THE SCIENCE BEHIND THE NAPA VALLEY APPELLATION

An examination of the geology, soils,
and climate that define Napa Valley as a
premier grape growing region.

By Gerald D. Boyd

Napa Valley is a name that conjures up many images, thoughtful reflections and names of legends and leaders that are emblematic of the contemporary meaning of the valley as a major wine region. In 1966, with the opening of his eponymous winery in Oakville, Robert Mondavi, Napa's elder statesman, recognized the unique qualities of Napa Valley soils and the wines they produced. "We knew then that we had the climate, the soil and the varieties that made our own distinct style of wine that could be the equal of the great wines of the world, but it did require the winegrowing and the wisdom to know how to present it to the world."

By the early 1970s, in another part of the country, I became acutely aware of Napa's growing reputation when I made my first wine trip to France. As a newly minted wine writer, based in Colorado, I sensed that California wines were on the verge of making a major impact in the world wine market and that Colorado was hardly a thriving wine region. Fact is, although California wines were gaining shelf space in Denver, it was clear that Americans were then more Euro-centric in their wine tastes.

It was a sign I took to heart while planning for my first trips as a wine writer. I mistakenly figured that the French winemakers on my travel itinerary would be well versed on California wine, so I should be prepared. And the best way to do that, I reckoned, was to first head to Northern California and immerse myself in the local wine culture. So, I set appointments in the valley with wine notables like the venerable Joe

Heitz, who provided me with a no-nonsense account of the life of a Napa Valley winemaker.

Heitz, and others I visited on that trip, became my tutors, sometimes reluctantly. In a somewhat compressed time period, I learned a lot about Napa Valley wines. So, armed with this fresh knowledge of the Napa Valley and its wines, I naively made my second miscalculation. Conscious of not wasting winemaker's time, I needed an ice breaker, a vinous hospitality gift that would charm even the most parochial French *vigneron*, so that he would welcome me as a long-lost *neveu.* I made space in my suitcase for a half dozen bottles of Zinfandel, the quintessential California wine.

At my first stop in Bordeaux, I was met by the proprietor of a noted chateau and after accepting his gracious invitation to visit the *chai*, I presented him with a bottle of Napa Zinfandel. It was a shock to his senses. Not wishing to appear rude, especially since I had carried the wine across a continent and an ocean, my host smiled politely and nodded, then grasping the top of the bottle between his thumb and index finger, he gently swung the bottle of Zin in an arc toward a hallway table, holding his arm away from his body as though he were disposing of a dead rat. Truth is, I don't remember his exact words, but the sentiment was something like, "*Mais oui!* Napa Valley wine...I heard they were doing something with grapes there but was never quite clear exactly what."

In the intervening years since that first trip to Bordeaux, the French, and the world, have come to accept and respect the quality of California wines and the importance of the Napa Valley as one of America's premier wine regions. Vintage after vintage a succession of Napa winemakers and grape growers have confirmed with their wines that the Napa Valley is indeed America's Eden. But while the proof is in the pudding, much

of the evidence that the Napa Valley has the right wine stuff for greatness was anecdotal. For some, Napa wines and the personal accounts of their makers were enough, while others wanted more.

So, from July 2001 to October 2003, the Napa Valley Vintners (NVV), a non-profit trade group representing more than 230 members, commissioned three major studies to demonstrate and verify that the Napa Valley AVA's unique geology, soils, climate, weather and topography all work together in a myriad of associations to nurture a select group of wine grapes. The first study, "The Foundations of Wine in the Napa Valley: Geology, Landscape and Climate of the Napa Valley AVA," by Jonathan Swinchatt of EarthVision, commissioned in 2001 and completed in 2002, addresses geology, landscape and climate. Paul W. Skinner, Ph.D., of Terra Spase, was then commissioned in September and October of 2002, to write two studies: "Soils and Wine Grapes in the Napa Valley" and "Weather and Wine Grapes in the Napa Valley," which were completed in 2003.

Bob Steinhauer, senior vice president, vineyard operations, Beringer Vineyards and NVV president knows the viticultural map of the Napa Valley AVA like the back of his hand and he places great value on the reports as growers' tools. "I was very excited to review the NVV sponsored geology, soils and climate reports for the Napa Valley. The three reports will be the foundation for future viticultural decisions and an integral part of every viticulturist's and winemaker's knowledge. Together, they demonstrate the complexities of the Napa Valley, allowing us to grow a wide range of high quality, world-class wines. The combination of complex topography, geology, soils and climate combined with farming and winemaking practices provide immense differences in wine

styles. I personally believe that there are strong synergies developed in wine style because of the complex soils and climate."

A LITTLE HISTORY

More than 30 years ago, the name Napa Valley resonated as the main powder charge in what would become the "wine boom" of the early 1970s. Then and now, Napa Valley was an energized name that needed no official wine stamp. Fact is, most wine people of that day, myself included, felt the California frontier of New World winemaking was too wild and wooly, given the freedom of experimental winemaking and grape growing, to be tied down to the restrictive control of an appellation system like the French *Appellation d'Orgine Controlee.*

Napa Valley's wine heritage took roots in the late 19th century, and soon raced past neighboring Sonoma Valley, the reigning wine region of the day. From 1861, when Charles Krug arrived in St. Helena, to the opening of Beaulieu Vineyard in 1899, Napa Valley wine scaled many heights. But it all started to come apart in 1890 with the discovery of phylloxera, a vine pest that nearly decimated the valley's vineyards. Fast forward through a period of sluggish growth, hindered by two world wars and Prohibition, to the so-called modern era of winemaking. The birth date of this era is arbitrary (Heitz Cellars was established in 1961), but present day wine consumers are likely to put the date precisely in 1966, when the Robert Mondavi Winery opened in Oakville.

With the boom now expanding with a steady roar, legitimacy was expected as Napa Valley vintners looked longingly at the vast export potential. So, in 1983, the Napa Valley American Viticultural Area (AVA) was established, encompassing almost the

entire county, stopping short in the northwest of the hard scrabble area near Howell Mountain known as Rattlesnake Ridge. On the western edge, running along the spine of the Mayacamas Mountains, the appellation borders Sonoma County, and in the east, it stops at Lake Berryessa, while in the south, the Napa Valley AVA morphs into the bi-county appellation of Carneros. Although there are pockets of vineyards beyond the valley proper, the viticultural core of the Napa Valley AVA is an area 35 miles long and four miles wide at its widest point. In addition to a collection of 13 sub-AVAs within the valley (with the two proposed AVAs of Oak Knoll and Calistoga poised to join them), there is a series of smaller valleys --Wild Horse, Pope, Chiles, Wooden, Gordon – reaching back into the eastern Vaca Mountain range.

