Farming for Quality
Vineyard Tours

These are true Oregon vineyard experiences where you'll learn about our progressive viticulture practices and why they work so well in this region. We'll discuss clones, rootstocks, vine spacing, trellis systems, crop yields, and other current topics.

A Visit to Elk Cove's Clay Court Vineyard

Moderated by owner Adam Campbell, and Vineyard Manager, Travis Watson

Discussions:

History of Clay Court
Soil types - the key differences between Laurelwood, Willakenzie, and Jory soils
Practices in leaf pulling and thinning of a vineyard

A Visit to Elk Cove's Goodrich Vineyard

Moderated by owner Adam Campbell, and Vineyard Manager, Travis Watson

Discussions:

History of Goodrich
Farming Procedures; differences or not, for Pinot noir versus Chardonnay
Managing for vine balance

A Visit to Elk Cove's Mount Richmond Vineyard

Moderated by owner Adam Campbell, and Vineyard Manager, Travis Watson

Discussions:

History of Mount Richmond
Site orientation, site selection
Long term and Annual vineyard decisions

Q&A

Section Contents Include:

Farming For Quality

- Long-term vineyard decisions
- Viticultural practices for optimal fruit quality
- Maintaining vine health

Soil Into Wine

- Physical characteristics of soil types
- Flavor characteristics in wines
- Relationship between soil and AVA's

FARMING FOR QUALITY

Growing Great Pinot Noir

This workshop is an in-the-vineyard experience of Oregon's cutting edge, cool-climate viticulture practices. You will see firsthand the innovative techniques and technologies coupled with sound farming wisdom learned over generations that modern Oregon winegrowers employ to produce premium Pinot noir. All of our efforts in the vineyard are carried out with the goal of expressing a precise statement, which varies depending on the land in which the grapes are grown to the hands that bring the wine into being. We will discuss clonal selections, trellis systems, rootstocks, spacing decisions, cultural practices and our efforts toward maintaining biodiversity and improving the sustainability of our activity.

WORKSHOP DETAILS
Presenters, wines, and location information available at this link following OPC.

POINTS TO INVESTIGATE
Adapting to the permanent physical environment

- Farming at the margins of acceptable climatic conditions
- Site selection for specificity
- Clonal selections
- Rootstocks
- Density adaptations

Adapting to a year of moments

- Managing for vine balance
  - Canopy management
  - Crop yields
  - Water management
- Managing for pests and disease pressure

Adapting to the uncertain future

- The farm in the landscape

Much is said about Pinot noir's unique propensity for expressing the truth of a place. First and foremost we point to what is typically referred to as terroir, that special combination of the factors of the physical environment: geology, topography, climate and soils. Save for the one-time decision to plant Pinot noir in a certain place, these are the limiting factors. However, terroir does not end there. Beyond these limiting physical realities, the grower and the winemaker impose complex layers of social and cultural institutions relating to viticulture and

winemaking that develop in a particular region over time. All of these factors combine to define the character of a region, a vineyard, a block and a vine. That Pinot noir will communicate this all-encompassing sense of place in the end product is not a foregone conclusion, however. It is a study in balance and adaptation.

ADAPTING TO THE PERMANENT PHYSICAL ENVIRONMENT

Farming at the margins of acceptable climatic conditions

Anywhere Pinot noir is grown you will find that great effort and expense are dedicated to its production. It is very difficult to find the grower who got in the business to produce "mediocre" Pinot noir. But the nature of Pinot noir dictates that the level of finesse will vary greatly depending on the climatic conditions.

Pinot noir, like all varieties, has an inherent climatic threshold for achieving optimum quality. This niche is particularly narrow for Pinot noir, and it is only when grown in these precise conditions that it achieves the best expression of terroir for which it is known. A long, cool growing season ensures a period of flavor development that is perfect for Pinot noir, and we are fortunate to have just those conditions here in the Willamette Valley.

Our vineyards are located along the 45th Parallel North, in the valley formed between the very tall Cascade Mountain Range to the east, and the lower Coast Range to the west, abutting the Pacific Ocean. This reality determines a fairly mild macroclimate, with fair resemblance to a very northern Mediterranean climate, with wet, mild winters and warm and dry summers. While this may sound delightful and not marginal at all, what we lack is the grace of season. In most years, every last moment of sunshine is critical, and when the rains begin in October we can usually assume that our season has come to an end. Therefore, every single decision we make along this path of the vintage has immense implications for the wines.

Beyond the topographical and geographical framework, our year-to-year climatologic realities are heavily influenced by water temperature oscillations in the eastern Pacific. During an El Niño the temperature in the eastern Pacific is higher than normal, whereas in a La Niña the easterly trade winds increase and there is an upwelling of cold ocean temperatures in the tropical Pacific. This El Niño/La Niña occurrence has been both more frequent and intense over the past 20 years, with fewer "Niño neutral" years. For us this means that from one year to the next we can experience vast fluctuations in the timing of and conditions during all the phenological stages, from budbreak to bloom to veraison to harvest. At each stage we make critical decisions as growers in order to achieve the quality and style of the end product. Experience, education and international and local collaboration have all led to this moment, when Oregon is consistently making great wines even in the face of an increasingly unstable climate.

Site selection for specificity

For the reasons already introduced to you in the first chapter, the Willamette Valley provides a unique opportunity for growing premium Pinot noir. While the macroclimate and its influences have been generally described, the mesoclimates within the valley and the soil composition and

depth vary greatly with elevation and aspect. Berry development, flavor and composition are heavily affected by site-specific exposure to wind and sun. Furthermore, soil variation (type, depth and water holding capacity) is commonly expressed in vine vigor, canopy density and fruiting habits. Therefore, this one-time decision of site selection is critical to the expression and character of the wine.

The vast majority of the vineyards in the Willamette Valley today have been planted in the low to mid-slope elevation hillsides with southern exposure, between 300'-800'. These rocky hillsides tend to have shallower soils, and to be less vigorous than the deep and rich soils of the valley floor. The hillsides are less prone to frost, but slightly later to ripen than the valley floor. As new categories and styles are explored for Oregon, and as our climate fluctuates, we are seeing more and more exploration with plantings of Pinot noir in both the lower and higher elevations.

