STELLA di CAMPALTO

Terroir

1. General principles and an approach to the word “quality”

Let’s start by clarifying the concept of “terroir” and how profoundly it is linked with and, in one way, propaedeutic to the concept of “zonation”.
Terroir, in its broadest term, refers to the unique potential of the “quality” that a vineyard can, at least theoretically, express. As a matter of fact, a terroir is defined by a multitude of factors that interact and cooperate, ultimately sublimating in the glass of wine.
However, the term “quality” remains ambiguous because different meanings may be attributed to it.
There are many expressions that evoke quality without clarifying its terms, and that thus pave the way to subjective evaluations. The sentence “Brunello is a quality wine”, which has been repeated countless times, is not without meaning; however, a wine with a commercial value that is five or ten times lower can sometimes also be rightly considered a “quality” wine.
Often, the quality of a product is measured based on how easily it is sold, on its ability of creating demand. Such approach is the result of a time where profit maximisation and rapid growth at any cost are widely shared reference values. The creation of brands according to standardised criteria gives more confidence to a client feeling disoriented in a world of unlimited offers. While some problems were solved; new ones have been created.
And yet, was not the concept of quality once linked to the improvement of life conditions and to the growth of happiness?
Wine is a discretionary good; it is not necessary in order to live. Its connotation goes beyond that of a drink that meets a primary need. A glass of wine can, on the contrary, carry a moment of revelation; it can be fascinating and disorientating at the same time.
A sensorial experience is not tangible. What matters is the moment - a long-lasting moment.
In a world where everything is generically categorised as “quality”, the “Quality” of wine should thus be defined in a different way. Its value resides elsewhere, in the irrational, so often overshadowed by endless sales analyses and figures. Its value resides in the wonder of its beauty.
How can we define quality from our perspective and how can we demonstrate it in practice?
To begin with, take a well-known expression: “Wine is made in the vineyard”.
The vine grower - putting aside the ever-increasing administrative obligations - does indeed spend 85% of his or her time in the vineyard, with only 15% of the work taking place in the cellar.
The basis to approach the quality of a wine is thus found precisely in our vineyards - in the habitat, micro-climate, exposure to sunlight, and hardships of frost and wind that characterise them and that have created over millions of years of history, a unique environment.
This is where our vines grow; this is the precise setting in which they need to integrate in order to produce healthy, ripe grapes with characteristic aromas and minerals, all instrumental in obtaining a great wine.
The latter can only be achieved if the wine grower is directly involved in daily work in the vineyards; indeed, the sensibility required to understand the land and plants is only refined through practical work. In addition to all these efforts, sufficient experience and knowledge of the matter are also required, as they are essential, for example, in the selection of the vine variety, rootstock, training method, and in every decision made in the vineyard as well as all on other farming practices.
A deeper understanding of the land is necessary in order to recognise its potential sustainably and maintain it with responsible methods.
The vineyard is and remains an intensive monoculture; this is why acting with rationality

