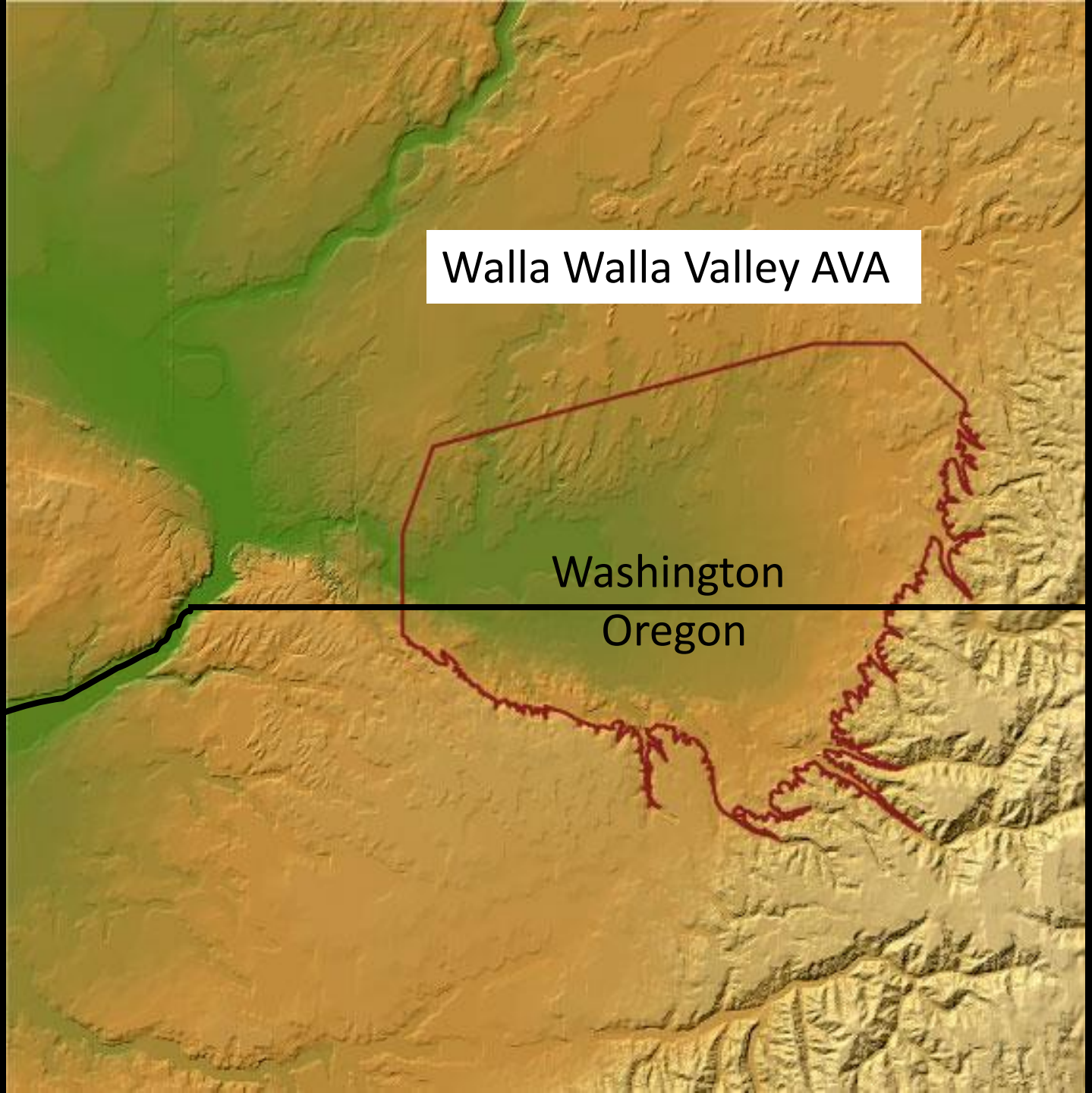
Each American Viticultural Area (AVA) has its own unique terroir.

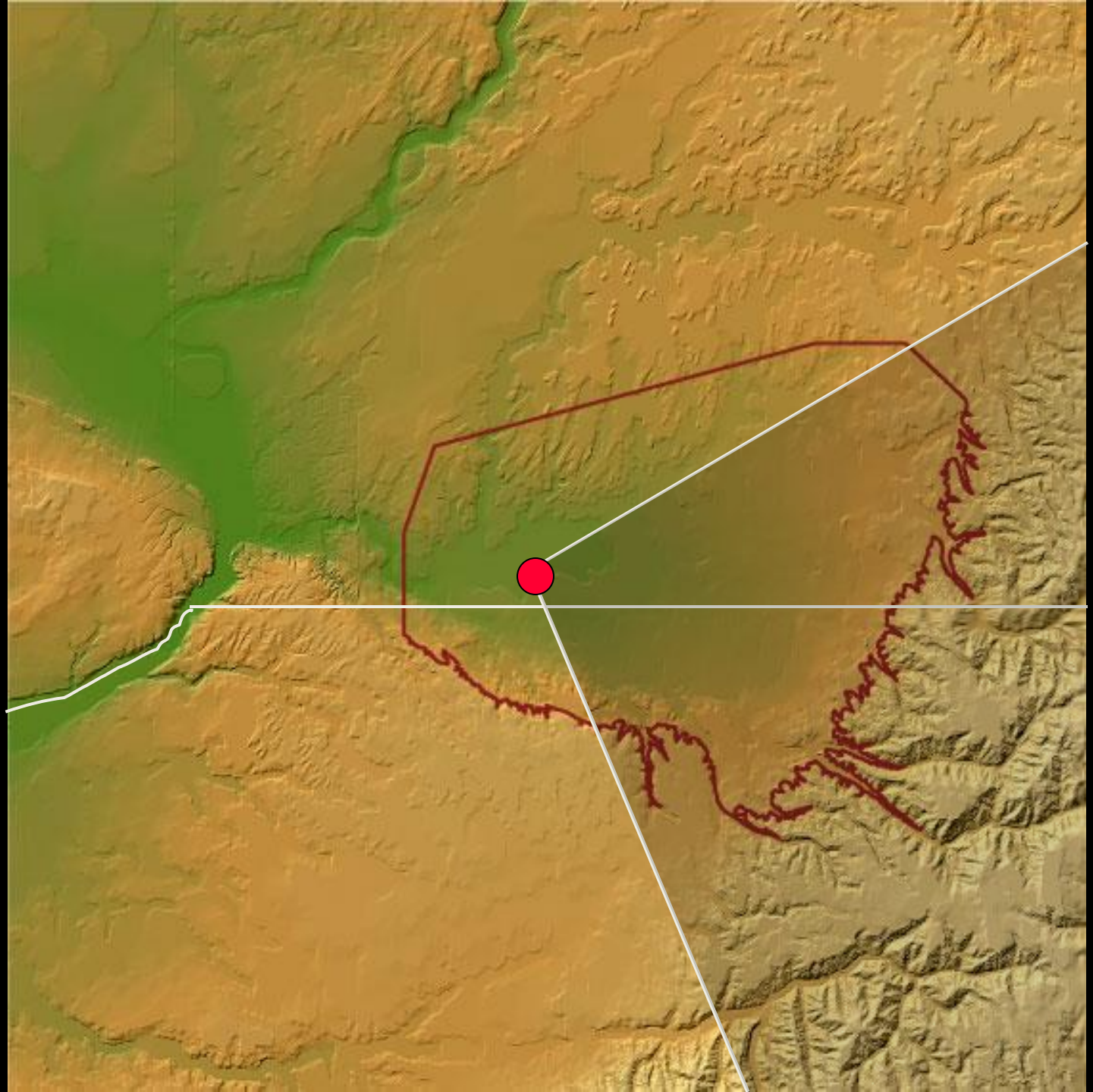
Corollary: It's perfectly reasonable to make reference to "Willamette Valley terroir" or "Walla Walla Valley terroir".