Clonal selections and rootstocks

The species Vitis vinifera, responsible for all the commercially important varieties from which we make wine, shares the characteristic of adaptability with those who endeavor to grow it. Its ancient heritage has meant a very long period of evolution, which is responsible for some of its most alluring and frustrating characteristics.

Vinifera can adapt to its growing conditions quite rapidly. It is very heterozygous, meaning that the already complex gene makeup can be combined and recombined easily and exponentially. Furthermore, at some point in its long history, vinifera conveniently became almost exclusively hermaphroditic. Its propensity for vegetative reproduction and bud mutation has been responsible for many of the varieties we know today, and amongst other varieties of vinifera, Pinot noir is particularly mutable.

The process of clonal selection has evolved from simple to complex, with varying results. Essentially, via generations of careful observations (historical) or by complicated measurements (modern), individual vines are selected for a particular trait or traits, such as cluster size, being early or late ripening, growth habit, disease resistance, yield, etc. These vines are then propagated through cuttings (historically) or from tissue cultures (modern) from the base material. The resulting selections, theoretically genetically identical, are often referred to as clones, and are assigned a name or number (113, 114, etc). In the U.S. there are strict protocols of ensuring the sanitation of clonal selections before the plant material can be made commercially available.

The early plantings in the Willamette Valley were from plant material out of California. The Pinot noir plantings came almost exclusively from two variants (UCD4 and UCD5) of the Pommard clone, originally from Burgundy, along with variant WD2A of the Wädenswil clone, also originally from Burgundy via Switzerland, where it was appreciated for its adaptation to cool and rainy conditions. The Chardonnay planted in the beginning was almost exclusively from Davis selection 108 and various clones out of the Wente vineyards in California. These selections have produced and continue to produce excellent wines, particularly where the early

plantings still exist and have achieved some age.

Beginning in 1974, David Adelsheim led an initiative to bring new selections to Oregon from the research program led by Dr. Raymond Bernard at the University of Dijon. These selections came from various vineyards in Burgundy. This plant material was finally made available to growers in 1988, after a period of quarantine and evaluation, and has provided growers with many options to enhance diversity and winemakers with different components in the cellar. Today new selections are being tested, indexed and released, expanding the diversity of plant material and therefore our ability to learn and adapt even further.

Rootstocks

The pioneers of Oregon viticulture put their vineyards down on their own roots, before the discovery of Phylloxera in Oregon in 1990. Since that date, many vineyards have been replanted and almost all new plantings are put on phylloxera-resistant rootstocks. The last remaining own-rooted heritage plantings in the Willamette Valley are tended with great care, and continue to produce beautiful fruit under careful management.

Beyond providing resistance to this tenacious pest, the most profound effect these rootstocks have is on the vigor of the scion. Rootstock selection is a tremendous tool for adapting to site diversity. Where a more vigorous rootstock like 3309 can be useful on a very weak slope with little to no soil, a devigorating rootstock can be critical on deeper soils where excess vigor can be an issue. Rootstock also certainly affects the vegetative cycle of the plant and may advance ripening.

Density and trellising adaptations

Plant density and trellis systems vary greatly throughout the world, but are both critical tools in vineyard design and should not be discounted for their influence on yield and quality.

How many plants an acre of ground can support depends on both water availability (whether by irrigation or just a moist climate) as well as the soil quality. In early Oregon vineyards, much of the trellis and spacing decisions were again borrowed from California and Swiss protocols of the time, around 500-800 vines per acre. Where these early plantings are still in the ground, there was often experimentation in divided canopy trellising to manage vigor where it was an issue. This resourceful management of trellis (Geneva Double Curtain, Lyre and Scott Henry) is more common in older, lower density plantings, whereas vertical trellis, also known as VSP or Vertical Shoot Positioning, is the norm in more recent plantings.

During the years between the first plantings of the late ‘60s (10'x10', 10'x12') and the ‘80s, vine spacing trends in Oregon tightened up, representing a period of “intermediate spacing”. The late ‘80s and early ‘90s saw much more dense, Burgundian style plantings in Oregon, bringing a new generation of equipment as well. Concurrently, of course, was the spread of phylloxera, and thus these plantings were also on rootstock. In high-density plantings vines compete with one another for moisture and nutrition, which in theory hastens ripening and also may affect the size of the clusters.

In the Willamette Valley we have very diverse soils in terms of their strength or weakness, their ability to hold water and their depth. The availability of water is more critical in Oregon than many realize due to the very dry, hot summers we experience. We get plenty of water during the winter, but that water dissipates quickly under dry, hot, sunny conditions and more so in some soils than others. At any rate, Oregon has hugely different soils and growing season conditions than either California or northern Europe. Therefore, spacing decisions must be thoughtfully made and experimentation, when possible, is warranted in order to fine tune.

Capture of light by leaves, managing sun exposure of the fruit, disease pressure and the fruitfulness of a vine: these are all goals of trellis systems. For our climate and growing conditions most growers feel that some form of vertical trellising is the most appropriate for maximizing quality and managing disease.

ADAPTING TO A YEAR OF MOMENTS: THE QUEST FOR VINE BALANCE

Winter pruning

Winter pruning is an oft-overlooked art in viticulture. It is our first tangible influence on the next vintage. One cannot stress enough the influence this practice has on a vineyard's productivity. Grapes are only produced on shoots that grow from one-year-old canes, and more so on canes that had good sun exposure. This art is informed by Vitis' unique evolutionary history and its complete dependence on birds for seed dispersal. In the Cambrian period, grapes had to climb trees to get to the sun, as their buds will only express cluster primordia if they have been exposed to sunlight. A bud that did not see sunlight would produce a tendril, to cling to trees to get to the sunlight. Having reached the canopy of the tree, the following season the vine would produce fruit. Therefore, selecting the proper canes to lay down for the following vintage has a tremendous influence on your potential crop even before bloom.