and moderation is so important. Moving huge amounts of soil or forcing vine growth cannot lead to rich, genuine grapes or to a unique, expressive wine. A glaring example of this is the use of herbicides and weed killers. These formulations contain molecules created through chemical synthesis that damage the micro-flora in the ground, consequently altering the energetic activity of the edaphon and of all processes underlying the renewal of organic matter in the surface layer, with a direct impact on the availability of water and nutrients for the vine. In such cases, from our perspective, speaking of terroir is not possible.
If the origin of a wine is not to be disowned, the wine in question can only come from vineyards where work does not delve too deep in the land and is always carried out with great caution. For example, soil compaction can be prevented by planting mixed grass covers that add organic matter, creating an ideal habitat for insects to settle in, and grow roots in the first, as well as in deeper layers of the ground, correcting its texture. The enrichment of biodiversity in the vineyard is, in the long term, undoubtedly important to determine the ecological balance in the vineyard and has a decisive impact on the terroir.
Phytosanitary products, the use of which cannot be avoided in monocultures - whether organic, biodynamic, or more generically environmentally-friendly - need to be chosen among those that cover, i.e. preventively act on the leaf canopy without penetrating into the plant.
Pruning, thinning, and any other type of seasonal work carried out on the aerial parts of the plant should only be performed manually. The same is true for the harvest: tact and experience are required when choosing the right time to start picking the berries. Brain, eyes, and agile hands all play a fundamental part.
A wise vine farmer's goal - which is anything but simple to achieve - is to preserve in the wine the authenticity of the flavors and aromas of the grape. This depends mainly on professional expertise and mastering of cellar techniques, as well as on strong personal intuition.
Must fermentation with indigenous yeasts is fundamental for the typical characteristics of the vineyard to be expressed in the glass ensuring they remain genuine and recognisable. However, spontaneous fermentation cannot happen without control, as that would lead to the risk of developing flawed aromas. On the contrary, the vine farmer needs to be present to take care of remontage multiple times every day and to monitor, taste, and make decisions or, in other words, to intervene on how fermentation evolves. Intervening means guiding - not changing - the direction of the metamorphic process. Examples of possible actions are: higher or lower aeration, remontage timing, covering must with CO_2 from other fermenting vats or, in case of a halt in fermentation, triggering it with indigenous yeasts from another wine from the same vineyard that is fermenting correctly.
A genuine wine excludes the use of selected yeasts, enzymes, and nutrients a priori. Terroir wine is self-made. A clean cellar, well-kept vats, sufficient humidity, and a constant temperature are conditions that are essential and indisputable. Laboratory tests are equally essential, as their purpose is to direct cellar practices in order to

avoid errors and rather encourage positive experiences.
Wine ageing traditionally takes place in oak barrels. The range of quality of woods is extremely broad, hence, the need to rely on a cooper, who through his expertise, knows how to choose the right trunks from within the forest, personally chops the wood, and leaves it to age outdoors in the open for as long as necessary.
The duration of ageing time in wood is determined by the wine, not the winemaker. Each vintage may require a different length of time and only frequent tasting will indicate when the wine is ready for bottling - a step that will obviously have to occur without filters or fining agents for wine clarification.
Despite individual choices supported by studies and experience, intuitive action is what defines the style of the winemaker, who can never be satisfied with simply achieving standards and needs to strive for qualitative improvement on a regular basis, making the most of rare opportunities when they present themselves.
Although this "style" may be partially identified by referring to certain analytical parameters, trying to define this mystic intuition from a scientific perspective is pointless. This is the starting point of the magic that renders so sensual the encounter with a complex wine as is a terroir wine. As R. Löwenstein wrote, "Pleasure is an act of balance on the edges of perception".
From this point onwards, only poetry can provide adequate descriptions and explanations - when these are possible. Science, instead, examines the more regular aspects, setting standards that may be useful "tools" to demonstrate quality. However, standards are but a mere attempt to capture and reproduce uniqueness. They are not enough.

Farming and cultural experiences gained by vine growers, who are undoubtedly able to recognise the best grounds and exposures in their vineyards, should be used to elaborate a better classification of terroirs. This, in addition to scientific criteria, would enable the identification and definition of areas with more character within a vast production zone such as, for example, the one in Montalcino, which embraces the whole territory of the commune.

That would already be enough for terroir wines to become a separate class and, in the best-case scenario, even a work of art.

"What is the best way to express the domain of art? Naturally, the beginning of everything is Nature, but nothing ultimately happens without the intercession of an impressive culture that unites bequeathed wisdom, ancient traditions, magical artifices, mysterious recipes, and love for a unique work. Yes, the work of art lies at the end of this alchemical process." Michel Onfray, 1995, p.24

Only at this point do wine lovers, interested journalists, experts, and our esteemed clients become the protagonists.

Consistently with such premises, we have focused our attention on the territory and started to take a closer and more scientific look at the geological formations of the vineyards in Montalcino. The results of this (summary) research are reported in the chapter that focuses on the "Geological Factor".
The extension of an investigation aiming to exhaustively describe the characteristics of the territory of Montalcino by uniform areas is naturally imposing and requires a multidisciplinary commitment. As a matter of fact, in addition to the geological aspect, other factors of extraordinary importance contribute to the characterisation of the different areas.
It is the complex combination of geological, pedoclimatic, floristic, faunistic, energetic, and many other factors that determines a significant part of the character of a terroir.