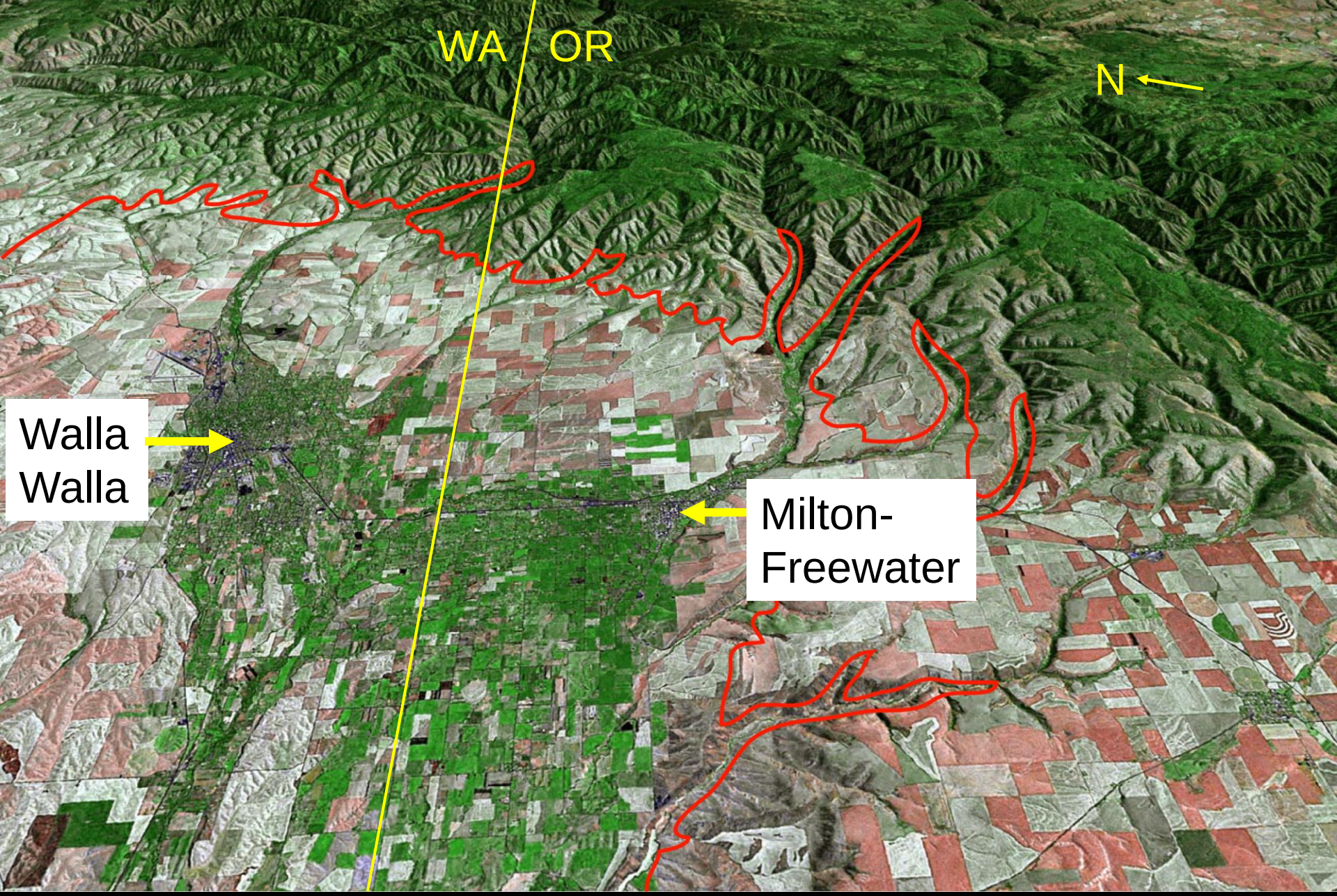
- When describing terroir, the physical, biological, or cultural attributes identified as producing the distinctive characteristic must be present throughout the area in question, and provide an identifiable sensory characteristic.

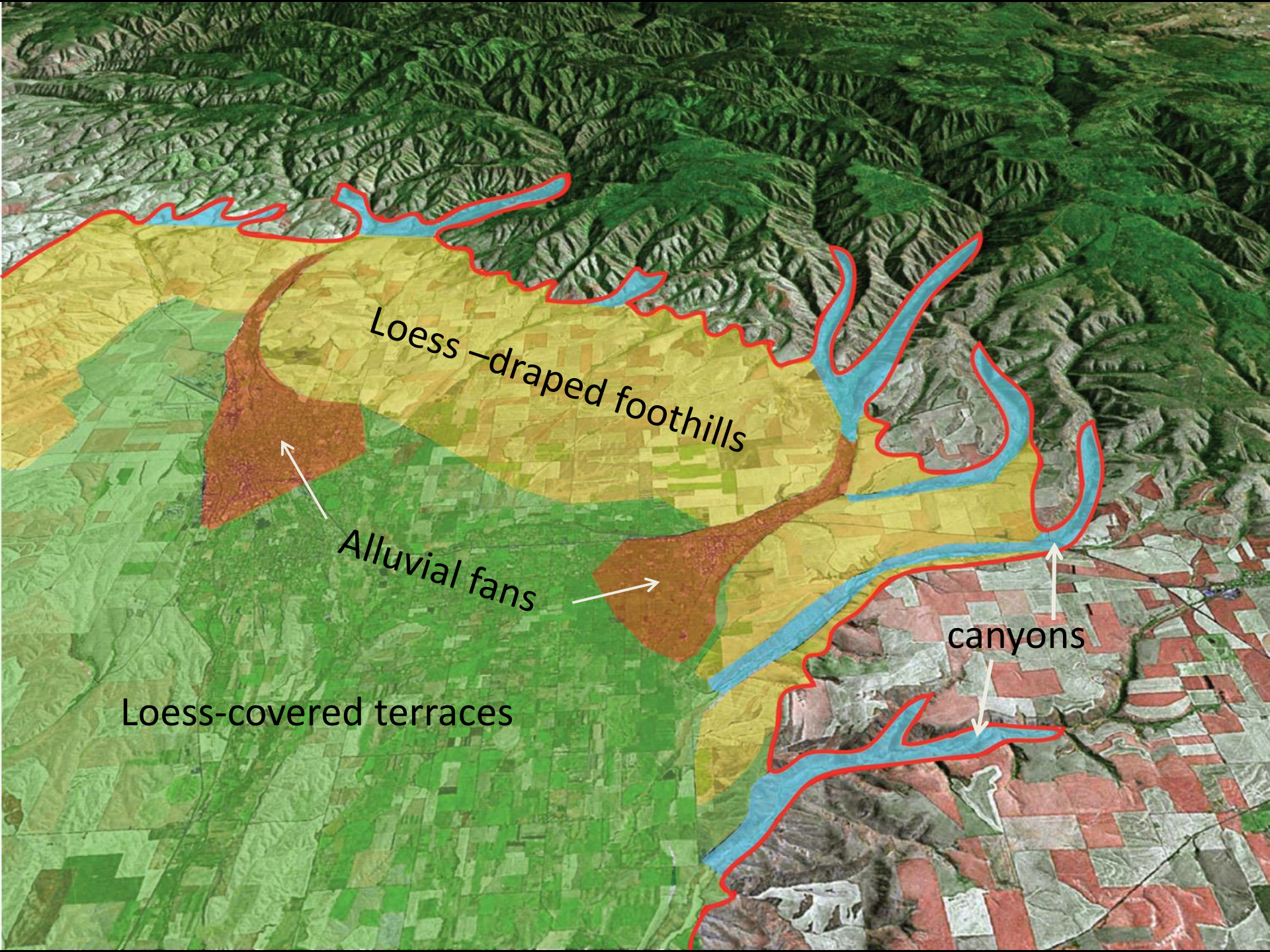
- Since larger areas tend to have greater variations in these attributes, terroir is a concept that becomes progressively more applicable, and its impacts more discernable, as the area diminishes in size.

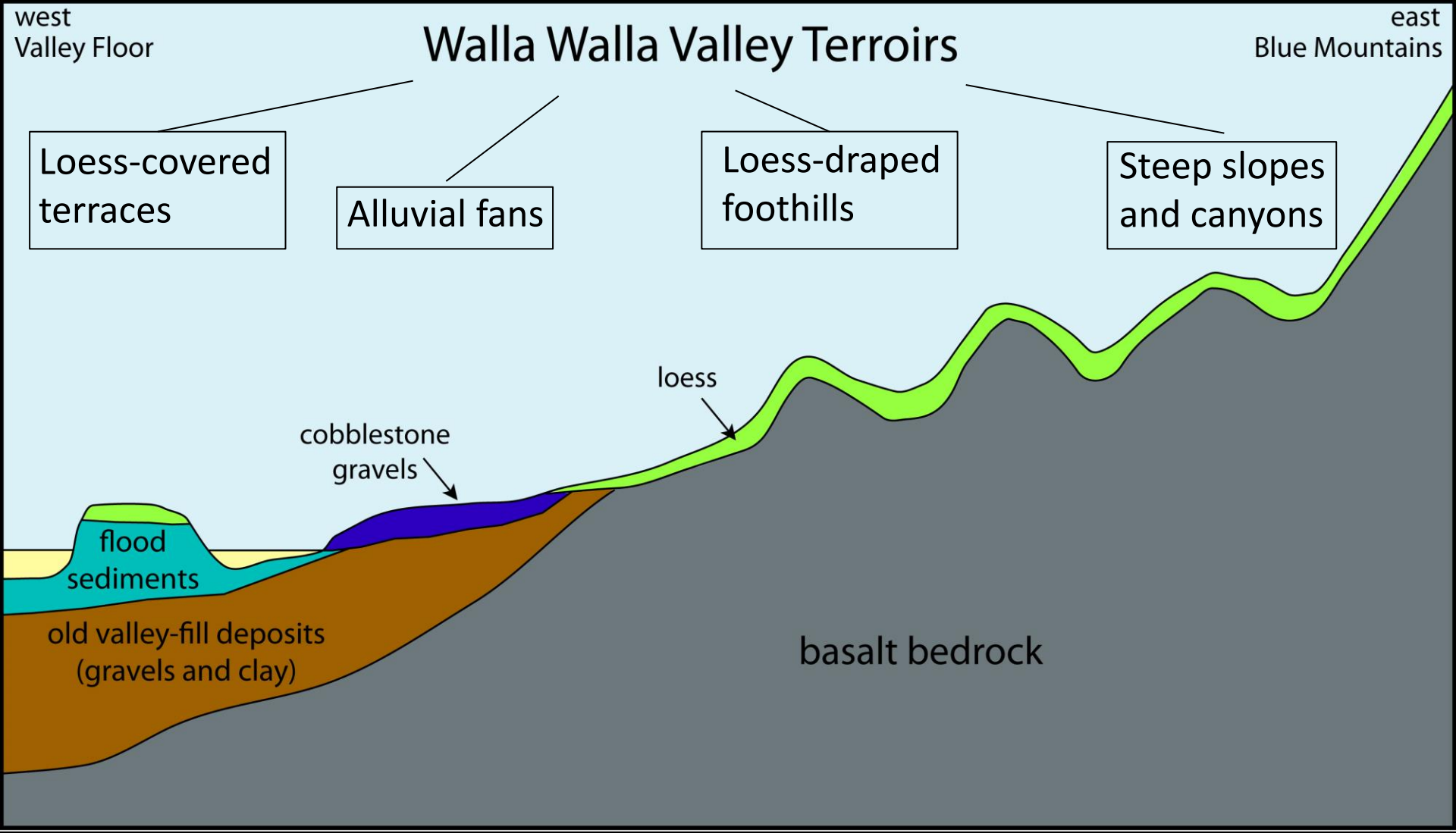
- Terroir is therefore primarily a vineyard-scale phenomenon. AVAs should be viewed as collections of terroirs assembled for the purpose of marketing a wine-producing region.