Within the delimited space known as the Napa Valley AVA, there are no fewer than 33 different soil series, a variety of microclimates, steep mountains and sloping foothills on the eastern and western flanks and a network of pocket valleys that meander eastward off the valley floor. Nowhere in the United States is there such a compact and varied spot for growing premium wine grapes.

Historians are better trained and informed about the history of the valley and its environs. What we are concerned with here is the evolution of the Napa Valley AVA as it relates to geology and soils, climate and weather and landscape, the factors that when combined form the foundations of wine in the Napa Valley. Having an in-depth source of knowledge about what makes the Napa Valley tick is of value to the established and neophyte grower alike, as well as anyone considering growing grapes and making wine within the Napa Valley AVA. Because in today’s high-profile, high-cost wine market, nurturing quality wine grapes is an expensive undertaking that requires a thorough

knowledge of the total vineyard environment that may help defray some of the costs in time, effort and money.

Like all attentive wine writers, keeping one eye on the ever-changing world of wine and the other eye on the fickle wine consumer, I've concluded that most wine consumers want to know two things: "Does the wine taste good?" and, "How much does it cost?" For some wine lovers, though, having a total wine experience is an awareness that goes beyond mere taste and cost. Understanding what makes certain grapes grow better in one *terroir* and not another is as essential to understanding a wine as knowing an author's background is to understanding the central core of a novel.

Armed with this background information, the diligent reader will notice some overlap of factors such as soils and climate, in the three studies. Disagreements also pop up, but appear to be based on professional perspective and belief in certain scientific data collection methods, and looked at from a positive view, the differences add balance and credibility to the findings. It should also be noted that the authors' approach to the materials covered is unique to their background and experience, with each study intended to form part of an overall consensus on the geology, soils and climate of the Napa Valley AVA. With that in mind, let's start then at the beginning.

DOWN AMONG THE BEDROCKS

Even to the most casual observer, the Napa Valley is so fertile and productive that it is popularly believed all one needs to do is drive a grape cutting into the ground, then stand back and watch it grow. Trudging through a vineyard, dirt caked on your boots, the casual visitor can admire the symmetry of the vine rows, the healthy appearance of the grape clusters and canopy and how it all seems to fit so nicely into the environment. But

no matter where one looks, beneath the ubiquitous soil, which seems at a glance to have the same machine-ripped texture and color, things are quite different.

Geology is the foundation (or if you'll pardon the pun, the bedrock) of viticulture: bedrock is layered with sedimentary materials then covered by a thin veneer of soils. In a way this matrix is similar to a wall in a house, sheathed in sheetrock, topped with a coat of primer and then paint or wallpaper on the surface. Geologist Jonathan Swinchatt, of EarthVision, summarized the value of first understanding the geology of a vineyard in his "Foundations" study for the NVV, "Our charge is to summarize the scientifically characterizable attributes of the (Napa Valley) AVA…the topography, the bedrock and surficial geology, the distribution of surface sediments and soils and regional variation in temperature and precipitation…and how they make the Napa Valley an ideal place to grow a wide variety of wine grapes."

Swinchatt points out that geologic history is the long-term story of the earth's crust, that 150 million years ago most of what we now call California did not exist. Throughout the millennium, a series of geologic events, or to use Swinchatt's words, "a continual dance of crustal plates," caused the shifting, sliding and lifting of land masses that "plastered material onto the edge of North America and formed it into its present, temporary and ever changing configuration." It is these processes, he adds "that have created the place that, for a wine grape, is Eden: the Napa Valley."

Throughout his study, Swinchatt takes the reader on a tour of the geologic eras, providing a detailed account of the geologic history of California and the formation of the Napa Valley, noting that the story of the valley had its genesis 145 million years ago. Cataclysmic events occurred as the Pacific Plate dove beneath the North American Plate,

melting rocks into magma that rose to the surface forming a chain of volcanoes. Erosion over thousands of years eventually deposited sediments forming what is now known as the Napa Valley AVA. As the land masses shifted and slid, material from the ocean plate was "plastered" onto the edge of North America. "This material is now known as the Franciscan Formation," says Swinchatt, "a complex and diverse rock unit that underlies much of coastal California and which is one of the major bedrock components of the Napa Valley AVA."

More recently, about 24 million years ago, another geologic event occurred that formed the initial foundation of the Napa Valley. As the Farallon and Pacific and North America plates met at a "triple junction" in Southern California, they pushed northward, creating the San Andreas Fault. As the triple junction slowly moved north, dragging the San Andreas Fault along, tremendous compression forces pushed up wrinkles in the earth's crust that became the Coast Ranges and the Mayacamas Mountains. The scope and power of so much unleashed raw energy is unimaginable.

"Bedrock is the ultimate source of the chemical and mineral elements of soils," says Swinchatt, driving home his point that the character of the sediment and soils in which grapes grow is directly affected by the bedrock on which they rest. Most of the bedrock in the Napa Valley AVA can be found in what Swinchatt calls three major bedrock units: The Great Valley Sequence, the Franciscan Formation and the Napa Volcanics.

Joel Aiken, winemaker and vice president winemaking operations for Beaulieu Vineyard, is a long-time student of Napa Valley soils. "I have always been aware of whether a soil is volcanic or marine origin and have felt that this origin (which relates to the bedrock) can have an effect on the vine and ultimately on the flavor of the wine.

Although I know that the parentage of the soil has an effect on nutrients, it is only one of many factors that affect the nutrient status of soils. Some soils retain water and nutrients better than others based on the structure of the soil more so than the soil's parentage. Also, water used for irrigation throughout the valley has a hugely different mineral content. Some water has such high levels of some nutrients that it cannot be used for irrigation."

The Great Valley sequence is a huge trough, piled high with sandstone, conglomerate and shale deposited over the period of 140 million to 60 million years ago. These sandstones and shales, derived from volcanic rocks, contain quartz and feldspar and are rich in sodium and potassium. Surface exposures of the Great Valley Sequence bedrock can be seen mainly on the west side of the valley, roughly between Oakville and Carneros. Small areas of the Great Valley sequence also occur in the Stag's Leap District, near Calistoga and the hills northwest of Lake Hennessey. Especially good outcrops of representative fine-grained sandstones and silty shale are visible at the top of the Oakville Grade (Figure 6) and along the east side of the Silverado Trail (Figure 7).

Not as well understood is the origin and composition of the Franciscan Formation. Geologists remain puzzled how the Franciscan Formation came together, but believe that it is made up of a number of distinct types of materials, all derived from oceanic environments of the Pacific and Farallon crustal plates. Part of the mystery is the presence of material that geologists say shows characteristics of high-pressure, low-temperature environments. Swinchatt notes that such an anomaly "is a mystery as geologists could find no environment on or in Earth that had those characteristics."