The firm belief that terroir diversity results in wines with different characteristics provides the greatest opportunity to attribute to the Brunello di Montalcino the value it undoubtedly has: that of being one of the most fascinating red wines in the world. A myth!

2. Climactic factors

The extent of a serious evaluation of the territories of Montalcino for the purposes of a full description of all its terroirs (in the broadest and all-encompassing meaning of the term) is enormous.
Aside from the different ground formations we describe in the chapter “Geology”, the factors identified below represent an equal number of fields of investigation requiring the planning and undertaking of a deeper study and research commitment in the near future.
The following are influential factors and, as a whole, attempt a structural description of the word “terroir”.

Micro-climate

The term “micro-climate” refers to the climate in the layers of air near the ground, up to approximately 2 m above the ground, or the climate that forms in a small and well-defined zone. Proximity to the ground is decisive, as there are fewer air movements, i.e. wind vortices created by wind depending on the vegetation, ground surface, and higher temperature variability that can lead to significant climatic contrasts. Therefore, surface conformation, along with ground properties and cover (micro-relief, number of vines, etc.) have a direct impact on micro-climate. These structural characteristics can lead to different climate conditions because they influence ground heating. (Bendix, 2004).

Micro-climate depends on the macro-climate and is contained within it. (Kuttler, 2005). Micro-climates are determined by the radiation balance. They can be better described by taking the example of the local temperate weather. Such temperate weather is also called radiative micro-climate, and is characterised by summer days with reduced ventilation and low presence of clouds. (Brand, 2008).

Smart and Robinson (1991) refer to micro-climate as the climate that forms in the leaf canopy and in its immediate surroundings (exposure to light, temperature, air humidity within and around the leaf canopy, between individual leaves, and around the grape bunches). Therefore, the micro-climate is determined above all by how thick the leaf canopy is, while the latter depends on training and viticulture systems.
Of course, two entirely different micro-climates may reign in two adjacent vineyards and will determine significant differences in terms of vine growth and grape maturation.

Meso-climate

“Meso-climates” are formed by different micro-climates, so they can extend for a few hundred metres. The height of this layer varies over the seasons, and is normally 1-1.5 m high in spring and summer. The structure of this layer is strongly influenced by ground grading; for example, take the difference existing between mountain and valley. (Bendix, 2004).
This is the reason why topographic conditions, fields, and surrounding vineyards play an important role from the point of view of weather conditions. Irradiation and thermal balance depend on the exposure and grade of the considered zone and on the resulting angle of incidence of sun rays. Such factors are of great importance for the quality of a vine. The boundaries between meso-climate and micro-climate are not clear. (Brand, 2008).
Here, as opposed to what happens in a micro-climate, ground exposure in general is also important. Therefore, the meso-climate is sometimes referred to as the areal climate and is determined by direct sun irradiation, evaporation potential, water balance, and temperature, which in turn depends on the slope grade, direction, planting height, and exposure to winds and cold air.

Macro-climate

The “macro-climate” refers to the climate of an entire, defined region. It impacts on final quality because it determines the duration of periods with favourable conditions for plant growth (the number of days on which the average day temperature is higher than 10 C°) as well as the energetic characteristics of such periods; combined, these two aspects determine plant activity (growth, photosynthesis, etc.). Naturally, extreme climate conditions (severe droughts, humid climate, particularly high temperatures, etc.) can have an impact.

Climate has a positive influence on maturation, on the sugar contained in grape berries, on the amount of polyphenols and on aromas: in practice, it influences the overall qualitative development.