Walla Walla Valley AVA
Washington
Oregon




WA
OR
N
Walla
Walla
Milton-
Freewater


Loess –draped foothills
Alluvial fans
canyons
Loess-covered terraces


west
Valley Floor
Walla Walla Valley Terroirs
east
Blue Mountains
Loess-covered terraces
Alluvial fans
Loess-draped foothills
Steep slopes and canyons
loess
cobblestone gravels
flood sediments
old valley-fill deposits (gravels and clay)
basalt bedrock

Loess covered terraces - elevation 700-1200 ft.

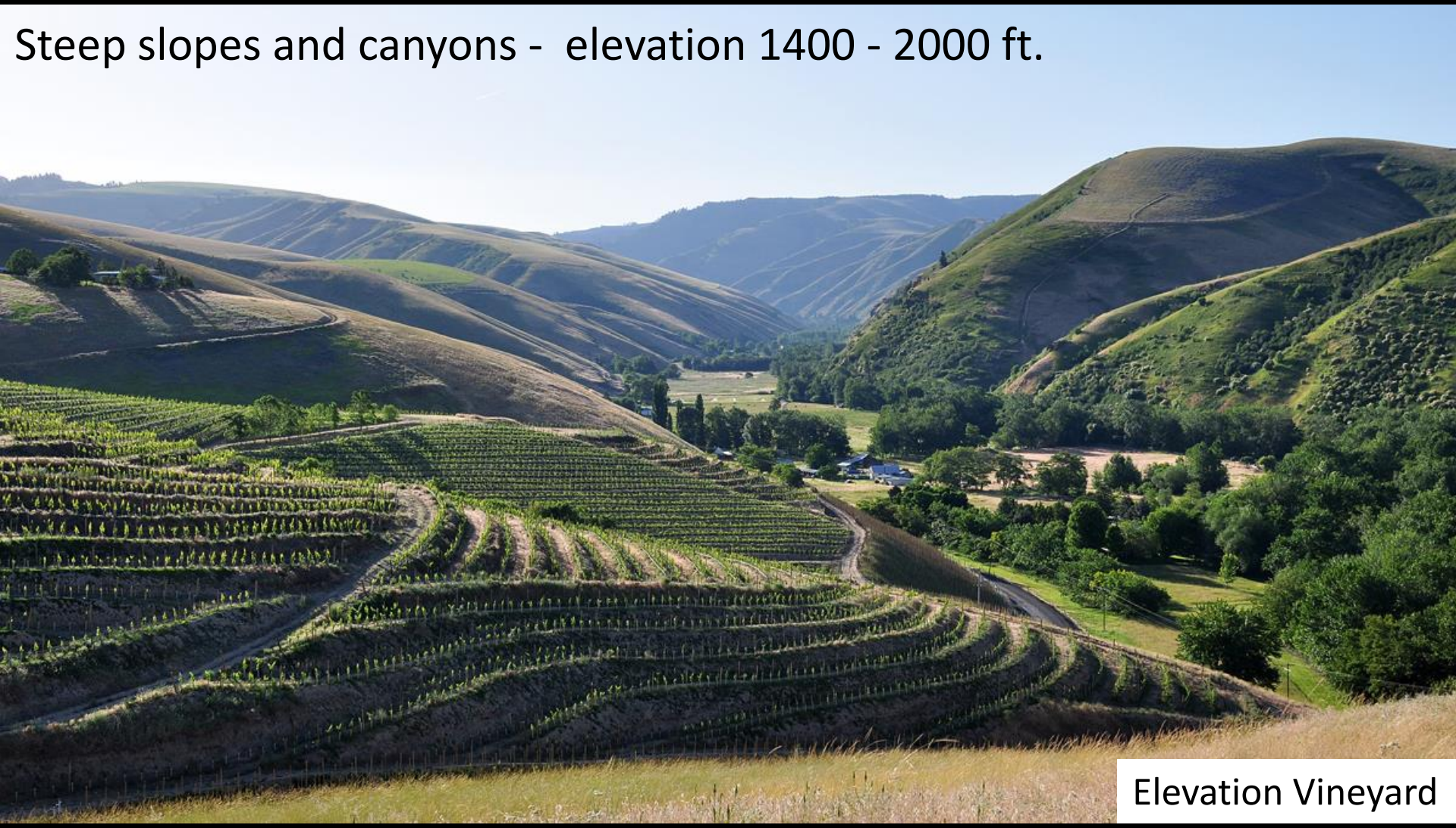
Pepper Bridge Vineyard


Alluvial fans - elevation 800-1000 ft.
Stoney Vine Vineyard

Loess-draped foothills - elevation 1100-2000 ft.

Spring Valley Vineyard

Steep slopes and canyons - elevation 1400 - 2000 ft.



Elevation Vineyard

(this is Oregon…)