For viticulturists, it is important to know that Franciscan Formation sites are rich in calcium and sodium feldspar but lack potassium feldspar. Chris Howell, winemaker, general manager Cain Winery and Vineyard, on Spring Mountain, notes that the soils of Cain vineyards are, indeed, poor in potassium, a factor, along with others that he calculates gives Cain grapes more hang time. “I think that the low yields we experience (1 to 2 tons per acre) reflect the low amounts of available water and nutrients, especially nitrogen and potassium, which I think leads to slower ripening.”

According to Swinchatt, two large areas in the Napa Valley AVA, with Franciscan Formations, *may* be suitable for growing grapes providing the climate is also suitable. A band of Franciscan runs along the middle Mayacamas Mountains from the southern boundary of the Oakville Fan, north to St. Helena and west over the mountains into Sonoma County. Franciscan rocks also occur in the Rutherford viticultural area, Chiles Valley, in spots on Spring Mountain, such as Cain Vineyard (Figure 8) and south of Lake Hennessey where it crops out in road cuts.

Chris Howell, an ardent student of Napa Valley viticulture, provides this view of the local geology: “The Cain Vineyard sits at the crest of the Mayacamas range in the Spring Mountain District, where most of our soils are clearly of Franciscan origin, tending to be formed from sandstone and shale. Even so, in one of our highest blocks, right along the crest, we can find large round rocks that obviously formed in a moderately sized creek bed – not what one would expect on a mountaintop.”

Then, there’s “Napa Volcanics,” a term coined by Swinchatt for a geologic entity that is not officially recognized (there is similar strata in a neighboring county). The Napa Volcanics is a collection of rock types such as volcanic ash (tuff) (Figure 11), volcanic

glass (figure 13), lava flows, pyroclastic deposits, volcanic mudflows, rocks not from volcanic eruptions and sedimentary rocks of volcanic origin. Found mostly along the west central part of the Napa Valley AVA, the broad band of volcanics also forms the underlying foundation of the northern one-third of the Mayacamas Mountains. In addition, virtually all of the hills and knobs within the valley are formed of Napa Volcanics, except for the Pine Ridge knob, which is underlain by Great Valley sequence strata.

In a time when scientists are probing further into space, suggesting that our universe was formed billions of years ago, it is still a stretch for most people to think (and imagine) in terms of centuries, let alone geologic periods of millions of years. Suffice it to say that within the Napa Valley AVA there are sediments and soils deposited there that were formed as long ago as 1.6 million years. Swinchatt has found that these deposits (Figure 15) “make up the alluvial fans in the valley and the materials associated with the Napa River and the various streams and creeks.” Further, “A large percentage of the grapes grown in the AVA are grown on these materials.”

Closer yet to the direct association of the vine’s physical environment and the quality of the grape itself, is the transformation and evolution from bedrock, to sediments and soils. Swinchatt maintains that a large percentage of the grapes rooted in the Napa Valley AVA are grown in sediments deposited during the Pleistocene and Holocene epochs, which he refers to as “surficial deposits.” Further, the diversity of the rocks and other materials, says Swinchatt, contributes to the diversity of these sediments and soils that are the direct foundation of grapevines.

Before leaving the mind-bending subject of geology and the importance of bedrocks to grape growing in the Napa Valley AVA, it should be noted that some soil scientists, like Paul Skinner, author of the study "Soils and Wine Grapes in the Napa Valley," take a different view about the source of grape vine nutrients. Whereas Swinchatt claims bedrock is the primary source of nutrients, Skinner maintains that vines draw their nutrients from the soils. In Part 5 of his study, Swinchatt has this to say about the relationship of soil scientists and geology: "Prior to the late 1970s, the agriculturally oriented classification adopted by the Soil Conservation Service of the United States had a significant geologic component. In more recent years, soil scientists have paid little attention to the underlying geology. The 1978 Soil Survey…reflects this change." Nevertheless, Skinner maintains that soils control the growth and production of grapevines in the Napa Valley through the influence of soil depth and texture and through inherent and modified fertility levels. "Soils are a reservoir of nutrients that are required by vines to complete their growth cycle," claims Skinner.

The learned words of scientists like Skinner and Swinchatt persuasively further the argument that regional flavor and character do exist in wine. This is good news since some critics maintain that regional flavor sometimes suffers at the hands of winemaking, despite the fact that wines with purer fruit character, reflective of the vineyard terroir, are once again crowding wine shop shelves.

SOUNDING OUT THE SOILS

In his May 2003, "Soils of the Napa Valley AVA" study, Paul W. Skinner brings the vine nutrient-growth mechanism closer to the surface of the earth, wherein he contends that soils act as building blocks in determining the quality of premium wine grapes.

"Without the complex nature of soils, there would be no terroir," he claims, referring to the French viticultural buzz word that describes the unique attributes of such diverse components as weather, climate, topography, soils and location.

The wide range of surface layer soils, encapsulated in the collection of soil series of the Napa Valley, is at the core of Skinner's findings. For centuries, he says, soils have been closely associated with premium quality viticultural areas and wine grape production. "Soils are also recognized as being an integral part of the complex of variables that determine the terroir of a particular vineyard."

If it were possible to view a cross section of the Napa Valley, divided on a north-south axis, showing the mountains, the valley floor, the surface soils and underlying stratification, the dense layered scene would resemble a complex, enigmatic painting by the 16th century Flemish artist, Heronymous Bosch. Texture, form, color and other components, blend and whirl, separate and diverge, presenting a matrix far too complex to be digested in one take. Within the Napa Valley AVA there are 33 separate soil series that are alike in all aspects except the texture of the surface layer.

Skinner believes that everything is interconnected and dependent. "Each of the five soil forming factors (time, climate, biota, topography and parent material) plays an important role in defining the vigor of soil series with respect to grape growing in the Napa AVA." In turn, he notes, the potential of soil vigor influences such vineyard practices as irrigation, fertilization, canopy management and disease control. At the surface, the soil series has an effect on the selection of rootstocks, irrigation systems, vine and row spacing and trellis types. An understanding of each of these factors and how they work together, places the focus on Skinner's belief that the diversity of the wide range of

soils in the Napa Valley influences the quality and complexity of all of the premium wine grapes grown there.

For a thorough understanding of this working relationship, Skinner suggests studying the formation of soils, by employing the interaction of the five soil forming factors. “At the core of the soil forming factors is the interaction of environmental variables with the geologic substrate.” he says. Citing other independent studies, Skinner continues, “the concept of soil forming factors defines soil as a component of ecosystems that must be characterized by both geology and biology…and geologic characteristics represent the site factor that defines the initial condition for soil formation, while climate and biology factors represent the energy input that drives soil development.”