Solar irradiation

Solar irradiation is important for the vine because it provides the plant with the energy it needs for its metabolism. The factors that determine solar radiation are: grade, direction, geographical latitude, and clouds covering the sky and horizon. The average insolation varies between exposures. The irradiated solar energy is measured on the one side as Photosynthetically Active Radiation (PAR - µmol·m-2·s-1), and on the other side in calories. Specialised literature defines a 150-300 PAR compensation threshold below which leaves consume more carbohydrates than those they produce. A 700-920 PAR value, or a 400 W energy value is considered optimal for photosynthesis. When these values are exceeded, leaf assimilation capacity is drastically reduced.
The amount and intensity of solar irradiation are profoundly influenced by topography and should thus be evaluated separately for each single vineyard. Along with irradiation intensity, air temperature should also always be considered in order to define an optimal situation.
As for viticulture, the following, determining circumstance can be pointed out: thanks to the higher energy availability on slopes exposed to the south, temperatures at ground level are higher than they are on slopes presenting potentially identical natural conditions but with exposure to the north. Furthermore, another aspect in regions with vine cultivations, slopes exposed to west should be preferred to those exposed to east, even when the value of insolation is potentially identical: because of insufficient temperatures at dawn and during the morning, radial intensity is not assimilated as efficiently. Lastly, morning mists (Müller et al., 1999) often prevent the vineyard from receiving direct insolation.
Slopes with south-to-west exposure are thus characterised by a thermal optimum: thanks to the convergence of a strong irradiation and very high temperatures in the region in question, optimal conditions for vine cultivation are mainly present in slopes exposed to south-west. (Kiefert, 2009).

The water balance

The effect of precipitation is quite negative when sufficient humidity is already present, while its effect can be positive following a period of drought.
In Montalcino, precipitations amount to approximately 800 mm/m²/year. However, there are often particularly dry years, such as 2003, 2007, 2012, 2015 or 2017 when precipitation ranged between 450 mm and 750 mm/m²/year, or particularly rainy years, such as 2002, 2014, 2016 or 2018 when the amount of precipitated water ranged between 950 and 1380 mm/m²/year.
What determines the benefit or damage is rain distribution.
We have of course more rain during autumn and winter, from September to May, with average precipitations from 50 up to 115 mm/m² per month.

Wind

The predominant winds in Montalcino are: Leveche, Minstral, Sirocco, Gregale, and Tramontane.
The Leveche, which blows from south-west, carries humid and warm air from the sea; it mainly blows in the summer and is a messenger of imminent rain.
The Sirocco, which blows from south-east, often blows during the vegetative stage of the vines. This wind forms in the Sahara but picks up a significant amount of humidity while passing over the Mediterranean. Its high levels of air humidity favour the powdery mildew.
The Tramontane carries fresh and dry air from the north and favours a healthy climate in the vineyards, In Montalcino, the Tramontane often precedes good weather.

The Minstral, which blows from north-west, carries moderate temperature and some humidity from the Mediterranean. As opposed to Provence, the Minstral in Tuscany is quite mild.

In viticulture, winds can be harmful, but they can also be beneficial. Damage caused by the wind can lead to lower quality and reduced production. Dry winds such as the Tramontane can increase hydric stress; however, in most cases, they are useful, as they strongly limit chances of fungi attacks to the plant.
Wind strength increases with elevation. The less protected the position of a vineyard, the higher its exposure to wind.
Wind direction on radiation days is important, because that is the circumstance in which micro-climate is developed.