Loess covered terraces

Loess over Ice Age Flood deposits

Alluvial fans

Basalt cobblestone gravels

Loess-draped foothills

Deep loess with calcareous horizons

Steep slopes and canyons

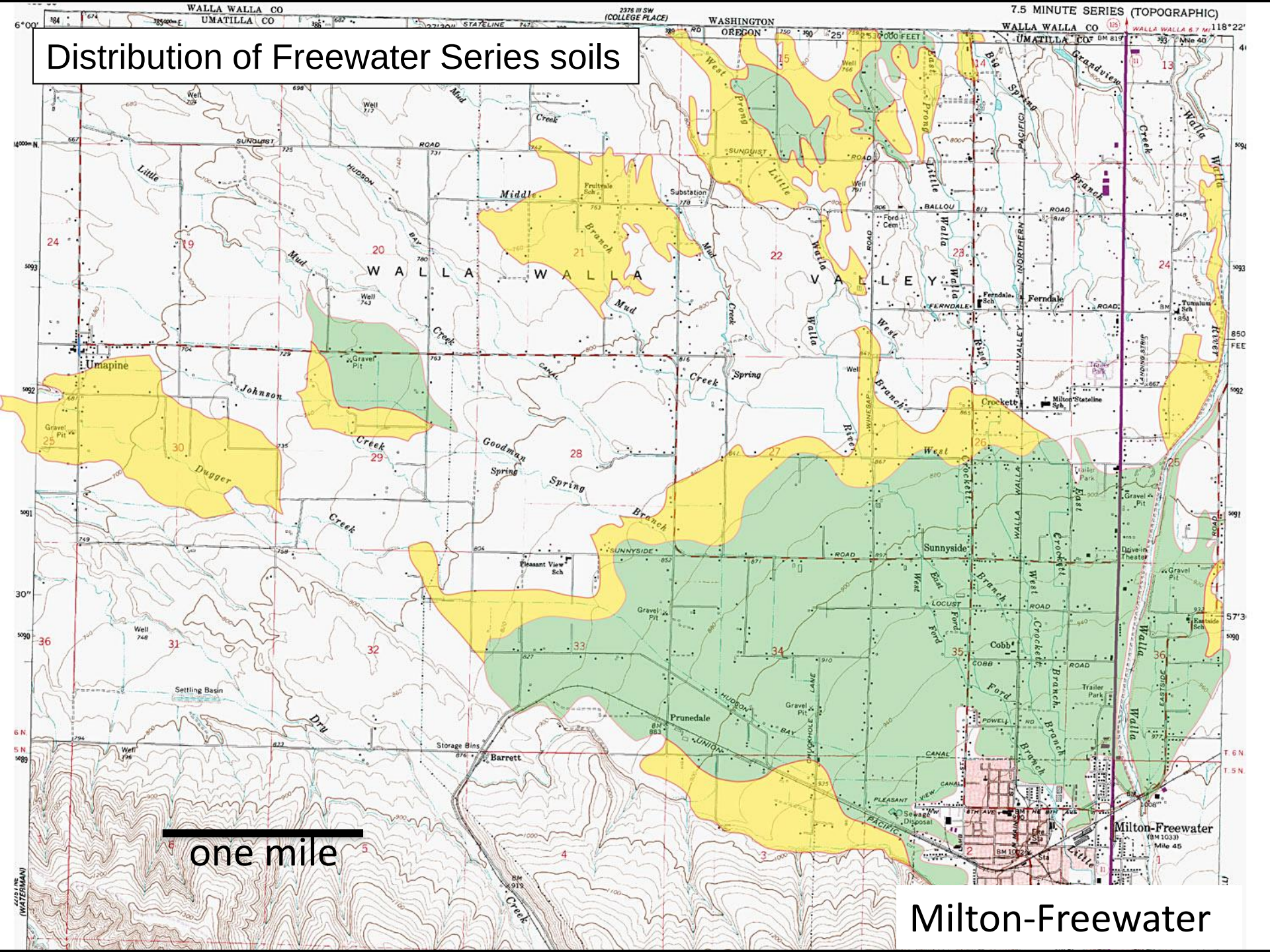
Shallow loess over basalt bedrock

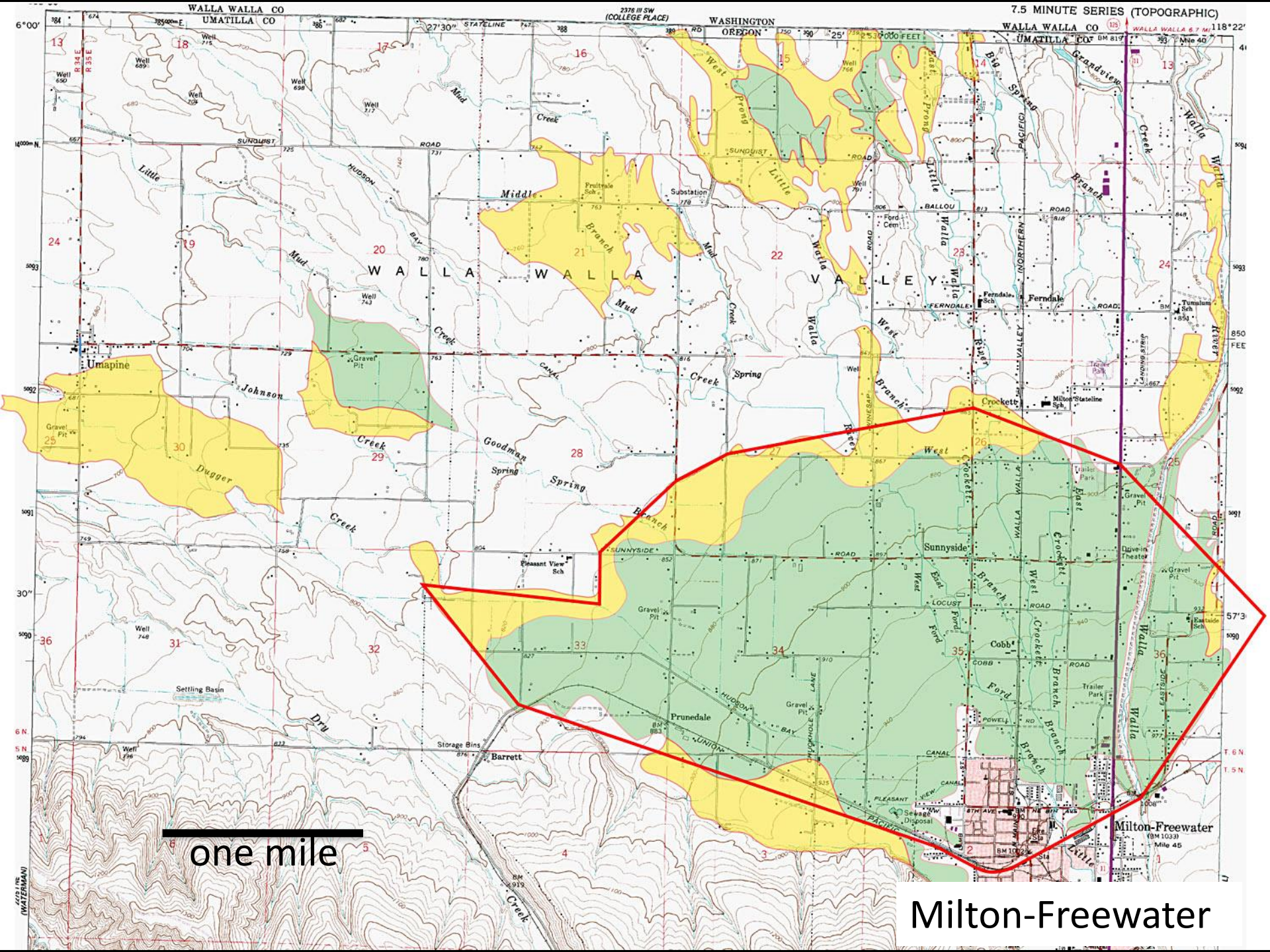
A truly terroir-driven AVA would have boundaries that enclosed an area that was as uniform as possible with regard to:

- Geologic substrate
- Soil type
- Topography – slope, aspect, etc.
- Elevation
- Climate

In February 2015, the Rocks District of Milton-Freewater was approved as Oregon's 18th American Viticultural Area. Based on the uniformity of the physical characteristics within its boundaries, it is perhaps the most terroir-driven of the 239 AVAs within the US.

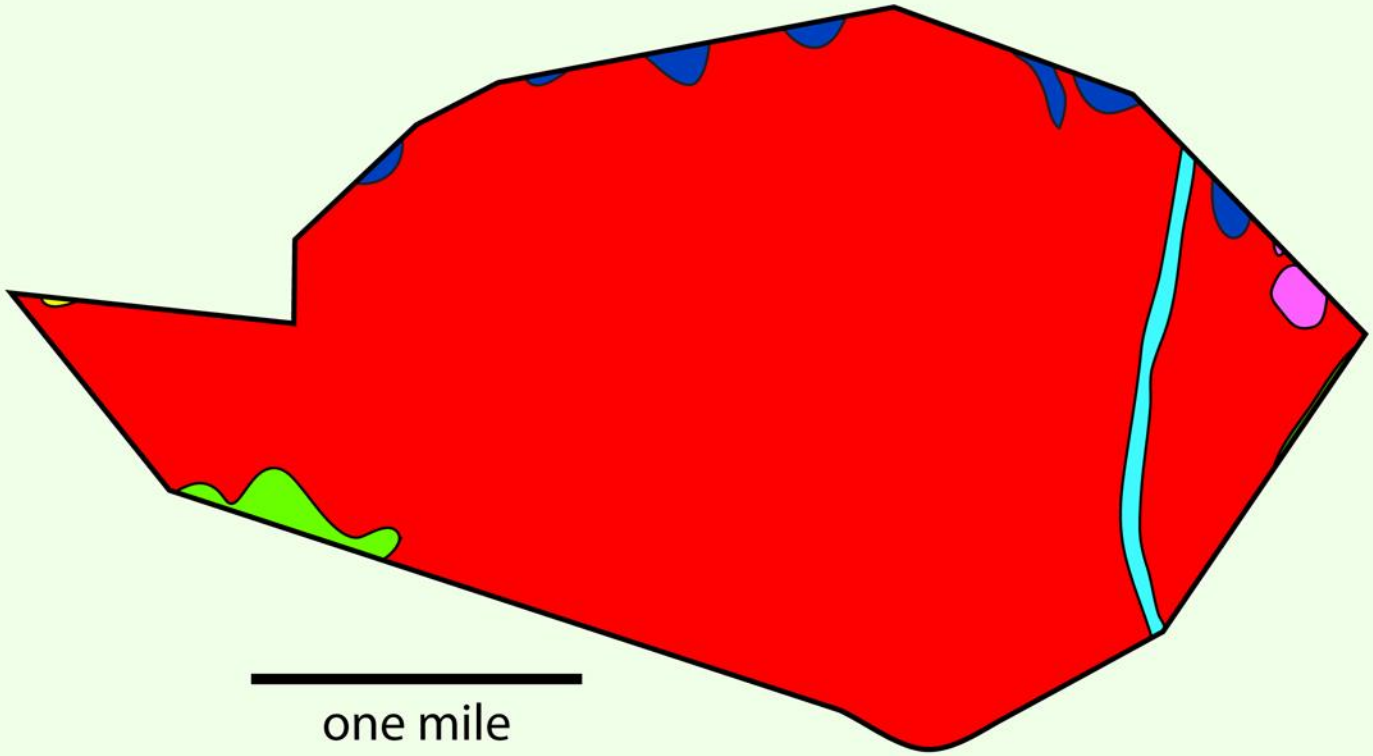
- A relatively small area (3770 acres) with a uniform climate
- 96% of soils belong to one soil series
- Occupies a single landform with similar slope and aspect
- Limited range of elevation
- Uniform geologic substrate


Distribution of Freewater Series soils
WALLA WALLA CO
UMATILLA CO
WASHINGTON
OREGON
7.5 MINUTE SERIES (TOPOGRAPHIC)
WALLA WALLA CO
UMATILLA CO
WALLA WALLA VALLEY
Umapine
Johnson Creek
Dugger Creek
Middle Mud Creek
Little Mud Creek
West Prong Little Mud Creek
East Prong Little Mud Creek
Goodman Spring
Spring Branch
Crockett Spring
Big Spring Creek
Grandview Branch
Walla Walla River
West Walla Walla River
Sunnyside
Ferndale
Crockett
Milton-Freewater
Prunedale
Barrett
Settling Basin
Storage Bins
Sewage Disposal
Pleasant View Sch
Milton-Stateline Sch
Ferndale Sch
Eastside Sch
Tumalum Sch
Fruitvale Sch
Substation
Cobb
Locust Ford
Powell Rd
Sunnyside Road
Ballou Road
Ferndale Road
Sundquist Road
Hudson Bay
Union Pacific
Northern Pacific
Pacific
Dry Creek
Drive-in Theater
Trailer Park
Gravel Pit
one mile
Milton-Freewater