It is the unique combination of the five soil forming factors, and how each affects soil processes, he says, that are responsible for the diverse soil conditions that support the ability of each Napa Valley AVA to produce a wide range of quality wine grapes. This, then, is a condensation of Skinner’s five soil forming factors and how they interrelate with each other in the Napa Valley.

TIME, is the measurement that governs all of the other soil forming factors. In a geologic span of young to old, soils form and develop, with varying degrees, in the Napa Valley AVA. “Young soils, such as the Cortina series,” notes Skinner, “show very little profile development. Old soils, such as the Haire series, have well developed profiles, with evidence of clay moving down through the soil.”

CLIMATE, namely temperature and precipitation, has a direct influence on soil formation and soil properties. Soil-forming processes in Napa County, characterized by warm, dry summers and cool, moist winters are influenced somewhat by cyclical

precipitation and temperature patterns. The wettest months in the county occur between November and April, with gradual shifts in climatic properties and noticeable variations in microclimates throughout the Napa Valley AVA, which influence the rates of soil transformations, translocations and losses.

Solar radiation and chemical and mineral weathering also contribute to the soil-forming processes. And Skinner notes that the interplay of these two elements "play important roles in determining production and fruit quality in the vineyards located on hillside soils of the eastern districts of Howell Mountain and Atlas Peak."

BIOTA is the plant and animal life of a region, which Skinner contends provide a significant energy input into the soil systems. Photosynthesis, the conversion, by plants, of carbon dioxide into organic compounds that are then deposited into the soil, helps to form a substrate for animals, insects and microorganisms. Plant communities in particular, says Skinner, play a significant role in determining soil, chemical and physical properties.

Throughout the Napa Valley AVA there is a healthy and active variety of plant life. According to Skinner, the soil surface layers, which vary depending on elevation, are rich in plant nutrients, organic matter, combined with beneficial physical characteristics. This combination promotes good yields of high quality fruit with moderate amounts of irrigation during the hotter months of the growing season, in the valley floor districts of Stag's Leap, Oakville, Rutherford and St. Helena. He points out that in the western hills, particularly Mt.Veeder, where precipitation is greater, the moisture and oak-grass-redwood vegetation forms thick organic surface mats, posing a challenge to consistent

grape yields. “Vegetation has a direct effect on important soil profile characteristics and as a result influences vine nutrition, water requirements and overall vine vigor.”

PARENT MATERIAL is the geologic substrate from which soil forms and is responsible for determining the basic chemical, physical and mineralogical nature of the soil. Skinner adds that “Parent material also contributes to soil properties such as nutrient supply and retention as well as water movement in the soil profiles.” The Napa Valley AVA is a myriad of complex geologic formations and soil landscape characteristics, varying shallow to deep and ranging from sandstone and shale in valley, to a combination of sandstone and shale or clay-rich soils on the mountain ridges. Soils in other parts of the AVA, especially the uplands, are rich in volcanic ash, as on Howell Mountain, or striated with serpentine, an igneous rock that has been altered by hydro-thermal pressures.

TOPOGRAPHY and its sub components elevation and slope directly affect soil formation “through its influence on meso-climate, drainage, erosion, plant cover and soil temperature,” explains Skinner. He also notes that the aspect of topography, or the direction in which a slope faces, has a major effect on the microclimate of the soils, by determining the amount of solar energy reaching the soil system. And, “Differences in soil drainage resulting from topographic properties commonly influence the formation of soils.”

A further breakdown, bringing to light a clearer concept of how soils are formed can be seen in terms of four types of processes: additions, the input of organic material by plants and microorganisms to the soil matrix; losses, soil mass lost from erosion and leaching caused by the downward and lateral movement of water; transformations, microbial

decomposition and physical and chemical weathering of parent materials; and translocations, or the movement of organics, solutes and clay particles within a soil profile.

Skinner cautions that materials formed from igneous rock formations are less fertile then those from sedimentary rocks, such as sandstone and shale. Soils composed of serpentine have an alkaline pH and very high magnesium to calcium ratio, which in turn reduces the calcium and potassium in soils; without adequate potassium levels, vines are less likely to produce fully ripe grapes. “I have found that nutrients, especially potassium, can have a strong role in mediating water uptake and the vine’s ability to manage water stress,” says Cain’s Chris Howell.

While the diverse factors of soil formation within the Napa Valley AVA have established a general foundation, resulting in a “mosaic of soil series that directly influence the growing of grapes and making of wine in this region,” Skinner adds that the soils series are neither random nor uniform in their distribution. “Instead they are variable expressions of complex physical, chemical, biological processes that form a continuum across the landscape.” He points to the importance of a “soils matrix” that allows the vine roots to extract water, oxygen and nutrients to support the growth of the vine.

Skinner places strong emphasis on the soil series descriptions, adapted from the Napa County Soil Survey, within the AVA. “The soil description contains information on depth, texture, color, consistence, profile development and chemical constituents among other properties.” At the core of soil descriptions are what soil scientists call “horizons,” a soil layer approximately parallel to the land surface, described by a number of components including depth, color, structure, acidity and root size and density. Skinner:

"One of the biggest challenges facing Napa Valley grape growers is defining the relationship between soil and possible rootstock characteristics then matching those with vineyard spacing and trellis that allows optimum fruit production and quality. The diversity of viticultural systems in use in the Napa Valley AVA that produce high quality fruit is unmatched."

Beringer's Steinhauer agrees with Skinner's caution to growers. "The ultimate decision (for growers) should incorporate the knowledge of these reports but also must be based on first-hand observation and history of the specific site. We are continually reviewing our farming cultural operation to improve wine quality." He cites Beringer's Chabot Vineyard as an example of the complexities of soil and climate that are encountered in vineyard sites throughout the Napa Valley AVA. "There are three basic soil types in our Chabot Vineyard – Bale, Forward and Perkins – that along with climate differences primarily due to sloping ground, show variability within the types."

The soils series descriptions are defined by an analysis of such factors as soil horizons, soil texture, color, rock fragments and basic chemical properties. Once the profiles have been compared and grouped according to similarities, an aerial photograph is taken of each profile and then combined to produce a soils map of the Napa Valley AVA. The descriptions that accompany the map cover many factors, including a differentiation of the horizon using specific terms outlined in the Keys to Soil Taxonomy, published by the National Resource Conservation Service.

In general, each soil series, such as Haire and Diablo, is defined by percent of slope, 0 to 75; elevation where the soil series can be found, roughly 20 feet to 4,300 feet and the types of vegetation to be found growing in each soils series. A look at the Haire series

soils, found in such appellations as Los Carneros and Oak Knoll District, provides a better understanding of this complex subject.

