GEOLOGY

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.

WORKSHOP DETAILS

More information including the panelists by site and wines tasted is available following OPC at oregonpinotcamp.com/workshops.

POINTS TO INVESTIGATE

- 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?
- 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?
- What is the relationship between soil types and AVAs within the Willamette Valley?

GEOLOGICAL HISTORY OF THE WILLAMETTE VALLEY

See Andy Gallagher's presentation, "Oregon Rocks: The Story of Our Soil and Wine" from 2016 Oregon Wine Symposium, for more information!

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:

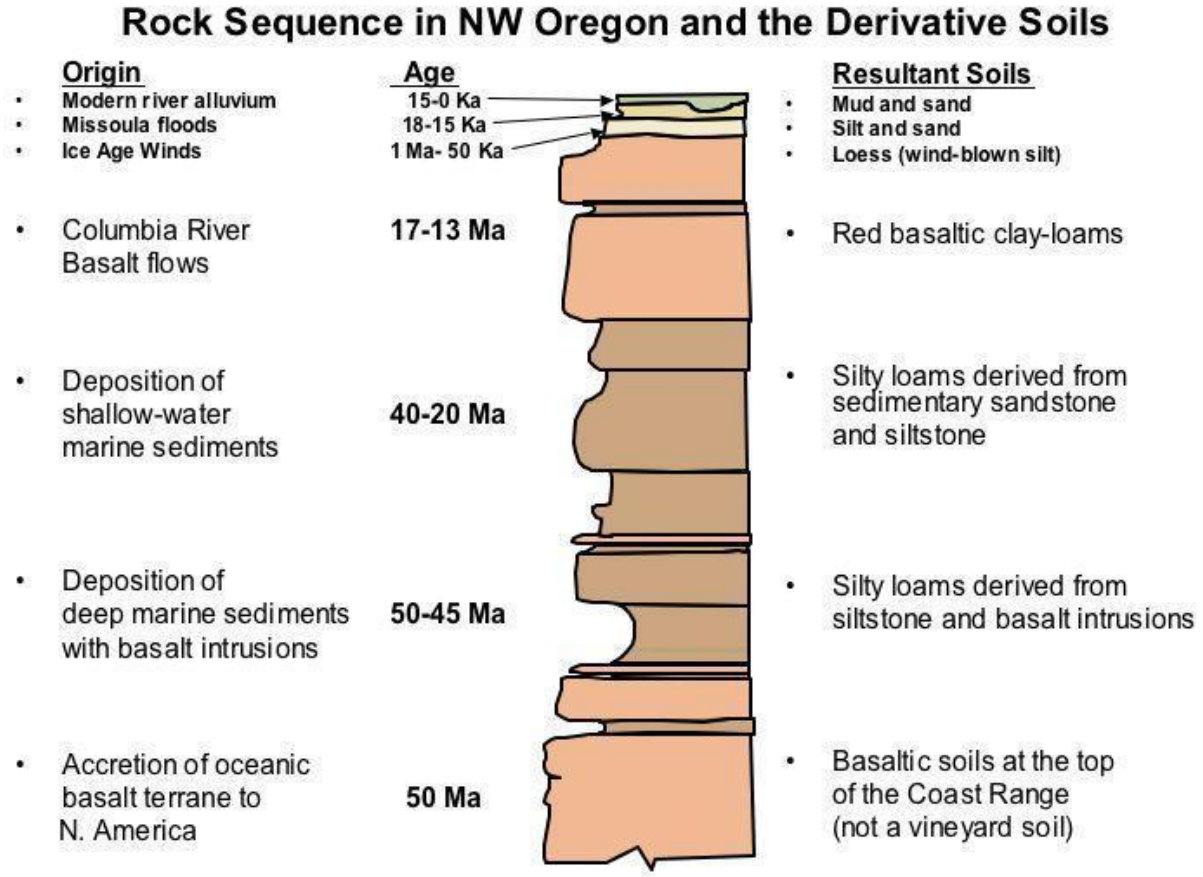
Marine sediments that were laid down on the floor of the Pacific Ocean
Examples: Willakenzie, Bellpine, Chuhulpim, Hazelair, Melbourne, Dupee