Milton-Freewater

The Rocks District of Milton-Freewater AVA



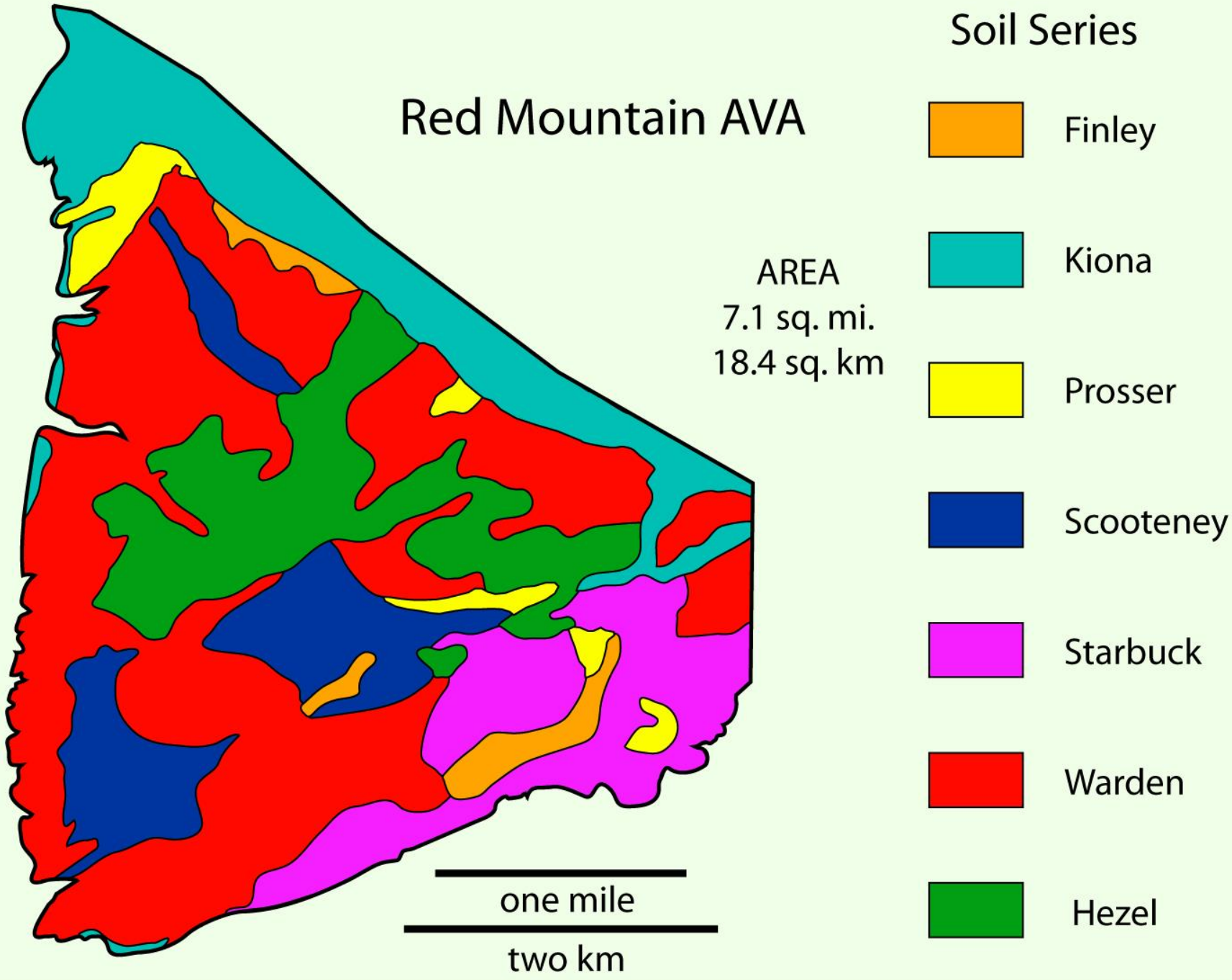
one mile

two km

AREA
5.9 sq. mi.
15.3 sq. km

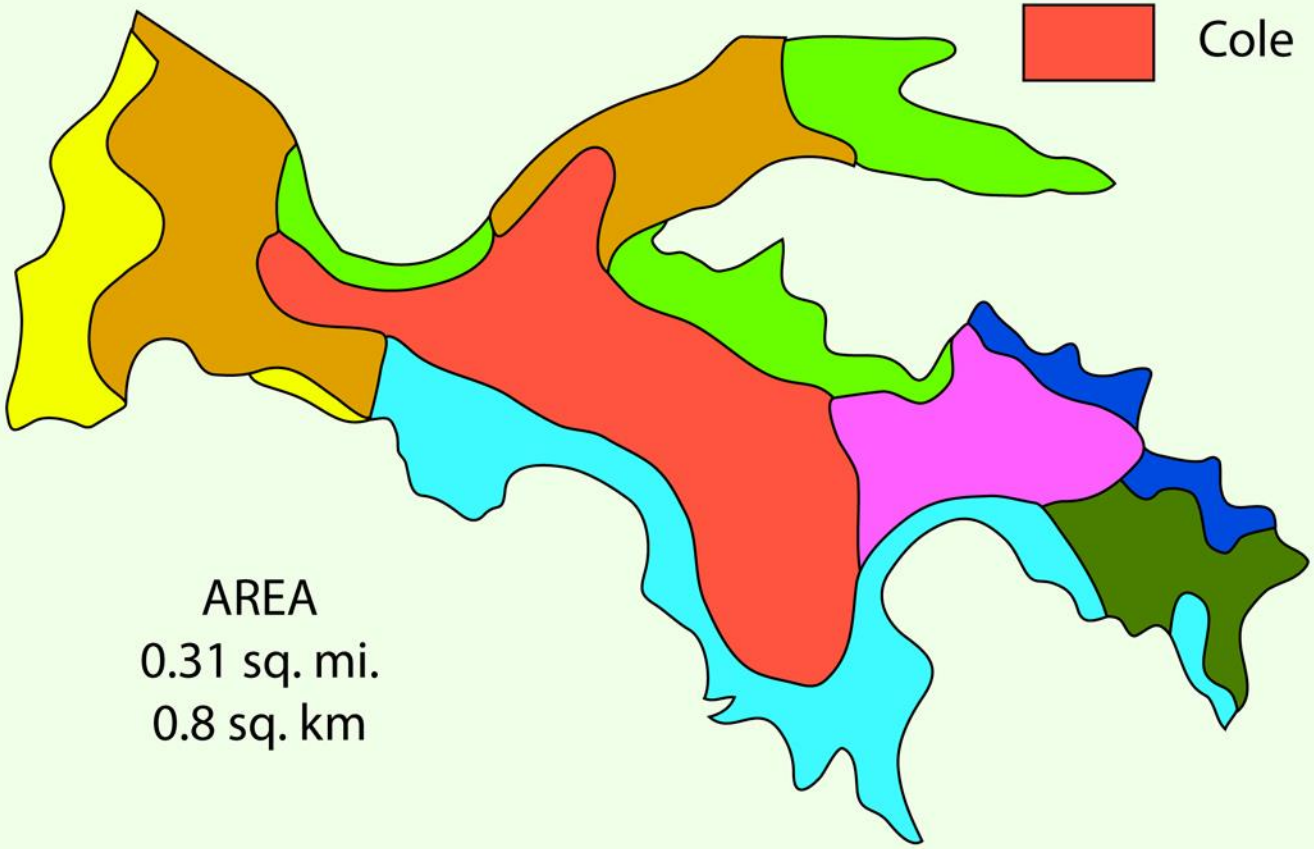
Soil Series

- Freewater
- Hermiston
- Onyx
- Yakima
- Riverwash
- Umapine
- Oliphant


Red Mountain AVA
AREA
7.1 sq. mi.
18.4 sq. km
Soil Series
Finley
Kiona
Prosser
Scooteney
Starbuck
Warden
Hezel
one mile
two km

Cole Ranch AVA

(smallest AVA)



AREA
0.31 sq. mi.
0.8 sq. km

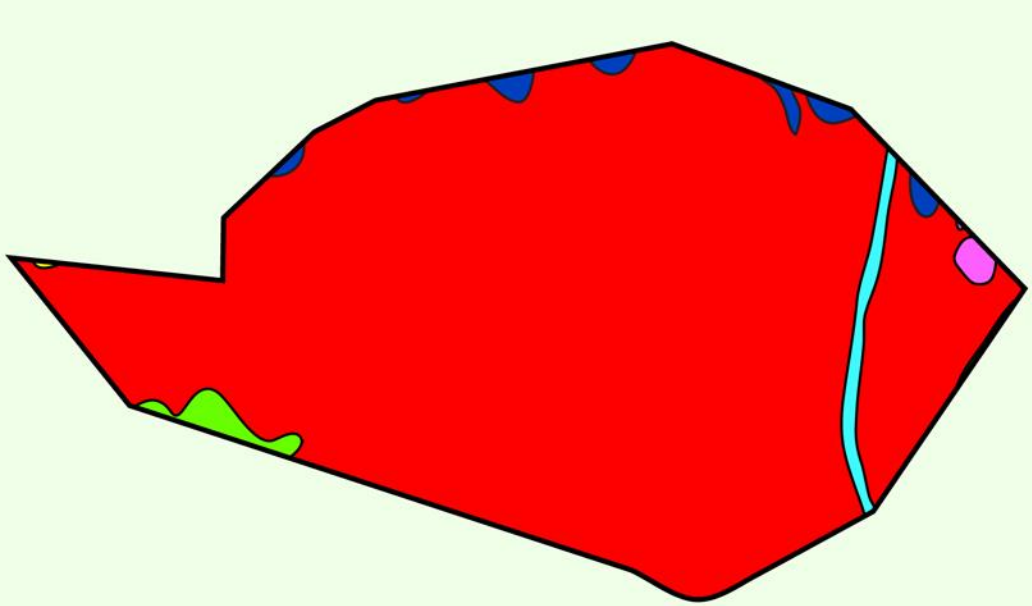
Soil Series

- Pinole
- Cole
- Bearwallow-Hellman
- Yorkville-Hopland-Woodland
- Bearwallow-Hellman-Witherall
- Yorktree-Yorkville
- Yorkville-Squawrock-Witherall
- Maxwell