"The Haire series consists of moderately well drained soils on old terraces and alluvial fans. Slope is 0 to 30 percent. Elevation is 20 to 300 feet. These soils are formed from alluvium derived from sedimentary rock. The vegetation in uncultivated areas consists of annual grasses and forbs." The Haire series is dominant in Carneros, 40 percent and Oak Knoll, 24 percent. Carneros also has patches of Forward and Diablo series soils, making for "abrupt transitions from premium Chardonnay to Merlot and Pinot Noir vineyards within relative short distances." Whereas Pinot Noir is typically planted on low vigor potential soils, including the Forward and Bressa series, Chardonnay and Merlot do well in high vigor potential soils, such as the Haire and Diablo series. A more detailed narrative follows in the Soil Profile Descriptions, covering all 14 individual appellations or districts within the Napa Valley AVA.

SWINCHATT ON SOILS

As a geologist, Swinchatt looks at soils and sediments as the surface development of the core rock formations. Soil scientists, he says, describe what they see; the loose materials at the surface of the earth, while geologists are concerned with the origin of those materials. It's a perspective not dissimilar to the more esoteric chicken and the egg argument. But Swinchatt proposes a new notion which he calls an Earth Process Unit (EPU), or sedimentary deposits that result from a breakdown of rocks through a complex network of processes such as weathering, heating and cooling and bacteria.

The view of the Napa Valley through Swinchatt's eyes is one of alluvial fans and terrace deposits, rocks and core stones and alluvial and fluvial (produced by a river)

sediments. It's a complex matrix, even for the trained eye, but Swinchatt says that "of all the materials that form EPUs, residual sediments reflect most clearly the character of the local bedrock." He points to the Stagecoach Vineyards, in the Atlas Peak AVA, as an interesting example of the character of residual materials, a site of volcanic bedrock, littered with boulder-like material (Figure 26) and soils varying in depth from a few inches to 16 feet.

Alluvial sediments are products that are disrupted on hillsides and moved down slope by water and gravity into major streams. As the streams enter river floodplains, water velocity decreases and the sediments begin to settle. This back and forth movement of the sediment-laden water knocks the streams off course, forming a fan-shaped sedimentary deposit called an alluvial fan (Figures 29 & 30), such as the famous Rutherford and Oakville Benches. While the alluvial fans develop from a single drainage watershed, fluvial sediments of the Napa River (Figure 33), which drains an estimated two-thirds of the AVA, are composites, mixed from materials delivered to the river from throughout its upstream course.

Swinchatt points out that while, at first glance, the distribution of EPUs in the Napa Valley AVA, shows residual materials in the hills, alluvial sediments along the edges of the valley and fluvial sediments on the valley floor, the overall distribution is more complex. Landslides, both ancient and active, are more common in the western Mayacamas Mountains than in the eastern Vaca Mountains. He warns that landslide deposits are highly unstable and subject to movement (Figure 36), especially when water from irrigation is added, thus the sites are "probably not suitable for (vineyard) development."

Alluvial EPUs (Figure 37), says Swinchatt, vary throughout the valley, with alluvial fans running almost continuously along the base of Mayacamas Mountains, from the city of Napa to St. Helena, sloping gently toward the Napa River. He describes the close proximity of the fans and the river, then noting how the fans change abruptly into flat fluvial sediments. To the east, across the valley, older alluvial fans can be seen along the rises and falls of the Silverado Trail, at Deer Park Road and Mumm winery, while fans at the base of the Vaca Mountains appear to be less developed, partly due to the size of the Lake Hennessey watershed. Good examples of fluvial EPUs, says Swinchatt, are along the present courses of the Napa River and Conn Creek (Figure 35) and may appear beneath surface materials in other parts of the valley.

Citing the 1978 Napa Valley Soil Survey, Swinchatt points out that soil classifications illustrated as the Soil Survey Map (Plate 1), are used for a variety of purposes, such as forecasting crop yields and water management. The Survey further classifies soils in Napa County in two groups: Uplands (84 percent of the county) and Lowlands (16 percent); 11 associations, such as slope and drainage; 38 Soil Series, which Swinchatt describes as the "principal building blocks of soil classification"; and 82 Sub Series or Mapping Units, based on slope angles.

Swinchatt says that local variation in sediments and soil profiles, "sometimes on a very small scale, is one of the most significant attributes of the winegrowing environment of the Napa Valley AVA. In examining both the generalized and detailed soil maps, we can identify little or no correlation between the distribution of soil types and other specifically characterizable features of the Napa Valley AVA." He adds that this is not surprising since soils tend to cut across boundaries defined in other ways for other

purposes, such as the boundaries of EPUs…there is a fundamental distinction between sediments and the soil profiles that form on them…if our studies in the Napa Valley taught us anything, however, it is that local variation, sometimes on a very small scale, is one of the most significant attributes of the winegrowing environment of the Napa Valley AVA."

But Swinchatt takes his argument a step further, maintaining that the "variation in vineyards in the Napa Valley AVA is most often attributed simply to soil variation and that much of the variation actually reflects the character of the materials upon which the soils are forming." He cites numerous variations, such as the Frogs Leap Vineyards that borders the Napa River and the Rudd Estate, which appears on the surface to be covered with coarse rock debris, but says Swinchatt, shows on closer inspection, that "half of the property is underlain by alluvial fan sediments, the other by bedrock weathered in place, similar to the material that occurs at Stagecoach Vineyards." Thus, Swinchatt concludes "that the bedrock and sediments of the EPUs are of greater significance to the diversity of wine grapes in the Napa Valley AVA than are the types of soils that develop on those original materials."

Although agreeing with Swinchatt's findings, Terry Mathison, Rudd Estate vineyard manager, takes the viticulturist's view, "Our soils at Rudd are clay and red clay loam with an average of 70 percent rock content. The soils have very low water storage in the root zone, resulting in smaller, more concentrated berries." However, Mathison points out that beyond the Rudd vineyards, is a different picture. "As you move out of the red soils, north, south and west of Rudd, the soils are a darker color with more silt and loam

and much less rock. Water capacity in these soils is greater, which means less stress on the vines, producing bigger, less concentrated berries."

Still, Swinchatt reiterates, "the bottom line is that soil type appears to be of secondary or tertiary importance to the materials of the EPUs and the characteristics of the place other than soil type." Going even further, Swinchatt disagrees with the Noble and Fisk (1989) position that wine character is affected by location, specifically by different soil types. "We would suggest…that wine character is reflecting primarily a different variable, that of material upon which the soil is forming – the sediments of the EPUs," adding that the EPUs, together with the influence of the veneer of soils that has formed on them, have created in the Napa Valley AVA a marvelously rich mixture of microenvironments for grape growers and winemakers to explore. This is, together with diversity of bedrock and climate, he concludes, the heart and soul of the Napa Valley AVA.