Canopy management

Canopy management is essentially the series of decisions made by the viticulturist during the growing season to achieve particular goals for leaf volume, leaf area, shoot position/orientation, spray efficiency and fruit exposure to sunlight. Countless research projects have studied the relationship between canopy (health, density, orientation) and resultant corresponding fruit quality. This "balance" is the holy grail of viticulture, and current research is looking at Oregon-specific metrics for balanced canopy/crop ratios.

As photosynthesis is the engine that drives fruit maturity, capturing sunlight is of utmost concern. Too few leaves will not have the energy necessary to ripen fruit. Overly dense canopies do not maximize photosynthetic potential, do not provide proper exposure of the fruit to sunlight and do not allow proper airflow and spray penetration for disease control. Canopy density directly affects the canopy microclimate. Furthermore, current research suggests that many critical stages of berry development and true ripeness may be linked to UV exposure, not necessarily heat.

After budbreak, adjusting the number of buds and shoots via bud and shoot thinning are ways we manipulate canopy density. We remove second and third buds at each node, excess shoots

and the suckers at the base of the plant. Once shoots are out, training young shoots between catch wires and actively positioning shoots for sunlight capture and airflow are repeated throughout the growing season. Ideally, vegetative growth would stop around veraison and all the plant's energy would be directed toward fruit ripening. In the absence of the ideal situation, shoots are often hedged once to several times to prevent excess shading by managing excess growth.

Pulling basal leaves is widely practiced to open the fruiting zone for both the exposure to sunlight as well as for having an efficient spray program, but it can also dramatically affect the retention of acids in the grapes, especially in warmer vintages. A spray program is only effective if the material penetrates the canopy for adequate coverage. Having an open canopy also allows for UV exposure (a natural enemy of many fungal pathogens and good for phenolic development too!) and airflow, as disease pressure increases in moist conditions. Most growers employ some level of leaf pulling, but the amount and timing is a personal decision and depends entirely on the goals for both canopy management and wine style.

Vineyard floor and soil

A vineyard system extends far beyond the vines themselves. What we see above ground of a plant is but a fragment of its total self, and its interaction with the above-ground environment is only the leading edge of the system to which it belongs. Go below and the system literally bursts into a complex web of life, circulating and cycling. And the soil, like us, has a history and a story to tell. Soil, like any natural thing, evolves with the influence of many things and events over time. Our interaction with it, brief as it is, creates impacts down a very long chain.

The makeup of the vineyard floor can have dramatic impacts on the microclimate as well as the biology (beneficial insects, soil flora and fauna, pests, disease, even wildlife) of the whole farm. Vineyard floor manipulation is a very effective tool for managing a host of concerns, but conscientious growers will always consider the impacts on both the vines and the system as a whole.

Having vegetation growing between the vines, whether permanent or seeded annually and at some point tilled into the soil, has numerous benefits, including:

- Minimizing soil erosion during rainy season
- Improving rainfall penetration
- Reducing compaction effects of equipment
- Reducing vine vigor (increasing competition)
- Recycling nutrients
- Preventing leaching
- Increasing soil health and diversity

Furthermore, maintaining some cover and diversity within the vineyard and its borders can provide invaluable continuity for beneficial insect populations, provided there are protected and uncultivated areas nearby. The presence of cover crops may also promote effective colonization by mycorrhizal fungi, symbiotic fungi that can improve nutrient and water intake;

research has shown that contact between grapevine roots and cover crop roots is important for efficient colonization. Cover cropping and/or permanent vegetation can also be quite effective tools for managing pests like rust mites and spider mites, which thrive in dusty conditions.

Whether and when to remove or till in a cover crop depends on the goals of the grower and the situation. High cover crops can increase frost pressure during early spring and late autumn. The presence of cover crops can also encourage pesky vertebrates like voles and gophers. Lastly, depending on the soil, vine age and water status, a cover crop may prove to be too much competition for a vine during critical stages of growth, at which point the viticulturist will remove it by cultivating it into the soil.

Most growers are at least somewhat occupied with the issue of weeds growing under the vines during the growing season. Not only are these weeds sometimes invasive, when they grow very near the plant they can compete for critical water and nutrition. Undervine weeds can be managed either chemically or mechanically, but either way timing is critical for control.

The soil, linking bedrock to the world above, is the very foundation of what we do. How we act upon the soil is perhaps our most significant impact, as winegrowers and as stewards of the land.

Crop yields

Alas, Pinot noir, though referred to as noble, has literally no concern for its role in the magnificent alchemy of winemaking. The prime directive of this excellent specimen of evolution is to reproduce, and grapes are perfectly successful at reproducing prolifically at ripeness levels no winemaker would accept.

Since the beginning of our history, growers have sought to understand the relationship between yield and quality, and we have learned a great deal. In many years, but especially in high crop years, reducing yield, or green thinning, ensures a dedication of the vine's resources to the remaining fruit that can be the difference between good and great, obvious and subtle. In a late vintage, crop thinning is an insurance policy that most winegrowers depend upon.

As with all things Pinot, however, this is about learning to adapt, to find the balance that gets you what you want at the end of vintage. The hand you are dealt is different every year. If a vigorous vine carries too little crop, it can become overly vegetative and this, too will negatively affect quality. Having a higher crop in warmer, longer vintages (provided there is adequate soil moisture) can mitigate some of the effects of very high temperatures, when the accumulation of brix is wont to outpace flavor development, and waiting for proper flavors results in very high sugars.

Water

It has long been observed that in winegrapes, some water deficit is beneficial for fruit quality. In fact, maintaining some level of plant water deficit after an appropriate canopy is established can help regulate vegetative growth, as well as assist in directing carbohydrates toward berry

development.

This is not to say, however, that "a stressed plant produces the best fruit". Stressed plants make stressed fruit. Plant water deficit does not equal drought stress. When a plant is under excessive drought stress, photosynthesis is inhibited and the movement of carbohydrates is arrested. The timing and degree of water deficit determine the effect on fruit quality.

In Oregon, with our wet winters and springs, we generally enter the growing season with adequate soil moisture to grow a robust (!) canopy. But even in our "cool" climate, we have hot, dry conditions during the summer months. As the canopy expands, the evaporative demand increases. At this point the plants accelerate their drawing down of soil moisture. Typically, with normal winter/spring precipitation, we approach veraison with adequate soil moisture to maintain very mild plant water deficit.