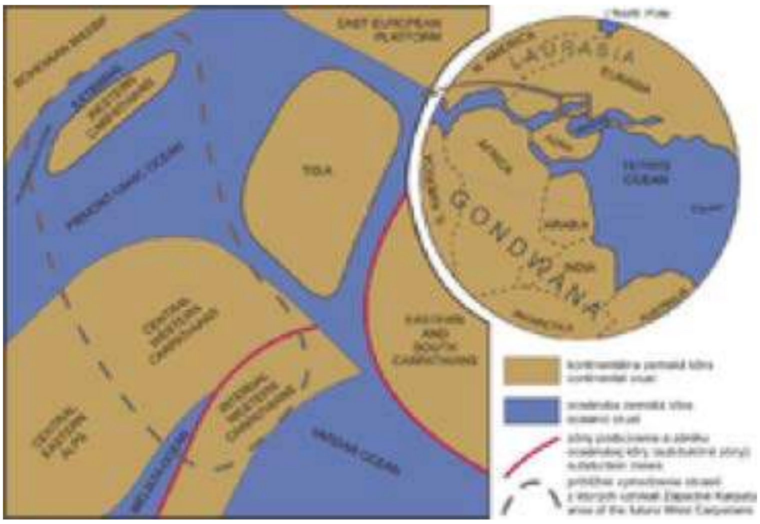
The risk of frost

The risk of late or early local frosts affecting the cultivation is a significant aspect to consider when evaluating territories. Late frosts put young vine shoots at risk from the end of March to the beginning of May. Cultivations located on a sloping ground are exposed to a lower risk because cold air is normally allowed to drift downwards. Vineyards located in a depression or basin are instead more exposed to the stagnation of cold air. Losses can be considerable, because only the main shoot is able to produce a sufficient amount of berries. Identifying zones at higher risk is thus important to be able to adjust farming where possible.

Heat, water, and root

As previously described, radiation and water provision are determining and important factors in defining the quality of a site. A good vineyard positioning mitigates effects linked to climatic extremes and should not be sought in conditions of abundance, but rather in a balanced and long-lasting presence of the afore-mentioned growth factors. A good position is thus where a suitable grape variety ripens fully, but slowly.

3. Geological factor



Tuscany

A glance at a geological map of Tuscany will reveal an untidy puzzle of rock slabs that differ in size, age, origins, and composition. The first step for a better understanding of our vineyards and their unique products is to attempt an illustration of the geological history of Tuscany, which will make this patchwork of land parcels clearer.

The story starts approximately 145 million years ago, in the Early Cretaceous. Following the disintegration of Pangaea, a northern (Laurasia) and a southern (Gondwana) continental block formed; the two continents were separated by an ocean that stretched eastwards and westwards called the Tethys Ocean.

Gondwana, the southern supercontinent, was composed of what are nowadays South America, Australia, India, Antarctica, and Africa. Subsequently, fractures appeared in multiple points, and several smaller lithospheric plates broke away from the continental plate. The most important microplates for our vineyards and for the genesis of Tuscany were those referred to as the "Adriatic Plate" (or Apulian Plate) and those named the "Corsica-Sardinia Plate".

Dragged by the drift created by the opening of the Atlantic Ocean, subduction processes were inverted and an unimaginable strength pushed Africa underneath the European Plate. The drift direction of the Adriatic microplate and the African Plate changed and they rotated anti-clockwise, clashing again against the continent called Eurasia. The collision of the Adriatic Plate with the European continent closed the Tethys Ocean in the central region of the Mediterranean, giving birth to the mountain range of the Alps.

Powerful tectonic movements closed the basin of Palaeo-Tethys Ocean, opening up a space for the Neo-Tethys Ocean, which expanded westwards and eastwards in the direction of the Iberian peninsula (fig.3). The latter was transformed from shallow basin into a deep sea.