Agustin Huneeus, Sr., owner of Quintessa wine estate in Rutherford, is still wary of defining a correlation between soil composition and wine character, but he says they continue to observe and learn. "When researching the soil, we were looking mostly at the physical profile of it rather than the composition or biochemistry of it. Was it deep, permeable, water retaining, sandy? In time, however, I have personally discovered the great importance that the composition of the soil has on the flavor of the grape…and when doing the research that led us to a decision on Quintessa, apart from looking into the physical structure of the soil, we were very interested in variety of composition."

THE EFFECTS OF TOPOGRAPHY AND GENERAL CLIMATE

Turning to topography, Swinchatt observes the form taken by the surface landscape, and to structure, which he defines as the architecture of the rocks that underlie the surface. He is convinced that the primary control on the Napa Valley AVA topography is the underlying structure and composition of the rocks.

Viticulture within the Napa Valley AVA is subject to a number of factors, including slope angle, drainage, runoff, sun exposure, climate and temperature. Swinchatt says that topography greatly controls these many diverse factors, which in turn help to create the microenvironments of the Napa Valley AVA. He points to the constriction of the valley just north of St. Helena and the narrower, northern segment of the valley, "resulting from structural compression associated along the San Andreas Fault System." Swinchatt contends that this narrowing has had an impact on the distribution of sediments and, "there may also be an effect on temperature."

Supporting Swinchatt's position about temperature, while disputing conventional wisdom that the highest temperatures occur around Calistoga, Bo Barrett of Chateau Montelena, says that temperatures around Dutch Henry Canyon and Three Palms Vineyard, just north of the narrows, "commonly exhibit temperatures 10 degrees higher than those at Chateau Montelena."

The significance of daily sun exposure and slope setting, when combined with other factors, result in what Swinchatt says is a broad range of microenvironments suitable to growing a diversity of grape varieties. He cites the Stags Leap District as an example of how topography can affect climate and the quality of grapes. Strong, often cooler, afternoon wines are funneled up the narrow valley between the hills and the Stags Leap ridge, lessening the later afternoon heat that seems to build on the eastern side of the

eastern side of the valley. Admitting that there is no scientific evidence to prove the theory, Swinchatt nevertheless agrees with Stags Leap growers that the afternoon winds help create the distinctive character of cabernet sauvignon grapes grown there. “This seems a reasonable assumption, as the tannins structure of Stags Leap District cabernet sauvignon wines seems closer to that of wines in the cooler parts of the AVA than to those made in regions of higher temperature.”

Doug Shafer, of Shafer Vineyards, in the Stags Leap District, wagers that 19th century growers knew a little something about topography and climate. “Wine grapes have been cultivated on our site since the 1880s. I’d bet it’s because those early growers understood something of what we see today in terms of how topography shapes both climate and grape quality.

“First, because of our location in the southern end of the valley, the temperatures are cooler, at times by as much as ten degrees than what you find a few miles north. Next, we lie in a valley-within-a-valley. This narrow channel pulls in and holds cool air from San Pablo Bay; this is a breeze that travels every day in the late afternoon on the forefront of the fog rolling into the San Francisco Bay and surrounding area. Finally, because we’re situated on the eastern side of the valley our vineyards receive more hours of late afternoon solar light than vines that are in the center or are on the western edge.

“All of this adds up to a balance – lots of light without too much heat, and regular cycles of warmth and coolness. The result is twofold: less respiration of grape acids thanks to cooler temperatures and greater ripening thanks to longer hours of sunlight.”

Swinchatt ventures further with his observations, with one that centers on the origin of the hills and knobs that are scattered throughout the valley floor. “The hills and knobs

that dot the valley floor (Figure 19)…appear to be associated with an extensive and impressive geologic feature not previously recorded." Further, Swinchatt links these knobs with a series of regular, near-flat surfaces that cut across the face of the Vaca Mountains (Figure 20). Known by geologists as "displacement surfaces," these arcuate (curved bow-shaped) faces previously held large masses of rock that slipped or slid down. "Thus, we think that the flats upon which Dalle Valle/Showket/Vinecliff, Oakville Ranch and Stagecoach/Atlas Peak vineyards reside were formed originally at the level of the valley floor, uplifted during the formation of the Vaca Mountains, and then dropped down along arcuate slip surfaces to their present levels."

Swinchatt says that the sliding movement of these large land masses pushes up material at or near the toe of the slide, forming the hills and knobs. But he cautions that more investigation is needed to confirm or deny this notion, and especially if there is "any similarity between the bedrock between the knobs and their proposed position of origin." Looking at the implications for viticulture, the author notes some similarity in the rocks, sediments and soils of Rudd Estate, Dalle Valle, Oakville Ranch and Stagecoach vineyards. Heidi Peterson Barrett, who has made wines from most of these vineyards, says that the wines "have characteristics of the same family."

Finally, on the subject of topography and general climate, Swinchatt claims that topography per se is not important, but "rather it is the interaction of topography with water, with the sun and with climate…the topography of the Napa Valley AVA is fundamental to it being a place that is suitable to growing a broad variety of wine grapes, and fundamental as well to the subtle variations in character that make Napa wines interesting and enticing."

THE TOPOGRAPHY/CLIMATE CONNECTION

In a broadly defined continuum from the geologic formation of earth's interior to the elements that influence grape growing, the sequence, says Swinchatt, comes down to climate and weather. In his study on the geologic aspects of the Napa Valley AVA, he concludes with a few brief notes on climate, accompanied by monthly temperature and precipitation maps. More specific and detailed analysis on weather in the Napa Valley AVA is to be found in Paul Skinner's study, "Weather and Wine Grapes in the Napa Valley," covered later in this essay.

Swinchatt describes the climate of the Napa Valley AVA as "benevolent with a few extremes of temperature and rainfall." He notes that "The importance of climate to winegrowing is primary and evident." Other factors that directly impact grape growing, such as soil vigor and irrigation, can be manipulated by man, but little can be done about the weather, except to better understand the climatic elements of the region such as heat summation, temperature variations and amounts of precipitation.

He notes that because of abrupt local variation in topography, regions such as the Napa Valley AVA are difficult to characterize accurately. For his report, Swinchatt used a database of regional climatic evidence, showing the monthly rainfall and temperatures for an 18-year period, compiled by DAYMET. He cautions, though, that while the maps show some interesting trends (i.e., broad effects of elevation), "their significance is somewhat difficult to establish."

As a broad way to measure climate, Swinchatt places value on heat summation, but he notes that, "heat summation seems to tell us little about the true nature of the climate, about the distribution of temperature, nor does it say anything about sun exposure."

Citing a number of differences in the DAYMET study and Winkler's degree day system, Swinchatt says, "The degree day numbers of the DAYMET data appear to be quite different than those previously presented by Winkler…verification of Winkler's data is not possible, nor is it possible to evaluate the DAYMET database and methodology."