Post veraison, we often enter the hottest and driest part of our season, and the canopy and climatic conditions push water demand to its highest. Mostly this is still good, as it helps to arrest vegetative growth and assists berry development at a very critical stage. However, very young vineyards, weak rootstocks and shallow, fast-draining soils can all be risk factors at this point of the season. Excessive drought stress can certainly affect fruit quality in the current season. Extended drought post harvest can have grave consequences for shoot and fruit production the following year. Many growers have drip irrigation installed during planting as a valuable insurance policy for hot vintages and young plants.

Generally speaking, the use of irrigation is limited in Oregon and often used for plant establishment and very high drought conditions. This is a critical component of the sustainability of our farming, and we are very fortunate that our crop is so prudent in its water preferences.

Pests and disease

Oregon, and the Willamette Valley especially, enjoy a great diversity of agricultural crops. The landscape is a patchwork of varying crops, orchards, nurseries and forestland. This, coupled with our cold winters, is an important reason why we have heretofore experienced very modest disease and pest pressure. Our main disease challenge is powdery mildew, and botrytis to a lesser extent. Vertebrate pests like gophers, voles and birds can be commercially important in some years, but are generally just an annoying part of doing business. Invertebrate pests are more or less limited to mites, but the appearance of disease-transmitting mealybugs in vineyards in Oregon suggests that we will face more pressure in the future.

Controlling for powdery mildew is the reason for most of our spray activity in the vineyard. The cultural practices of maintaining a healthy, open canopy go a long way in helping control for both powdery mildew and botrytis, but some level of preventative spraying is universally practiced. Most spray programs use low concentrations of organic and soft fungicides, rotated to reduce resistance development. The spray interval varies based on the products used and the amount of pressure, but for most growers between 6 and 10 sprays are done for powdery

mildew and botrytis prevention.

All growers want to reduce the number of times they spray, and many of us have been working with researchers at Oregon State to develop new techniques for monitoring sporulation of powdery mildew. The ability to detect outbreaks may enable us to spray only when there is detection of spores. Also, advances in spray technology are making worlds of difference in the amount of material used and even recovered.

ADAPTING TO THE UNCERTAIN FUTURE

The farm in the landscape

Roughly five percent of our nation's great land base is set aside (for now) to protect what is "natural" and "wild" from industrial influence. Much of this is in Alaska. Twenty percent of the total land base in the U.S. is under cultivation of crops. If you add lands that are public and private but used for grazing livestock, that number grows to well over 50%. While the urban/rural interface grows in importance, it remains true that agriculture, not urbanization, has had, by far, the greatest impact on water resources (especially in the West), habitat and species fragmentation. As land managers in agriculture, we cannot underestimate our potential impacts on the future of the American land base.

All other idealistic causes aside, we have a tremendous opportunity to affect the health, longevity and continuity of the landscape. Small efforts we make on our farms to promote biodiversity, protect soil, reduce chemical and other inputs (including water) and generally create less of a disturbance can have very positive impacts. As a high-profile agricultural community, we have an opportunity to lead by example. Maintaining uncultivated and continuous areas for wildlife cover and passage, creating insectaries for beneficial insects, efforts to reduce tractor passes, restoring, protecting and maintaining healthy watersheds; these sometimes require sacrificing some plantable area, some effort and dedication of resources, but the benefits far outweigh the output required.

"Stewardship: the careful and responsible management of something entrusted to one's care." Oregon viticulture stands out in the tradition of stewardship. Before it was "en vogue" we scrutinized our practices for gaps in sustainability and continue to demand an ever-higher standard of transparency for our workers, our customers and ourselves. Taking care of the land that we farm and the people who work with us has been part of our identity since the first hippies broke ground for planting vineyards here in the mid-'60s.

Visit almost any vineyard in the Willamette Valley. You may have to ask the question, "what are you doing about sustainability," as we are not known for flaunting or self-promotion, but you will get an answer. Nearly 50% of all vineyard land in Oregon is certified by a third party sustainability program. While we recognize that we cannot do what we do and also preserve a completely natural system, we can continue to ask ourselves what we can do better to make it possible for natural systems to function in the presence of agriculture.

It is not revolutionary to make a connection between having a diversity of life on your farm and

the farm's ability to resist pests and disease. In farming, it is easy to focus on all the ways that biodiversity interferes with what we are trying to accomplish: the birds eat your grapes, the weeds compete for nutrition and water, the gophers and voles chew on the trunks and roots, the bugs chew on your leaves and shoots, the deer keep a tidy four-inch canopy on your end rows. All our efforts to maintain a pristine end result seem at odds with nature's endeavors. But remove just one element…

Pinot noir is about balance. When we maintain a diverse landscape, we come a little closer to achieving balance with nature. When our farm supports a diversity of life, our vines thrive and are better able to access the secrets, the truth, of this place, and deliver them in the wine.

FARMING FOR QUALITY

vine density	low	medium	high
vine spacing	6’ x 12’	5’ x 7’	3’ x 6’
vines per acre	605	1245	2420
row feet per acre	3630	6223	7260
tons per acre	2.0	2.5	2.8
gallons per ton	150	150	150
gallons per barrel	60	60	60
barrels per ton	2.5	2.5	2.5
gallons per case	2.38	2.38	2.38
cases per barrel	25	25	25
cases per ton	63	63	63
cases per acre	126	158	176
bottles per acre	1513	1891	2118
bottles per barrel	300	300	300
bottles per vine	2.5	1.5	0.9
tons per vine	0.0033	0.0020	0.0012
pounds per vine	6.6	4.0	2.3
pounds per cluster	0.2	0.2	0.2
clusters per vine	33	20	12
clusters per bottle	13	13	13

See Reference Section for *Clones in Oregon* and *Winegrowing Certifications*.