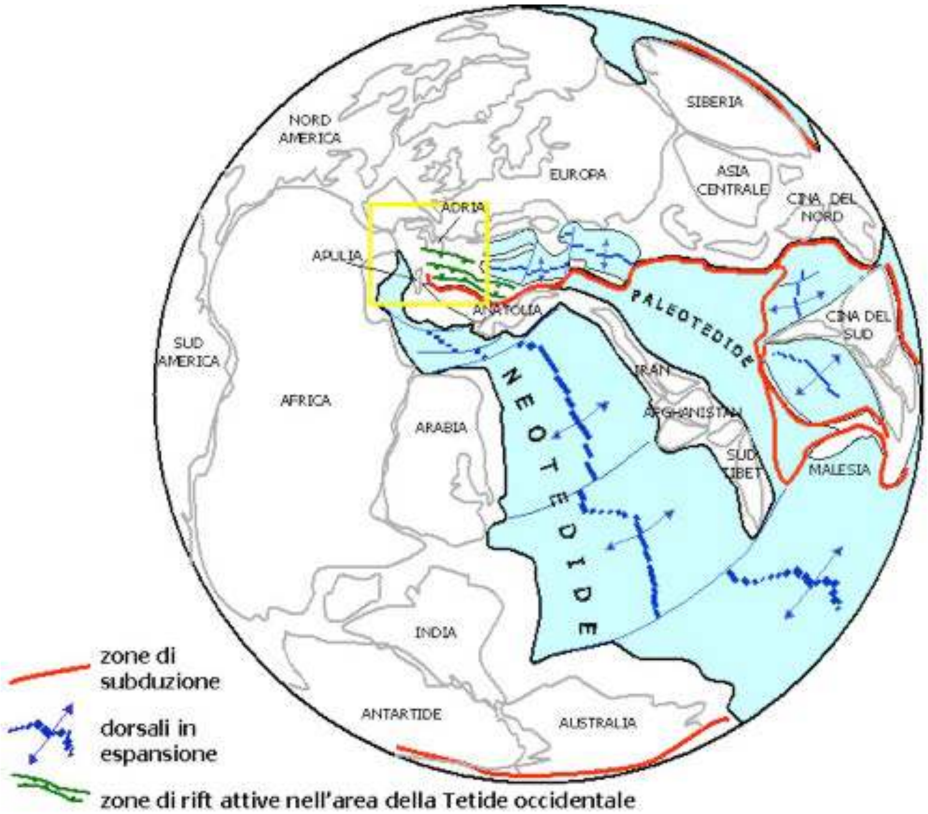


fig. 2 (wikipedia)

Opening, subduction, and overlapping movements of these enormous tectonic plates caused magma to emerge from the depths of the Earth to the bottom of the sea, as well as earthquakes and volcanic eruptions. Rocks called migmatites formed the oceanic crust that, over the course of years, was covered by fine sediments.

Deep under the sea, thin layers of sediments formed; their relatively low thickness can be easily explained with the low presence of plants and animals due to cooler temperatures. In shallow waters, instead, life proliferated: algae, corals, and crustaceans developed and, in the continuous cycle of life and death, combined with chemical sediments to form, over millions of years, kilometres-thick layers of organic sediments. Near coasts exposed to sea tides, particular sediments formed as a result of erosion, landslides, and matter carried by large and small rivers. Assuming that frequent earthquakes contributed to enhance this process appears reasonable.

The most important sediments for our investigation are calcareous and silica sediments.

To gain a better understanding of the multitude of geological formations and grounds in Montalcino, three different sedimentation zones need to be considered:

- The Ligurian Domain
- The Austroalpine Domain
- The Tuscan Domain

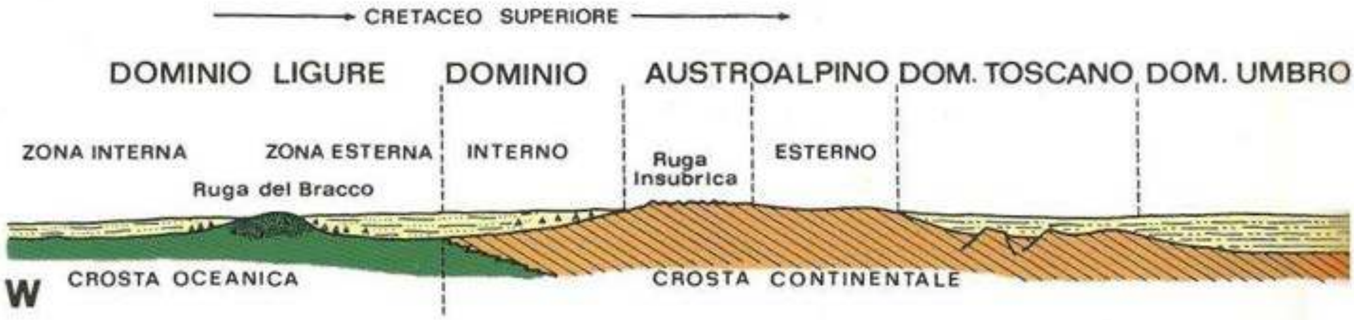


fig. 4 – reconstruction of the palaeogeographical domains in the Late Cretaceous.