Describing the Napa Valley AVA as a Mediterranean climate, Swinchatt points out that the DAYMET average temperature maps (Figures 42A-42L) seem to dispute the conventional wisdom that holds that "breezes moving north from San Pablo Bay control temperature gradients in the Napa Valley," and that "winds also blow from the Pacific through the Estero Americano Gap, eastward across to the Carneros AVA and then up the Napa Valley." He also notes that precipitation is related to elevation and topography and that it is greatest at higher elevations in the northwestern end of the valley.

Other climatic variables that Swinchatt adds as elements, " that nourish the ability of the Napa Valley AVA to grow a broad variety of wine grapes by adding to the micro-environmental variation, include fog and wind, "there seems to be a growing recognition that wind does, indeed, stress the grapevine by drawing moisture from leaves and grapes."

WEATHER AND WINE GRAPES IN THE NAPA VALLEY

Mark Twain once said that everybody talks about the weather but nobody does anything about it. Until recently, grape growers in the Napa Valley AVA talked a lot about the weather, hoping that it would cooperate in nurturing a healthy crop of wine grapes. Now, grape growing has gone high-tech. As Paul Skinner points out in his study, "Weather and Wine Grapes in the Napa Valley," over the last seven years the development of new wireless technology and miniature computers has meant that "the

collection of weather data 24/7 has become possible and has greatly improved researchers attempts to understand the many different ways weather variables can influence wine grape growing and fruit quality."

Moreover, grower attention has been focused on the localized effects of mesoclimates (intermediate) and individual vineyards as well as the entire grape growing region. Using data collected by a weather network managed by Terra Spase, Inc., Skinner's study attempts to "identify and describe the important climatic variables within the Napa Valley AVA that influence the production and quality of its grapes." For the purposes of his report, Skinner defines "weather" as the specific condition of the atmosphere at a particular place and time measured in terms of many factors, including temperature, humidity and precipitation, over an hourly, daily or seasonal time period. "Climate," he says, refers to the average weather, usually taken over a longer period, 5 to 30 years, for a particular region and time period.

Skinner notes that the weather and climatic attributes that characterize the Napa Valley AVA, as well as set it apart from other grape growing regions, are influenced by the mountain and valley topography. Topographic variables that define many mesoclimates, as well as the many different grape growing conditions and grape varieties, include variations in slope (0-70%), the range in directional aspects (north, south, east, west facing) and the range in elevation (25-3,000 ft) above sea level.

Richard Camera, vineyard director for The Hess Collection, is keenly aware of the correlation between topography and climate in the three mountain vineyard sites he farms on Mt. Veeder. "The factors of slope, aspect and elevation are very important to us on Mt. Veeder and we work with what we have. For example, in our Veeder Hills vineyard,

we can only farm the ridges of our hills as the stability of the sedimentary clay over shale soils are not stable on steep slopes. Our exposures are east, due west and southwest as that is what is available, at elevations ranging between 450 feet and 1120 feet, but it gives us our best cabernet sauvignon."

In contrast, Camera notes these differences at Hess' two other vineyards on Mt. Veeder, each with its own terroir. "Mont La Salle, by the winery, has similar climate, exposures and elevations but softer slopes with deeper soils, but the facings are more north than south, which adds to the challenge in cool years. On our Veeder Crest/Summit vineyards, at 1750 to 200 feet, we can farm steeper land as the soils are dominated by volcanics with a mix of rock and clay that gives good stability to the land. While we get better exposures here we also experience a different mesoclimate with the dynamic of elevation and exposure."

Camera says that location is everything on Mt. Veeder, particularly relating to climate. "If you happen to be a little further north of us on the mountain and have a view of the valley floor, you will be getting a warmer influence."

Precipitation, says Skinner, is another important factor that distinguishes the Napa Valley AVA as a special place for growing grapes. He notes that the average annual precipitation within the AVA varies greatly, with most occurring between November and March when the vines are dormant. And the fact that the Napa Valley AVA receives little or no precipitation during the middle and end of the grape growing season is important to grape quality, as "it allows for the early ripening of relatively disease free grapes of many different varieties."

Skinner maintains that the Napa Valley AVA is unique in that precipitation patterns combined with the distribution of soil types, allows growers to use different combinations of irrigation practices, grape varieties (or the same grape variety), rootstocks and spacing and trellis configurations, to achieve different quality and complexity levels in the grapes harvested. He stresses the importance of spring rains, claiming they "may have positive effects on vine growth and flowering depending on timing, location and grape varietal impacted," and can provide an early season boost to vines growing on rocky soils. But the downside to spring rains, says Skinner, is that they may cause flower shatter in such varieties as Merlot and Cabernet Sauvignon, reducing yields in low vigor vineyards such as those found on hillsides.

Moderate relative humidity, adds Skinner, "is thought to be associated with the reduced risk of powdery mildew and also with increased vine water use." Low springtime precipitation, warm temperatures and moderate relative humidity are the factors that allow Regulated Deficit Irrigation (RDI) to work, says Skinner, noting that the combination of the factors for RDI does not exist in the spring in many other regions. As for the risk of diseases like powdery mildew and botrytis, Skinner says the Napa Valley AVA is unique because of the length of the growing season in many of the districts.

THE MERCEDES EFFECT

Another contributing factor that works with weather is the combination of summer heat and the marine fog layer, which Skinner calls "The Mercedes Effect." Hot dry summer conditions coupled with the development of a cooling marine fog layer slows grapevine growth while shifting to fruit ripening, "as smoothly as a Mercedes changing gears."

Pausing between gears, Skinner drives home his point about the Mercedes Effect. “In my opinion, the smoothness of this transition and the frequency with which it accelerates at an optimum time in the vine growth cycle, may be one of the most important but overlooked climatic characteristics that set the Napa Valley AVA apart from other grape growing regions of the world.” It would appear that Skinner’s auto-analogy provides an explanation and, perhaps, justification for the popular practice by many winemakers today toward achieving physiological ripeness.

Noting that irrigation practices are influenced in a major way by the climatic conditions during the mid summer months, Skinner adds that “the marine layer cooling and increased humidity resulting from the proximity to San Pablo Bay, can affect the moisture status of grapevines and is widely believed to positively affect the color, acidity and flavor of most of the varieties of wine grapes grown in the Napa Valley AVA.” He points out the importance of managing water stress during the mid summer months by irrigating, but without the interference of heavy rains, as being “another factor that sets the Napa Valley AVA apart climactically from many other grape growing regions.”

Beaulieu’s Aiken adds, “I would say that I am believer. As you get closer to San Pablo Bay, this cooling and increased humidity or fog definitely allows for longer hang time, which allows for increased color in reds and greater physiological maturity leading to riper flavors in the wines. The cooler weather allows the grape to retain more acidity as well.”