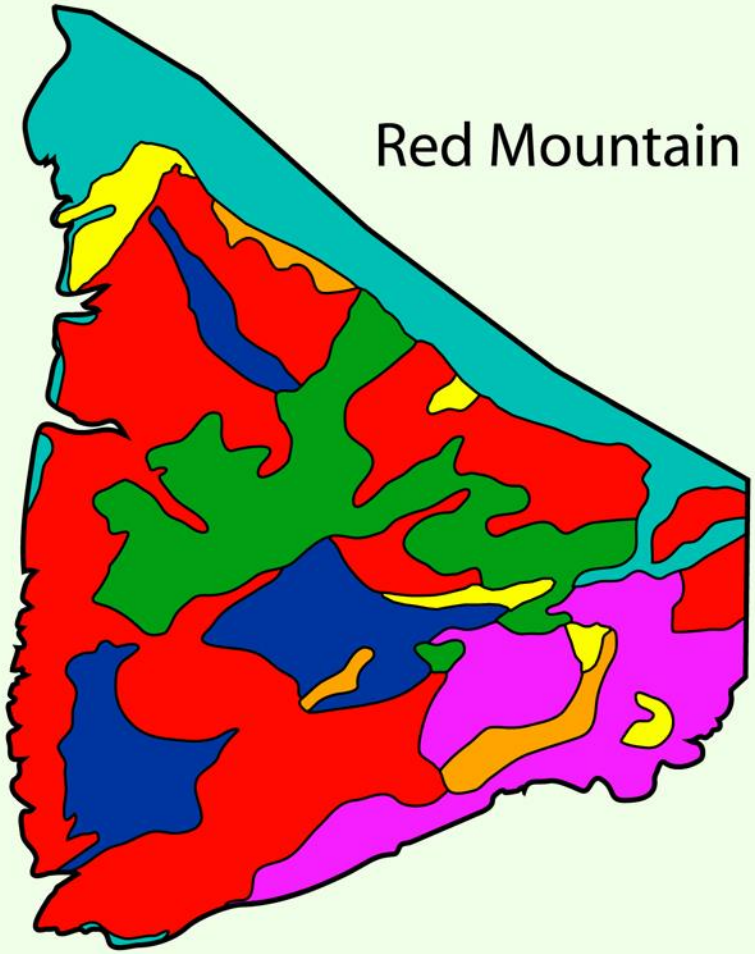
one mile

two km

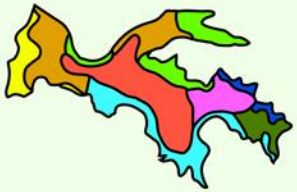
The Rocks District of Milton-Freewater



Red Mountain



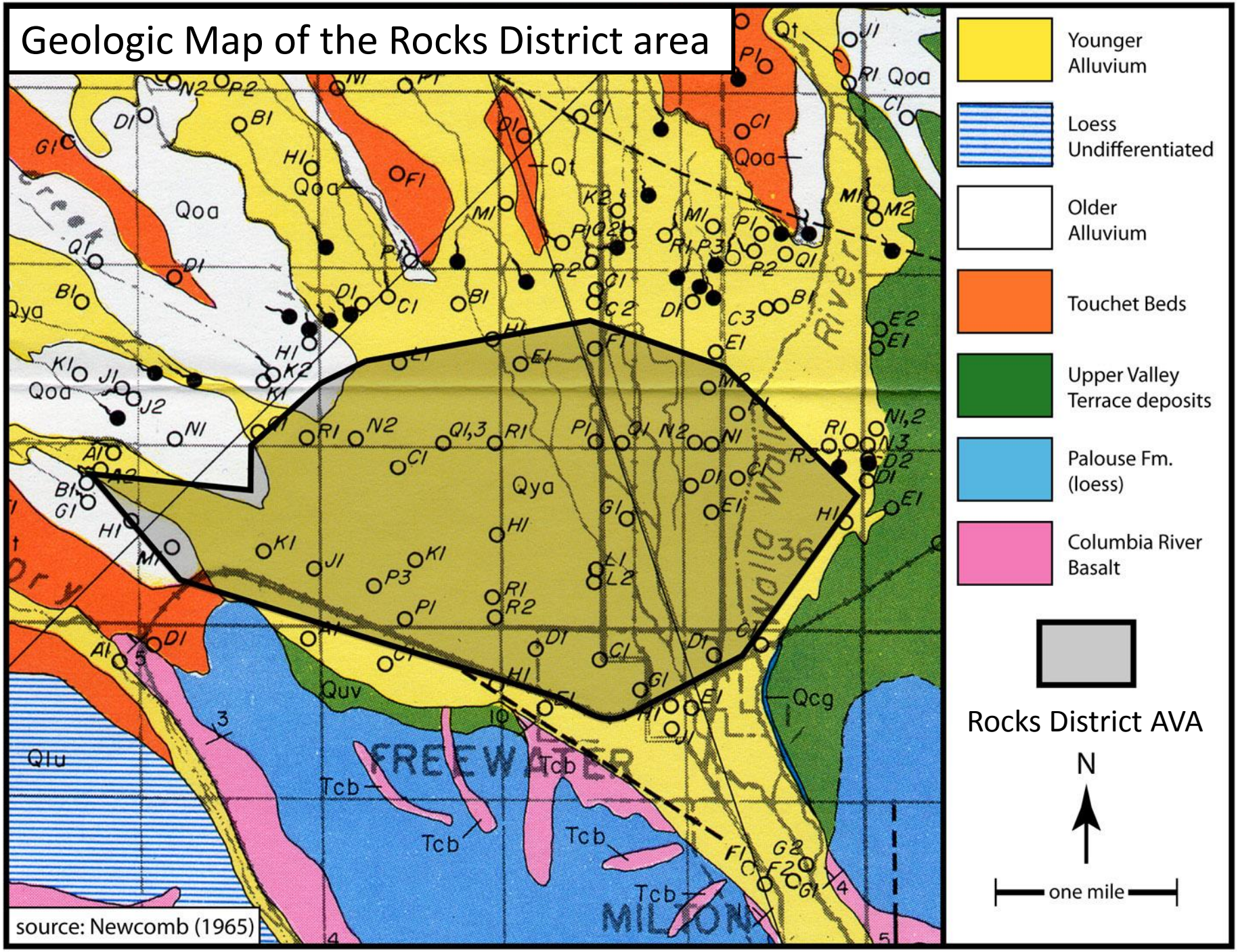
Cole Ranch

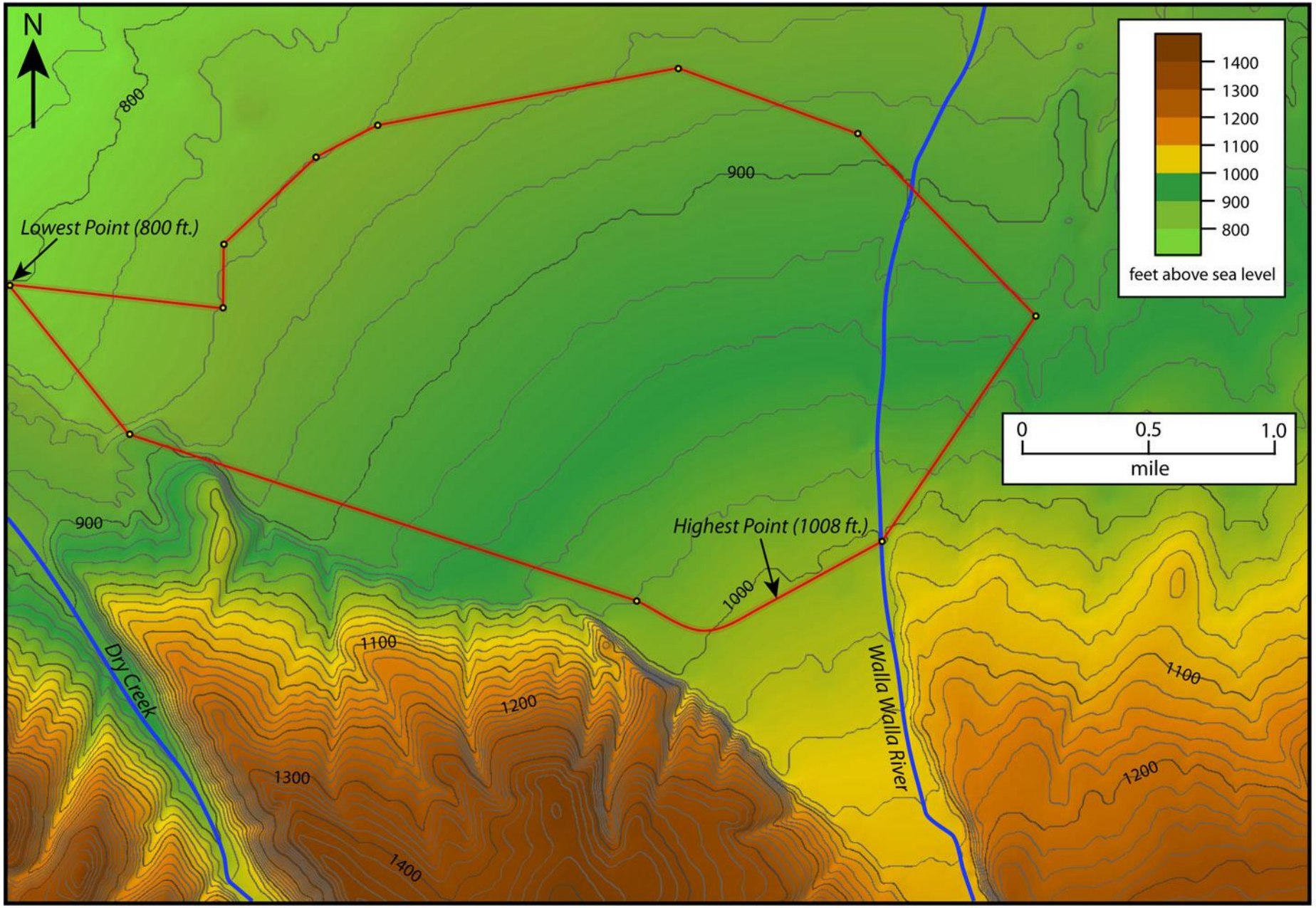


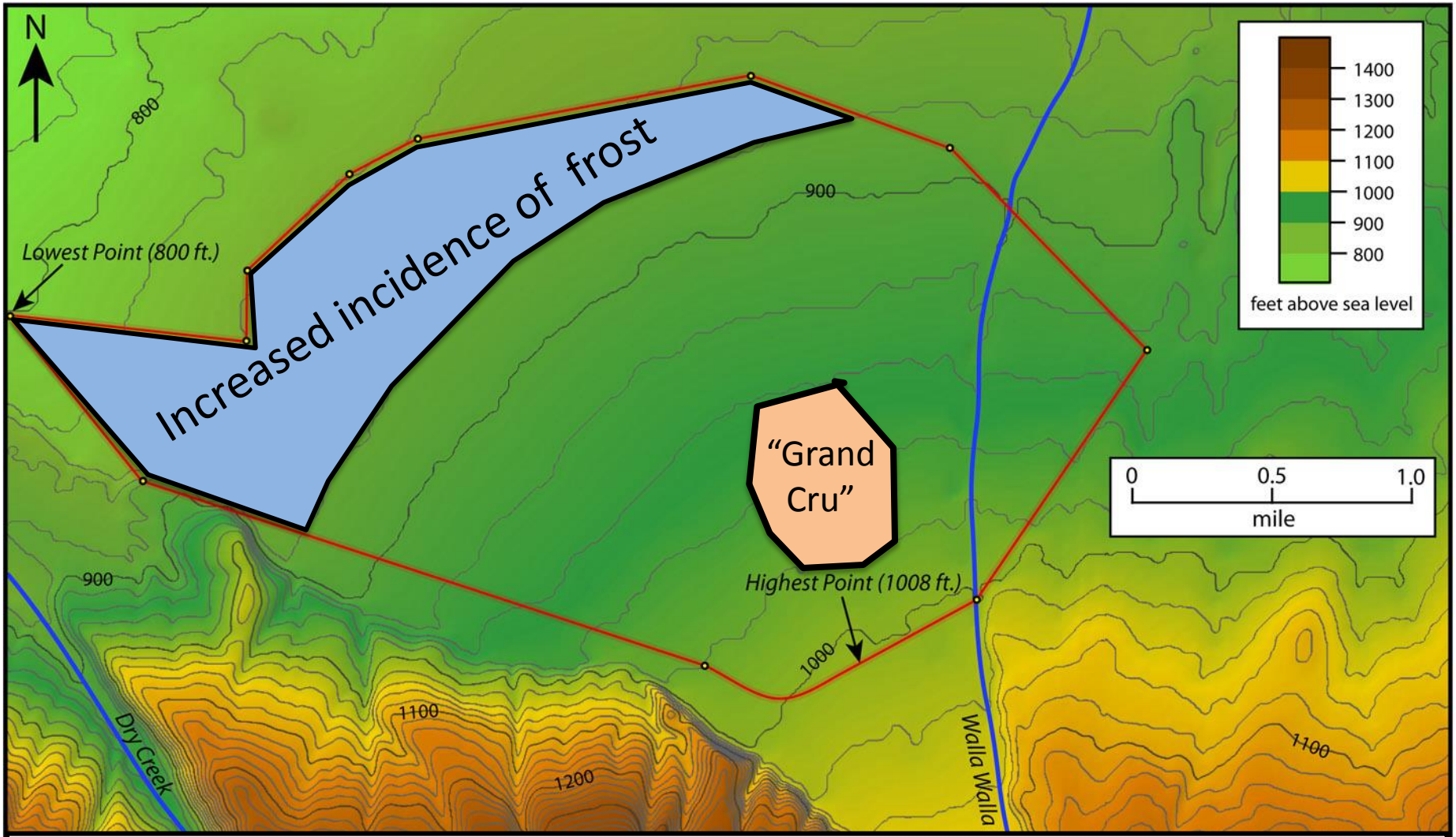