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

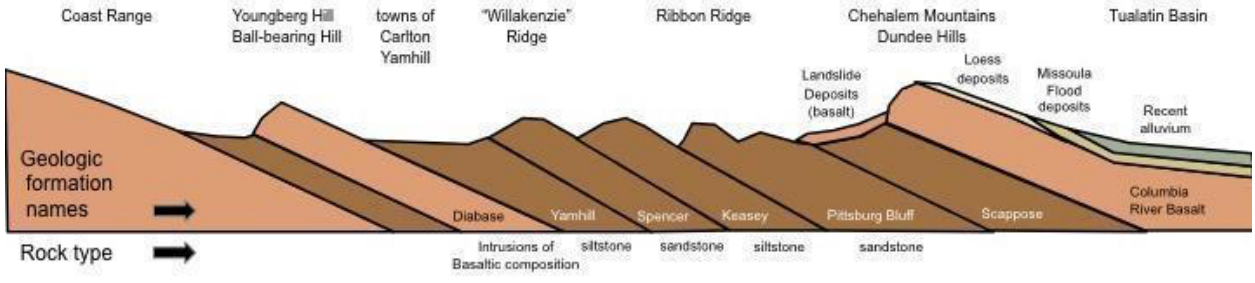
Windblown Loess, silt blown up from the valley floor onto northeast-facing hillsides
Example: Laurelwood

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

SW NE



GEOLOGY PROVIDES THE LANDSCAPE: ROCK LAYERS TILTED SIDEWAYS



Idealized cross section

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 ten of the eleven nested AVAs within the Willamette Valley (Van Duzer Corridor's lowest point is just below, at 180' above sea level) 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.*

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 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 eleven nested 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.

Laurelwood District AVA
Laurelwood soil (basalt base with loess top layer). High-elevation and younger vineyards can produce red-fruited and floral Pinot noirs. Lower elevations and older vines often result in brooding, blue-fruited Pinot noirs. Distinctive rustic and chalky tannins can be found in most Pinot noirs.

Tualatin Hills AVA
Predominantly Laurelwood soils. These loess soils combined with Pacific Ocean influence yield fruit with thick skins, high phenolic extract and elevated levels of acidity.

Mount Pisgah, Polk County, Oregon AVA
Marine sediment and silty loams. Mount Pisgah was formed 65 million years ago as a sea floor volcano, and has since been covered by marine sediment which pushed up out of the ocean. This AVA is characterized by the warmth of the nearby Willamette River, the mild influence of the Van Duzer winds, and the rain shadow of Laurel Mountain to the west. This unique geology allows the grapes to develop a deep complexity in the region’s shallow soils.

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.

Van Duzer Corridor AVA
Mostly marine sedimentary. The Van Duzer Corridor is an anomaly in the Coast Range through which oceanic winds funnel into the Valley, creating a cooling effect. As a phenomenon of wind protection, the grape skins thicken, leading to an abundance of anthocyanins (color) and tannin. The buffering effect is highly noticeable and varies from one vintage to another.

Lower Long Tom AVA
Bellpine (shallow clay loams lifted from ancient marine sediment) predominate. While Pinot noir is the predominant grape of the region, with wines leaning toward blue and black fruits and plush tannins for graceful aging, around a dozen white grape varieties are grown as well, including Chardonnay, Riesling, Pinot Gris, and Sauvignon Blanc.

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).

Laurelwood District

The Laurelwood District AVA, one of Oregon's newest AVAs, was approved in June 2020. Principals from Ponzi Vineyards and Dion Vineyards championed its petition. This AVA, which is nested within the Chehalem Mountains AVA, comprises more than 25 wineries and 70 vineyards.

The Laurelwood District's boundary is the predominance of a unique soil series recognized as Laurelwood, found on the north- and east-facing slope of the Chehalem Mountains. The Laurelwood District AVA encompasses over 33,000 acres and includes the highest elevation in the Willamette Valley, at 1,633 feet. Laurelwood soil is composed of a 15-million-year-old

basalt base with a loess (windblown freshwater silt) top layer accumulated over the past 200,000 years and at depths of 4' to 0" depending on the elevation.