SOIL INTO WINE

Digging Deeper into Oregon Pinot Noir

No grape variety is as reflective of site differences as Pinot noir. This in-the-vineyard workshop examines Oregon's cool-climate viticulture practices and the soils in which we grow wine grapes. Much of Pinot noir's magic rests in its ability to communicate a sense of the place where it was grown. While soil is not the only factor that gives Pinot noir its sense of place, there is no doubt that the fascinating diversity of Pinot noir wines grown in the Willamette Valley depends in part on the diverse origins of the soils in which our vineyards are planted.

We will focus on the two main soil types most commonly found in Willamette Valley vineyards. Two soil pits have been dug, one of marine sedimentary origin and one of volcanic basalt origin. These provide a close look at the soil characteristics that contribute to sense of place in Oregon Pinot noir. At each soil pit you will taste examples of wines made from that specific site as well as from both sedimentary and volcanic soils at other locations in the Willamette Valley. The two soil pits are interspersed with four other stations (two at each site) that will examine viticulture topics discussed in the Farming for Quality chapter in this binder.

WORKSHOP DETAILS
Presenters, wines, and location information available at this link following OPC.

POINTS TO INVESTIGATE

a. What are the origins and physical characteristics of the different soil types in Willamette Valley vineyards? How do these affect the root system, the vine and the grapes grown in those soils?
b. Can specific flavor characteristics in Pinot noir wines be correlated to specific soil types? How is the wine affected by the nutrient and water resources available to the vine?
c. What is the relationship between soil types and AVAs within the Willamette Valley?

GEOLOGICAL HISTORY OF THE WILLAMETTE VALLEY
Illustration: Willamette Valley Soils Map in the Reference Section
Until about 12 million years ago, western Oregon was on the floor of the Pacific Ocean. Before that, for 35 million years under the sea, it was slowly accumulating layers of marine sediment, the bedrock of the oldest soils in the Willamette Valley.

Starting about 15 million years ago, the pressure created along the coast by the collision of the earth's Pacific and North American Plates gradually pushed Western Oregon up out of the sea, creating the Coast Range and the intensely volcanic Cascade Mountains further inland. The

Willamette Valley thus began as an ocean floor trapped between two emerging mountain ranges.

During this period of uprising, from about 15 million to 6 million years ago, rivers of lava erupting from volcanoes on the east side of the Cascades flowed down the Columbia Gorge toward the sea, covering the layers of marine sediment on the floor of the emerging Willamette Valley with layers of basalt.

The Willamette Valley continued to buckle and tilt under pressure from the ongoing coastal collisions, forming the interior hill chains that are typically tilted layers of volcanic basalt and sedimentary sandstone, such as the Dundee Hills and Eola Hills (see figure 2, page 3).

The next geologic activity to add to our soils was the creation of a layer of windblown silt (called Loess) on the northeast-facing hills west of where Portland sits today. This started as long ago as a million years and may have continued until about 50 thousand years ago. These silts were blown in from the valley floor, but they originated from the severely weathered basalts and sediments.

Much, much later, about 18 thousand to 15 thousand years ago, at the end of the last ice age, the melting of a glacial dam near the location of Missoula, Montana, repeatedly flooded the Willamette Valley, creating a lake up to the 400-foot contour level, with only the tops of the two-tone hills sticking out, and leaving behind deep silts.

Thus we have in the Willamette Valley a complex series of soils with interesting and diverse origins:

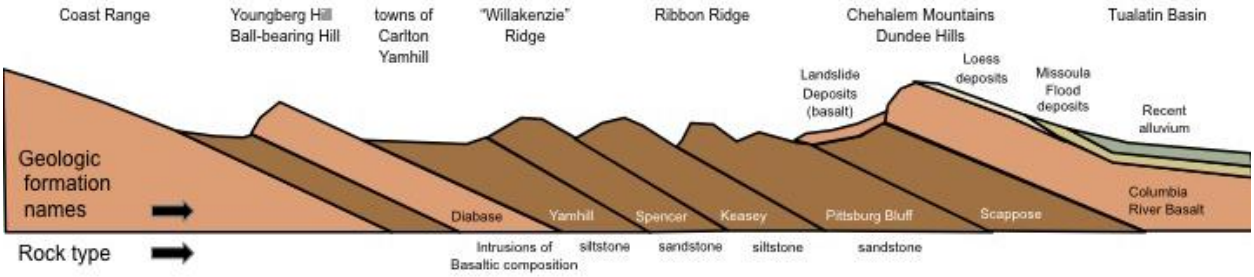
Marine sediments that were laid down on the floor of the Pacific Ocean
Examples: Willakenzie, Bellpine, Chuhulpim, Hazelair, Melbourne, Dupee

Basalts that originated as lava flows from eastern Oregon
Examples: Jory, Nekia, Saum

Windblown Loess, silt blown up from the valley floor onto northeast-facing hillsides
Example: Laurelwood