one mile

two km

Geologic Map of the Rocks District area

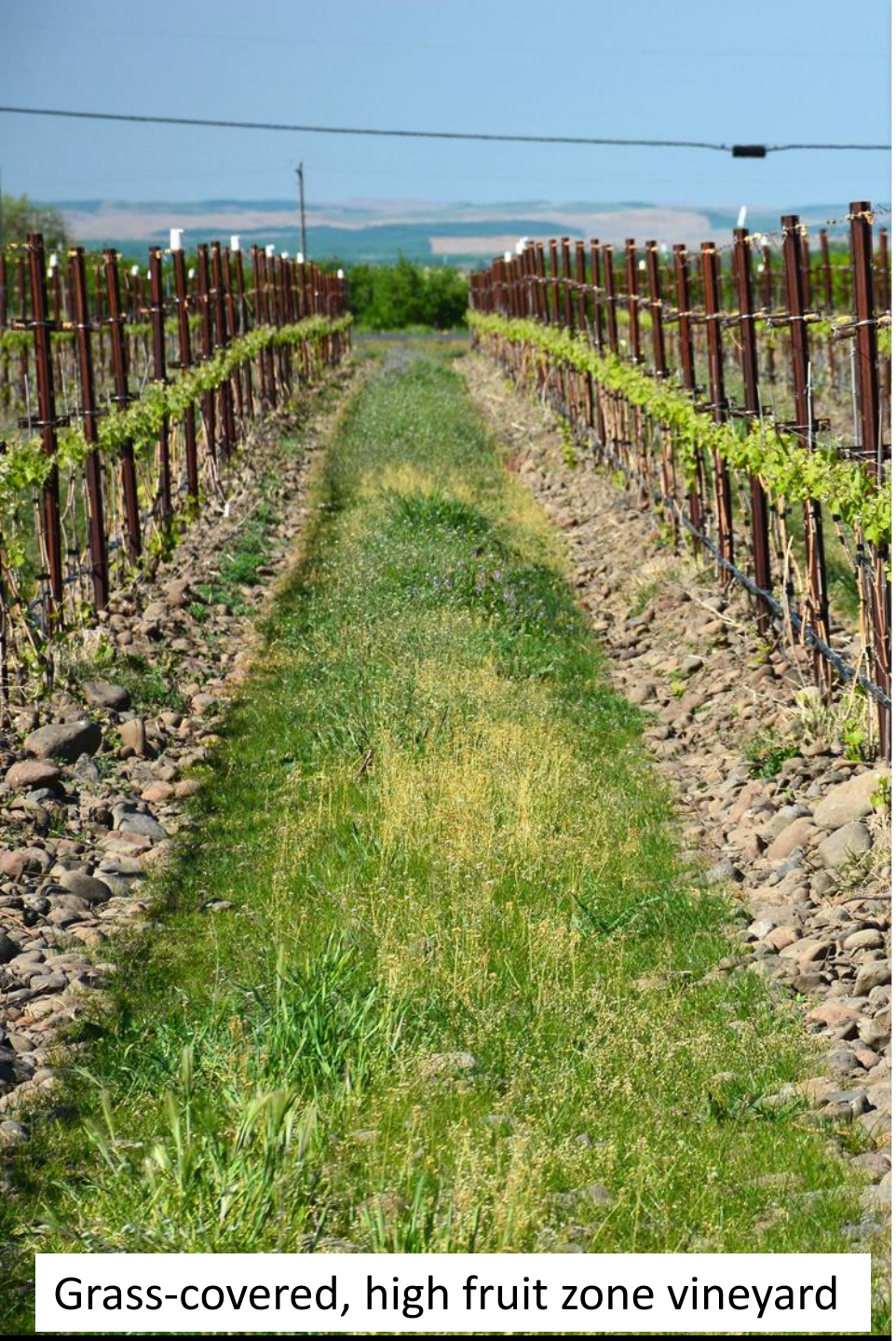



N
800
900
Lowest Point (800 ft.)
1400
1300
1200
1100
1000
900
800
feet above sea level
0
0.5
1.0
mile
900
Highest Point (1008 ft.)
1000
1100
1200
1300
1400
Dry Creek
Walla Walla River
1100
1200