Acknowledging the validity and importance of Winkler’s growing degree days (GDD) system as a formula to determine that certain wine grape varieties perform better in either warmer or cooler climates, Skinner claims that findings from the Terre Spase study do

show some differences. “Based on Terra Spase network data from 1996 to 2002, most of the Napa Valley AVA falls within the GDD ranges for Regions III and IV. However, in cool years (1998, 2000 and 2002) there are areas within the Napa Valley AVA which are close to Region II (2501-3000 GDD) while in warm years (1996, 1997 and 2001) some of the northern parts of the Napa Valley AVA achieve Region V status (4001 plus GDD).

The meat of Skinner’s study on weather and wine grapes can be found in an extensive series of graphs, describing the meso-climates of the 13 appellations (including the pending Oak Knoll District) within the Napa Valley AVA, employing such influencing factors as rainfall, frost, humidity, disease risk and GDD. In general, these are Skinner’s findings:

Rainfall: an overall average of 39.9 inches, with a low of 30 inches in Carneros and highs of 48 inches on Diamond Mountain and 52 inches on Spring Mountain.

Frost: vineyards in all districts, except Mount Veeder, Howell Mountain and Atlas Peak, are subject to damaging early frosts, especially those in low-lying parts of Stags Leap District, Oakville, Rutherford and St. Helena. The three mountain districts rarely experience frost, except in the coldest years.

Disease Risk: powdery mildew in Yountville and Oakville and powdery mildew and botrytis in all the other appellations. The study covers spring and summer risks.

Humidity: the humidity index for all districts show a range of 50% to 84%, with the low of 50% (and a high of 72%) on Spring Mountain and highs of 82% and 84% in Chiles Valley and Atlas Peak, respectively.

GDD: The districts of Oak Knoll, Yountville, Stags Leap, Oakville, Rutherford, St. Helena and Mount Veeder are Region III to Region IV; Spring Mountain, Diamond

Mountain, Howell Mountain and Chiles Valley are Region IV; Wild Horse is Region III; Atlas Peak is Regions II to III in the coolest years and Regions III to IV in the warmest years, while Carneros is Region III to IV in warmer years (1996, 1997) and Region II to III in cooler years (1998, 2000 and 2002).

Skinner's conclusions on the impact of heat summation figures, arrived at from Terra Spase research, not only differs with some of Winkler's GDD numbers, but is also at odds with the DAYMET findings, which also differ with Winkler, referred to by Swinchatt in "Degree Day Summation," Part 6, of his study "The Foundation of Wine in the Napa Valley." For his data, Swinchatt used DAYMET, a database of regional climatic data for an 18-year period. According to Swinchatt, "The degree day numbers of the DAYMET data appear to be quite different than those previously presented by Winkler." He does caution, though, that it is not possible to verify Winkler's data or evaluate the DAYMET database and methodology. This professional disagreement, then, appears to stem more from the use of different data collection methods than from the overall importance of the impact of heat summation on weather and climate in a vineyard scenario.

In the concluding part of his study on weather and wine grapes in the Napa Valley AVA, Skinner highlights some of the ways weather influences grapevine growth, at different stages of vine development, in the Napa Valley AVA. During the vine growth stages: vines are susceptible to spring frosts during bud break, especially in low lying parts of the valley; after bud break, grapevine shoot and leaf growth are directly influenced by air temperatures; prolonged cool or hot temperatures, cloudy weather and precipitation can affect flowering and reduce yields; high midday temperatures can result

in water or heat stress for some varieties; after bud break, irregular weather conditions are mostly responsible for the development of grapevine diseases. During the dormant season, Skinner notes these effects: winter floods can disrupt pruning work and destroy stakes and trellises; cover crops are necessary to help control erosion; winter and spring precipitation influence soil vigor potential, possibly requiring supplemental irrigation; winter precipitation events are major factors in the spread of vine diseases such as Eutypa and Bot canker.

"In my opinion," Skinner concludes, "the weather does have significant impacts on both the production and quality of all of the wine grapes produced within the Napa Valley AVA." Summing up the combined climatic effects of such factors as temperature and precipitation, that are well suited to the production of premium wine grapes, he reiterates the uniqueness of the Napa Valley AVA.

And that's the main purpose of the studies, and this essay: to substantiate, through scientific studies that in grape growing and wine terms, the Napa Valley is unique. Make no mistake, the studies on the rocks, soils and climate of the Napa Valley AVA are not bedside reading matter. Thus, this essay is presented as a general condensed overview of the three vital studies that attempts to demonstrate and verify the Napa Valley AVA's unique geology, soils, weather, climate and topography. The authors of the studies, soil scientist Paul Skinner and geologist Jonathan Swinchatt, support their findings with numerous charts and illustrations, a small percentage of which were used in this essay.

However, the "hard" facts contained in the studies only scratch the surface of a complex subject that has kept American wine drinkers, like me, coming back time and again, armed with a corkscrew, to examine new bottles of wine, searching for answers

and new tasting experiences. For me, the wine epiphany experienced in Bordeaux and later on my first trip to California, contributed to my overall understanding of wine and winemaking.

In those days, my thirst for wine knowledge was so strong that I ignored the basic tenet that winemaking starts in the vineyard and the understanding that the influence of rocks and soil is essential. We wine drinkers have been told for years, first by the French who hammered away at the concept and then, more recently, by California growers and winemakers who climbed on board the *terroir* bandwagon, that without understanding *terroir,* you don't understand wine. Having thoroughly read the studies by Skinner and Swinchatt, I can say that my new knowledge of soils, bedrock and climate, the essential components of terroir, give me a new appreciation and understanding of the Napa Valley AVA.

And understanding the character of a region and how it translates to the wines produced there is vital in today's wine market, where the most often heard buzz phrase is about regional influence, the relationship of local terroir, and wine character and taste.

To arrive at this "terroirist" position took a lot of talk and listening; and talk we did, and then we listened and we discussed and argued. And then we talked and listened more to rock, soil and climate experts like Swinchatt and Skinner. It all makes good sense; the character of any Napa Valley AVA wine flows directly from the bedrock, to the soils and sediment, into the vine, through the grape and directly into the glass. Along the way, though, roadblocks were set up that masked, not intentionally, the symbiosis between earth and wine, much the same way that billboards block the view of the countryside

along a thoroughfare. In many cases, regional character and influence in wine has been covered over by the reality of modern winemaking.

These “soft” facts aside, it is hoped that this overview provides a basic understanding of the uniqueness of the Napa Valley AVA while providing the reader with the incentive to look further at the studies, toward developing a better understanding of the Napa Valley AVA and its wines.

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