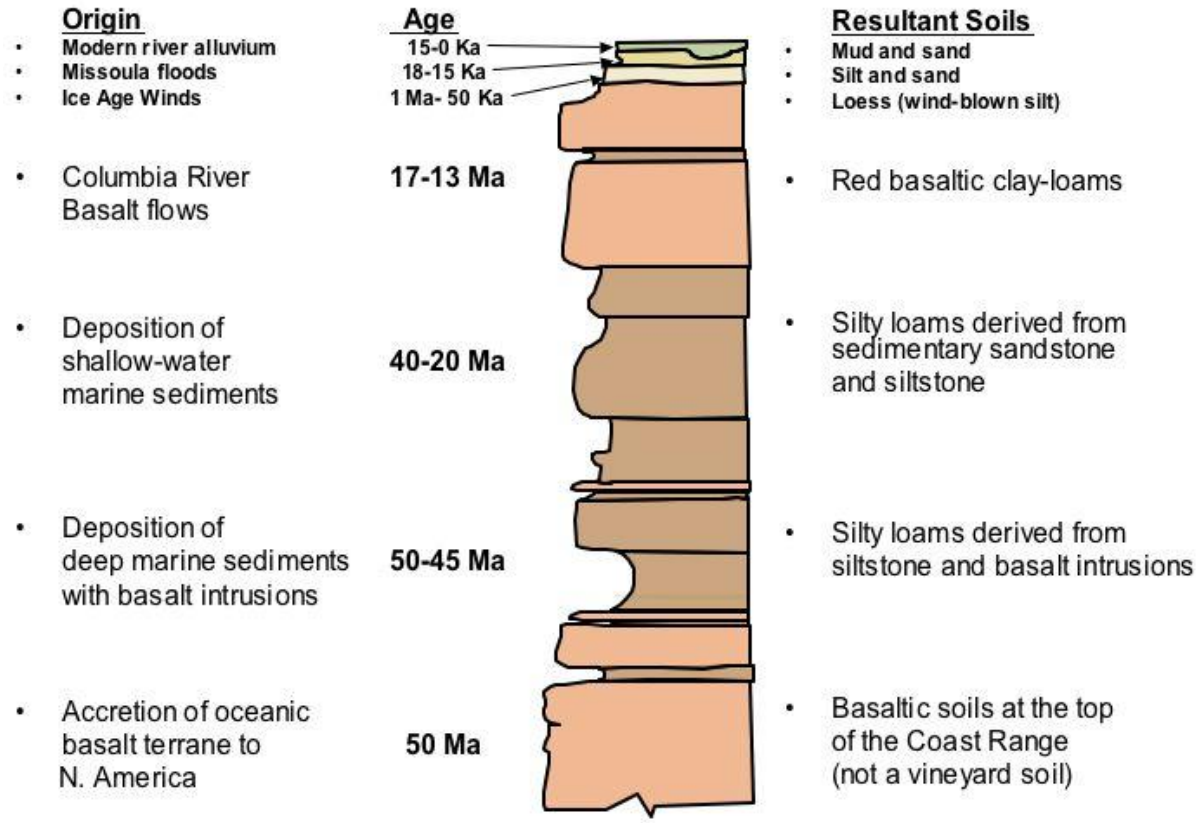
Missoula Flood deposits brought down the Columbia Gorge as the result of a repeatedly melting glacial dam
Examples: Wapato, Woodburn, Willamette

Geology Provides the Landscape: Rock Layers Tilted Sideways



Idealized cross section

Rock Sequence in NW Oregon and the Derivative Soils



Figures from *Oregon Geology–Parent of the Soil, Foundation for the Wine*, Ray Wells, 2006.

WHY ARE WE FOCUSING ON VOLCANIC, MARINE SEDIMENTARY AND WINDBLOWN SOILS?
Much is said about how and why the Willamette Valley is the perfect place to grow Pinot noir. But once that most fundamental "long-term vineyard decision" has been made, it is important to understand that not every acre in the Willamette Valley is suitable for growing great Pinot noir. Indeed, most of the acres of the Willamette Valley are those deep, rich valley-floor soils brought to us all the way from Montana by the Missoula Floods at the end of the last ice age. These valley floor soils are paradise for a great diversity of crops, but they can spell trouble for Pinot noir. Pinot noir at low elevations is subject to frost damage in the spring, and in such deep soils it becomes overly vigorous, prolifically growing new canes and leaves throughout the growing season and paying little attention to maturing fruit. The end result is that the vine is unable to ripen its fruit properly.

In almost all cases, great Willamette Valley Pinot noir grows on rocky hillsides facing south or southeast, at least 200' above sea level and avoiding cooler hilltop microclimates over 900'. This is a common factor amongst the six AVAs within the Willamette Valley and other favorable hillside areas for viticulture within the region, regardless of soil types and weather patterns. As it turns out, sites that meet these qualifications are generally found on volcanic, marine sedimentary or windblown soils, just because of the way the valley was formed in the first place. Favorable sites with windblown soils are found especially on slopes in the northern part of the valley, especially in Washington County.

SOIL PITS

"Soil is initially formed when decomposed organic material is encompassed into weathered mineral material at the earth's surface. The climate, the organisms living in the soil, the type of parent material, the local topography and the amount of time the soil has been developing all influence the resulting soil characteristics." *Magill's Survey of Science: Earth Science Series*.

Idealized Soil Profile

"O" Horizon: accumulation of fresh or partially decomposed organic material.

"A" Horizon: humus (decomposed organic material) mixed with mineral sediments.

"B" Horizon: zone of accumulation of materials transported down from higher horizons, e.g. minerals.

"C" Horizon: partially weathered parent material, unaffected by downward movement of material from above.

"D" Horizon: unweathered parent material, such as basalt, granite, sandstone or limestone.

Soil Terms

Horizon: a layer of soil material that differs from the layers above or below in physical, chemical, and biological properties.

Leaching: the dissolving out or removal of soluble materials from soil horizons by percolating water.

Sediment: rock fragments of various sizes, such as clay, silt, sand, gravel, cobbles.

Weathering: the mechanical disintegration and chemical decomposition of rocks and sediments by exposure to the elements. The parent material is broken down into many constituents such as soluble salts (leached away in older soils), clays, various oxides.

Soil is more than just weathered rock. Whether you are looking at volcanic, marine sedimentary or windblown soils, when you get to the "A" and "O" horizons (see figure above), soil is a living system, a community of organisms that convert nutrients from one form to another and make them available to plants and to other soil organisms. The soil food web is explored in more depth in the Farming for Quality chapter.

The focus of this workshop is on the physical characteristics of the soil.

QUESTIONS TO EXPLORE

How does the structure of the soil affect root penetration, drainage, moisture storage capacity, fertility, erodibility?
Why do volcanic soils warm up later, hold moisture longer, ripen more slowly?
Why do sedimentary soils warm up faster, dry out faster, ripen earlier?
What are the specific farming characteristics of windblown soils?
How does viticulture respond to these different soil characteristics?
How does fruit development respond to these soil characteristics?

TASTE THE DIFFERENCE

The opportunity at Oregon Pinot Camp is to try to taste whether differences in the soil type in which the grapes are grown produce distinct and consistent differences in the wines made from them. Obviously, stylistic winemaking variability, as well as vintage variation, make definitive judgments impossible with small samplings, but the thread of soils differences should still be of interest and will hopefully prompt you to further investigate the comparisons with your own tastings.