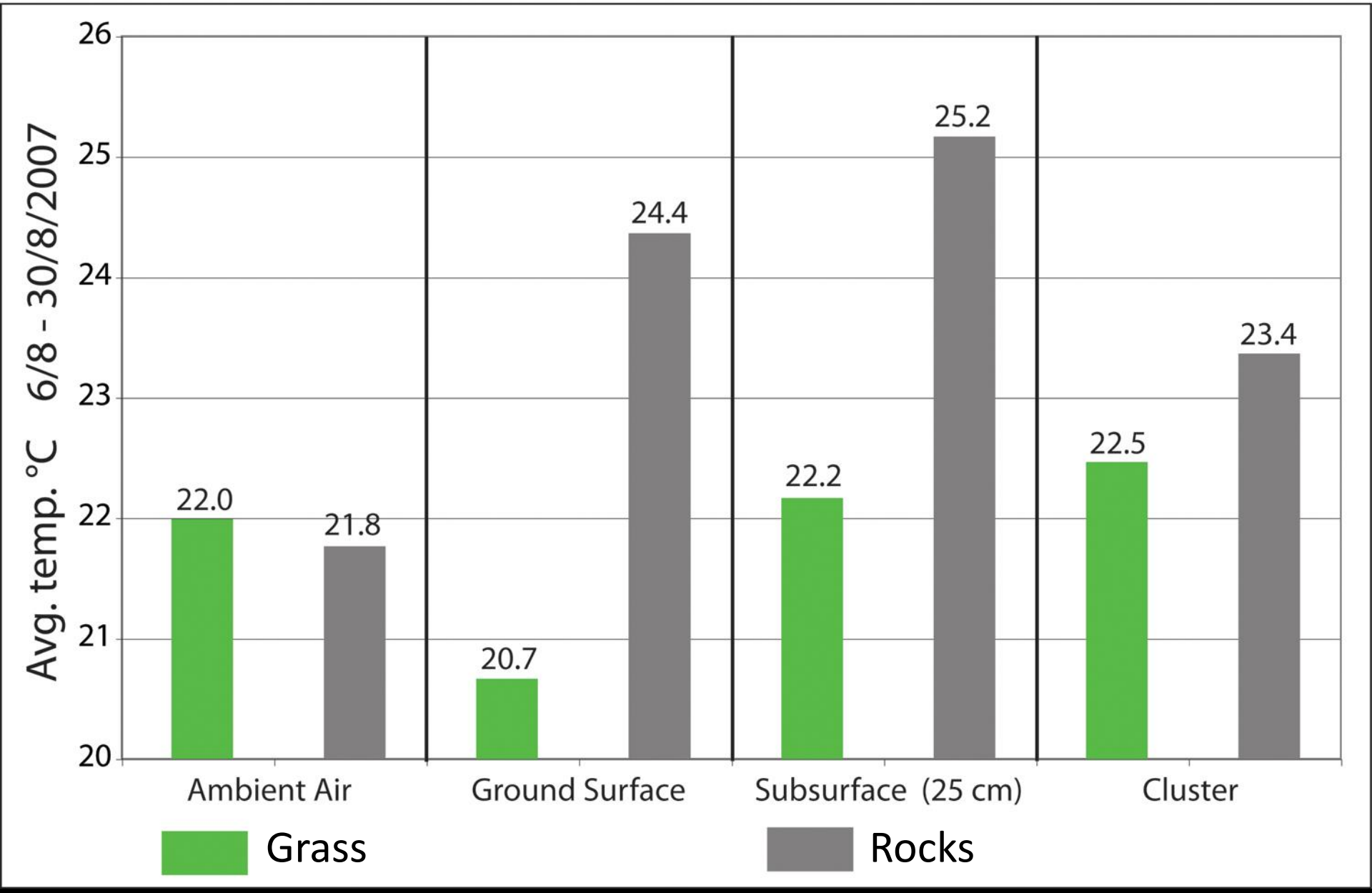
In spite of the homogeneity of its physical characteristics, growers in The Rocks District have already recognized distinctive terroirs, based primarily on the frequency and severity of vine-damaging cold weather events.

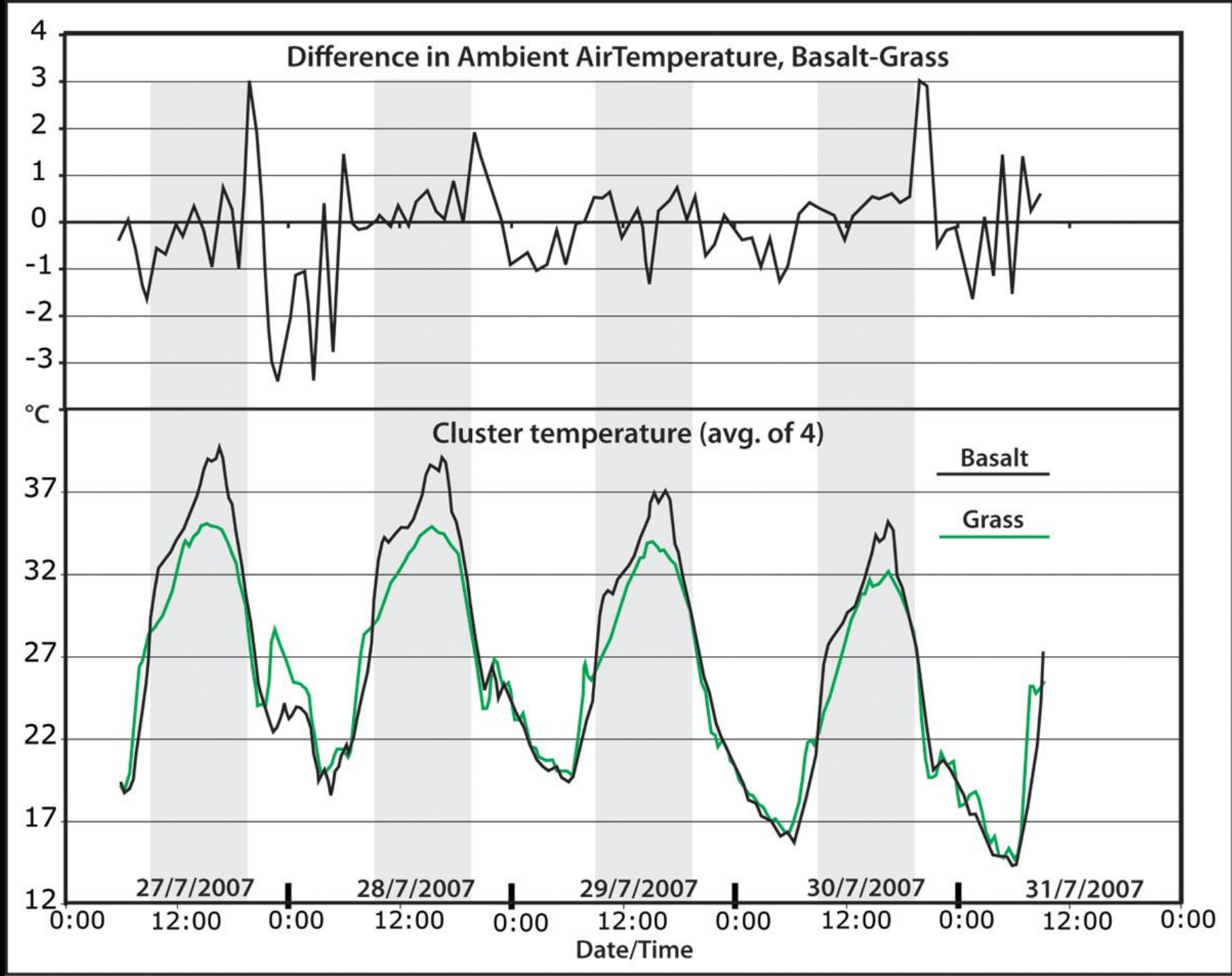
Viticultural practices can strongly influence or even overwhelm the site-specific physical characteristics that contribute to terroir.



Grass-covered, high fruit zone vineyard

Rock-covered, low fruit zone vineyard


Avg. temp. °C 6/8 - 30/8/2007
26
25
24
23
22
21
20
22.0
21.8
20.7
24.4
22.2
25.2
22.5
23.4
Ambient Air
Ground Surface
Subsurface (25 cm)
Cluster
Grass
Rocks


Difference in Ambient AirTemperature, Basalt-Grass
4
3
2
1
0
-1
-2
-3
°C
Cluster temperature (avg. of 4)
Basalt
Grass
37
32
27
22
17
12
27/7/2007
28/7/2007
29/7/2007
30/7/2007
31/7/2007
0:00
12:00
0:00
12:00
0:00
12:00
0:00
12:00
0:00
12:00
0:00
Date/Time

If you don’t like your soil, just create your own!

Crushed Carrera marble, hauled over 100 miles

Augmented terroir?

Some concluding observations regarding terroir

- Terroir is not a substitute for “the geography of a vineyard”. Terroir is a collection of the identifiable site-specific physical and biological factors that have influenced the characteristic sensory components of a wine – cause and effect must be demonstrated.

- Terroir is not a substitute for “the geography of an AVA”. If referenced to an AVA, terroir is the site-specific physical and biological factors that have influenced characteristic sensory components that are shared by the wines of an entire AVA.

- Terroir in a cultural sense does not apply to the way an individual winery makes wines or grows grapes. Cultural terroirs are regionally-applied methods of viticulture or wine-making that influence the character of that region's wines.

- Vineyard and winery practices have the potential to enhance, mute, or obliterate the often subtle effects on wines that result from site-specific physical and biological factors. The creation of a wine of terroir requires knowledge of site-specific characteristics, an understanding of the affects those characteristics have on grapes and wine, and a desire to showcase them.

- It is becoming increasingly clear that site-specific microbiomes, through their affects on phenolic synthesis and fermentation, are some of most important components of terroir. Viticultural and wine-making techniques that preserve site-specific microbiomes (e.g. native ferments) are fundamental to terroir expression.

- The impact of soil on terroir is primarily related to its affect on the availability of water and the influence of its chemistry and texture on the microbiome.


Thank You!