Lower Long Tom

Established in November 2021, the Lower Long Tom AVA sits within the west side of the Lower Long Tom Watershed, between Corvallis and Eugene. Vineyards are located on stream-cut ridge lines running east to west, with Bellpine as the predominant soil type. These clay-loams are formed from up-lifted ancient marine sediments, primarily sandstone. With Bellpine topsoils usually shallow, grapevine roots have to penetrate the sandstone below to find water and nutrients.

To the west, the region is flanked by significantly higher elevations of the Coast Range which serve to form a weather shield. The rain shadow of the peaks to the west reduces precipitation and, combined with the prevailing winds, creates a macroclimate with less disease pressure during the growing season and consistent fruit maturity, even in more difficult vintages. While Pinot noir is the predominant grape of the region, with wines leaning toward blue and black fruits and plush tannins for graceful aging, around a dozen white grape varieties are grown as well, including Chardonnay, Riesling, Pinot Gris, and Sauvignon Blanc.

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.

Mount Pisgah, Polk County, Oregon

Located in Polk County, the Mount Pisgah, Polk County, Oregon AVA is characterized by the warmth of the nearby Willamette River, the mild influence of the Van Duzer winds, and the rain shadow of Laurel Mountain to the west. It is the Valley's second smallest AVA but one of its most densely planted. Mount Pisgah was formed 65 million years ago as a sea floor volcano,

and has since been covered by marine sediment which pushed up out of the ocean. This unique geology allows the grapes to develop a deep complexity in the region's shallow soils.

The most common grape varieties in the AVA are Pinot noir, Pinot gris, Pinot blanc, Chardonnay and Tempranillo. Mount Pisgah, Polk County, Oregon AVA is located 15 miles west of Salem, Oregon, and is the second most southern nested AVA within the Willamette Valley AVA, next to Lower Long Tom, which was newly established in November 2021. To differentiate from another "Mount Pisgah" in Oregon's Lane County, it was necessary for the AVA to be named Mount Pisgah, Polk County, Oregon—now Oregon's longest-named AVA.

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.

Tualatin Hills

This 15-mile slice is tucked into the northwesternmost corner of the Willamette Valley and is home to the very first commercial vineyard in Oregon, with a long agricultural history. Recognized by its distinctive soil and climate, the AVA is named for and principally defined by the watershed of the Tualatin River.

It offers the largest concentration in Oregon of Laurelwood soil, a windblown volcanic soil mixed with basalt known as loess that was deposited by the Missoula Floods 12,000 years ago. At an elevation range between 200 and 1,000 feet, the area benefits from the rain shadow of the Coast Range with slightly lower rainfall, cooler temperatures in springtime and more temperate and dryer conditions during the critical fall harvest period. It is sheltered to the west by some of the highest peaks of the Coast Range mountains and shielded to the south by the large mass of the Chehalem Mountains.

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.

Van Duzer Corridor

The Van Duzer Corridor is an anomaly in the Coast Range through which oceanic winds funnel into the Valley, creating a cooling effect that occurs as early as 2:00 in the afternoon. This breeze dries out the vine canopy and decreases fungus pressure, making the area highly attractive for grape growing and supporting sustainable practices by drastically reducing the need for fungus spray. As a phenomenon of wind protection, the grape skins thicken, leading to an abundance of anthocyanins (color) and tannin.

The buffering effect is highly noticeable and varies from one vintage to another. When nearby regions of the Willamette Valley face overly warm conditions, this area is usually slightly cooler. The opposite is also true; when the nearby regions of the Willamette Valley face below-average temperatures during the growing season, this area receives generous mild air from the ocean, tempering the cold. These combined effects allow for near-perfect growing conditions with highly consistent quality.

Within the 35.9 square mile triangle that composes the Van Duzer Corridor, nearly 1,000 acres are occupied by 18 commercial vineyards and 6 bonded wineries.