Over the past several years, hundreds of Pinot noir wines were submitted for consideration from more than 50 wineries. The wines were divided by their soil type: "volcanic" and "marine sedimentary" along with a more limited number of Loess or "windblown". The wines were separated by vintage and then tasted blind by the workshop tasting panelist and OPC campers. These are the descriptors commonly used to describe the wines:

> Volcanic soil wines: "lush" "perfumy" "pure" "sweet" "pretty" "succulent" "soft" "candy" "bright red" and "mixed berry"
>
> Marine Sedimentary soil wines: "bold" "chewy" "big tannin" "black pepper" "spicy" "truffle" "licorice" "black fruit"
>
> Windblown soil wines: "blueberries" "licorice" "plum" "briary" "chocolate cherries" "spices" "expansive, round tannins"

We then incorporated those descriptors with broader descriptions of texture and balance. Here is the general description of how soil type affects Pinot noir in Oregon:

Pinot noir wines from Volcanic soils Usually exhibiting a style that accents the high-toned, floral and "perfumed" aromatics with brighter and expressive red and dark red fruits flavors layered with sweeter baking spices and softer, round and succulent tannins. Can retain good acidity even in warm years.

Pinot noir wines from Marine Sedimentary soils
Usually exhibiting a style showing the voluptuous and denser dark red berry and blue/black fruit with darker floral, earth tones and bigger, heavier and chewier tannins.

Pinot noir wines from Windblown soils
Usually exhibiting a style that shows mixed berry fruits, exotic spices, licorice, cedar and briary components. Can show a round, voluptuous tannin structure. Generally these fall midway between the Volcanic and Marine Sedimentary soil descriptors.

RELATIONSHIP BETWEEN SOIL TYPES AND AVAS

There is not a direct correlation between specific soil types and the six sub-appellations of the Willamette Valley. This can be clearly seen on the Willamette Valley AVA map in the Reference Section. Some have one predominant soil type; others have two or three different types. Additionally, the depth of the soil over parent material and the specific type of parent material varies between the AVAs. For most AVAs, the geographic and climatic factors are as important as soil type in defining the unique characteristics of the appellation.

Dundee Hills AVA
Mostly basaltic but marine sedimentary at the lower elevations on the western and northern slopes. Vines are often planted on very deep soils. This area is more insulated from daytime heat in the central Willamette Valley by the Willamette River just to the east. Further from the Van Duzer Corridor, it also cools more slowly. Generally a "gentler" place to grow Pinot noir.

Eola-Amity Hills AVA
Mostly basaltic but marine sedimentary at the lower elevations on the western and northern slopes. Vines are usually planted on thinner soils strongly affected by late afternoon winds blowing through the Van Duzer Corridor. Also moderated by daytime temperatures by the Willamette River just to the east.

Chehalem Mountains AVA
Basaltic and marine sedimentary on the southern and western slopes; windblown on the northeastern slope. This is the AVA with the most diverse soils, exposures and environmental variability, making it impossible to generalize.

Yamhill-Carlton AVA
Marine sedimentary predominant. This "upsidedown u"-shaped group of hills has no exposure to central valley heat, being mostly surrounded by other hills.

Ribbon Ridge AVA
Entirely marine sedimentary and separated from the Yamhill-Carlton AVA by a narrow valley.

Some areas can be very droughty in late summer, advancing grape maturity compared to the other AVAs.

McMinnville AVA
Primarily marine sedimentary with some basalt and alluvium. The AVA lies above a large hot valley just to the south that radiates heat into the hills during the day. It is the most strongly affected by late afternoon winds blowing through the Van Duzer Corridor, as it forms the northern mouth of the Van Duzer opening into the valley. One of the warmest areas in the day, it cools very quickly as the sun sets.

A more complete description of the geography and geology for each the six AVAs is provided at end of this section.

QUESTIONS TO INVESTIGATE AND DISCUSS
Are there consistent similarities among wines from the same soil type?
If yes, how can those similarities be described?
Are there significant differences between wines from the same soil type but from different AVAs – e.g. volcanic soils in the Dundee Hills vs. volcanic soils in the Eola Hills?
Are wines that express site characteristics more interesting than those that don't?

WILLAMETTE VALLEY AVAS

Chehalem Mountains
The Chehalem Mountains AVA is a single uplifted landmass southwest of Portland in the northern Willamette Valley, extending 20 miles in length and 5 miles in breadth. These mountains stretch from the town of Wilsonville in the southeast, snake between Sherwood and Newberg, and reach almost to Forest Grove in the northwest. They include several discrete spurs, mountains and ridges, such as Ribbon Ridge and Parrett Mountain. The highest point within the Willamette Valley is the Chehalem Mountains' Bald Peak, at 1,633', which affects weather for the AVA and helps to distinguish it from the adjoining grape-growing hillsides and surrounding lowlands, less appropriate for grape growing.

The geography and climate largely differentiate this AVA from others; that notwithstanding, the variety of soils within the AVA helps to play host to different grape varieties. Soils on the southern and western slopes are basaltic (including Saum and Jory) and marine sedimentary (including Melbourne and Willakenzie). Soils on the north face of the mountains are windblown Loess (Laurelwood). Inappropriate heavier alluvial soils are largely excluded from the AVA by virtue of its minimum elevation of 200'.

A wide range of Pinot noir can be produced in this AVA, from more lightly red-fruited, elegant and balanced stylings, to black-fruited, briery, earthy and highly structured wines carrying brown spice and wood notes, plus most gradations in between.

Dundee Hills
The first grapes in the Willamette Valley were planted in the Dundee Hills. It remains the most

densely planted locale in the valley and state. The 6,500 acres of this almost exclusively basaltic land mass run north-south and overlook the Willamette River to the south and the Chehalem Valley to the north, rising to 1,067' in elevation. It is approximately 30 miles to the southwest of Portland and 40 miles east of the Pacific Ocean, with protection from the ocean climate provided by the higher Coast Range of mountains.

Dundee Hills soils are reddish, silt, clay, loam soils derived from Columbia River basalt flows and, as such, are easily decomposed to provide moderately rich, deep and good water-holding soils. Soils and climate differentiate this AVA. The hillside planting regions above 200' provide good water and air drainage, good frost protection, moderate fertility and moderate temperatures for adequate ripening, but with acid retention.

Pinot noir from this AVA is characteristically red to dark-red fruited, with raspberry to black cherry ranges, offering bright floral, cola, sweet earth, truffle and perfume aromatics and flavors, with sweet spice notes and a core of juicy, bright fruit on the palate and supple, round and integrated tannins.

Eola-Amity Hills The name of this AVA is derived from a ridge of hills adjacent to the Willamette River. The ridge is actually composed of the Eola Hills, straddling the 45th latitude on the southern end, and the Amity Hills on the northern spur. The proposed minimum elevation for the AVA is 200'.

Two of the predominant influences on the characteristics of wines from the Eola Hills are shallow soils and the Van Duzer Corridor. The soils of the Eola Hills contain volcanic basalt from ancient lava flows. The basalt is combined with a preponderance of marine sedimentary rocks and/or alluvial deposits. These soils: Nekia, Woodburn and Steiwer, are generally much shallower and rockier relative to most other Oregon AVAs. These shallow well-drained soils tend to produce smaller grapes with greater concentration.

The Van Duzer Corridor essentially provides a break in the Coast Range that allows cool ocean winds to flow, dropping temperatures dramatically, especially during late summer afternoons. These late afternoon and evening breezes help provide the cool nights that keep acids firm and are essential for optimal ripening.

The wines tend to be bigger, more full-bodied wines. The fruit components tend toward raspberry, blackberry, black cherry and plum contrasted with raspberry, strawberry and cherry flavors, which may predominate in wines from deeper soils. The mineral content of the terroir is often present both on the nose and on the palate. The wines often display considerable focus and clarity of fruit. They also favor primary fruit character over spice, tending toward the darker black fruit spectrum (black cherries and blueberries). Compared to other North Willamette Valley regions, the wines often exhibit brighter acidity and firmer structure, along with considerable longevity. This is due to the cooling effect of the Van Duzer Corridor. Wines from lower elevations tend to lean more toward plum and bramble fruit, showing slightly more secondary flavors such as earthy, mineral and spice/herbal tones (e.g. white pepper and dried

flowers).

McMinnville

The McMinnville AVA sits due west of Yamhill County's wine country home, the city of McMinnville. It extends approximately 20 miles south-southwest toward the mouth of the Van Duzer Corridor, Oregon's lowest Coast Range pass to the Pacific Ocean. The AVA is a blend of geo-climatic factors that make it unique among Yamhill County's AVAs. Specifically, the appellation encompasses the land above 200' and below 1,000' in elevation on the east and southeast slopes of these foothills of the Coast Range Mountains. Geologically, this region is dramatically different in soil profile from other winegrowing areas in Yamhill County. The soils are primarily uplifted marine sedimentary loams and silts, with alluvial overlays. Beneath is a base of the uplifting basalt. Clay and silt loams average 20"–40" in depth before reaching harder rock and compressed sediments, shot with basalt pebbles and stone. The uniqueness of the soils for winegrowing is in the 20"–40" depth. Climatically, this AVA is, again, in its own class. These primarily east and south facing slopes sit in a protected weather shadow of the Coast Range Mountains. Rainfall is lower (33" annually) than sites only 12 to 20 miles to the east. The foothills also provide protection from chilling winds in the unstable air conditions of spring and fall. Winegrowers also have the option of placing vineyards on more southerly facing sites to take advantage of the drying winds from the Van Duzer Corridor. Of greatest note are the flavor qualities of the Pinot noir wines from this area. Unlike the wines from hillsides to the east, the Pinot noir from these soils are highly pigmented, with a strong backbone of tannin and acidity and a massive palate of black fruit and earthy flavors.

Ribbon Ridge

Ribbon Ridge is a very regular spur of ocean sediment uplift off the northwest end of the Chehalem Mountains, comprised of a relatively uniform five square miles (3,350 acres) of land in a breadloaf-like shape. The AVA is distinguished by uniform ocean sedimentary soils and a geography that shows that it is protected climatically by the larger and taller landmasses surrounding it. Paucity of aquifers forces many vineyards to be dry farmed. The AVA's elevation minimum is 200', with its highest point at 683'.

Pinot noir characteristics from Ribbon Ridge include predominantly black fruit (black cherry, blackberry and black currant), moderate to high structure sometimes bordering on rustic, good acidity especially in higher elevations and good extraction. Wines contain fine tannins, a range of brown and wood spices, fresh-turned earth and chocolate dependent on vintage. Wines are thought to ultimately age very well.

Yamhill-Carlton

North of McMinnville the land slowly rises to the hamlets of Carlton and Yamhill. Low ridges surround the two communities in a horseshoe shape. The free-flowing North Yamhill River courses through the center of a lush patchwork quilt of nurseries, grain fields and orchards. The neatly combed benchlands and hillsides of the Yamhill-Carlton AVA are home to some of the finest Pinot noir vineyards in the world.

Historically nourished by forestry and farming, this area is rapidly emerging as a global center of Pinot noir production. This pastoral corner of Oregon's northern Willamette Valley creates a unique set of growing conditions. The Coast Range to the west soars to nearly 3,500', establishing a rain shadow over the entire district. Additional protection is afforded by Chehalem Mountain to the north and the Dundee Hills to the east.

The coarse-grained, ancient marine sediments native to the area are the oldest soils in the valley. These soils drain quickly, establishing a natural deficit-irrigation effect. Thus, the vines stop vegetative growth earlier here than elsewhere, leading to more complete ripening, even in cooler growing seasons. This allows Pinot noir to develop deep ruby colors and broad, silky tannins. The mouth-filling wines exude powerful fruit aromas of raspberry, blackberry and black cherries complexed by minerality reminiscent of pipe tobacco, espresso, clove and dark chocolate and accented by scents of rose, violet, lavender and sweet wood smoke. These are alluring, complex, supple gems of Pinot noir to sip and savor.