1. The Ligurian Domain

The part of the Tethys that included the entire area between the European margin and the African margin was named "Piemont-Liguria basin". Faults generated within this water basin, allowing magma to emerge from the bottom of the sea.
The typical rocks of the oceanic crust, called "ophiolites", were a sequence of ultrabasic igneous rocks (from the Earth mantle) covered by (intrusive) basic igneous rocks and (effusive) basic lavas. These ophiolites were, in their turn, covered with marine sediments composed of the remains of organisms with calcareous or silica skeletons or exoskeletons, sediments of chemical origin, fine clastic materials (clays), and flysch-derived matter.
"Flysch" was characterised by material deriving from the erosion of the adjacent zone of the Eastern Alps; the turbidity currents thus carried sandy and clayey sediments from the west and from the east for long distances. Earthquakes caused by tectonic movements are likely to have favoured underwater landslides and, consequently, the build-up of sediments in this basin along hundreds of kilometres.
The materials characterising the Ligurian Domain, which has a cumulative layer of approximately 1,000 m, were driven over the course of millions of years towards north-east by complex tectonic movements generated by the continental collision between Africa and Europe above the adjacent and more ancient Austroalpine Domain.

The sediments that characterise the area of Montalcino mainly consist of ophiolites and clays with Palombino (Galestro) rocks.

2. The Austroalpine Domain

In the Mesozoic, approximately 200 million years ago, a partially emerging mid-ocean ridge formed. Inside it, tectonic deformations in crust sections occurred; as a result, faults led to the formation of lowered and lifted structures (graben and horst regions). A considerable amount of sediments deposited in the low-lying zones of this domain as a consequence of the erosion of emerged zones (Late Cretaceous - Cenomanian, approximately 95 million years ago).
In the west, this domain bordered with the Ligurian basin, which was characterised by the sediments of a generally deep sea, while a basin with sediments from a shallower sea lay in the east.
Following tectonic movements, the Austroalpine Domain shifted eastwards, overlapping with the Tuscan-Umbrian Domain.
The consequence of this complex movement is that today, in Montalcino, rocks of all these three domains emerge on the surface. Our vineyards grow on a ground where there is a clear predominance of rocks from the Austroalpine Domain, such as the Santa Fiora Unit, and the Argille e Calcari Unit.
The Santa Fiora Unit (the M. Morello or Alberese formation) belongs to the internal Austroalpine Unit and is composed of limestone, marly limestone, and sandstone (Late Paleocene - Middle-Late Eocene).
The Argille e Calcari Unit (Kalk-Ton Series or Canetolo Complex) that belongs to the external Austroalpine Unit consists of rocks composed of slate and foliated argillites with calcarenite intercalations (Paleocene - Middle Eocene).

3. The Tuscan-Umbrian Domain

During the long periods of the Mesozoic, these zones of the Apulian Platform had emerged and were surrounded by the sea. The oldest rocks formed approximately 250 million years ago between the Paleozoic and the Mesozoic, when Pangaea united and became a supercontinent.
Silica clays and metamorphic rocks are the main elements of this unit, which is predominant in the western Apennines. Similar traces from the same period are scattered everywhere in Europe and were generated when the two supercontinents Gondwana and Laurasia collided, forming the Variscan mountain range.
Because of the tectonic movements that led to the formation the Apennines, part of the sediments of this domain reached Montalcino. In particular, rocks belonging to the formation of the Macigno emerged; these grey-light blue (or yellow-brown if oxidised) sandstones nowadays give certain exposures a unique characteristic: a formation made of sandstone in facies of fine- or medium-grained flysch, intercalated with clayey-silty layers of limited thickness (Late Oligocene - Early Miocene).

This is the story of the sediments and rocks that today give quality and aromatic diversity to grapes and wine from Montalcino. However, to understand how they arrived where we find them today, a brief consideration on the formation of the mountainous range of the Apennines needs to be made.

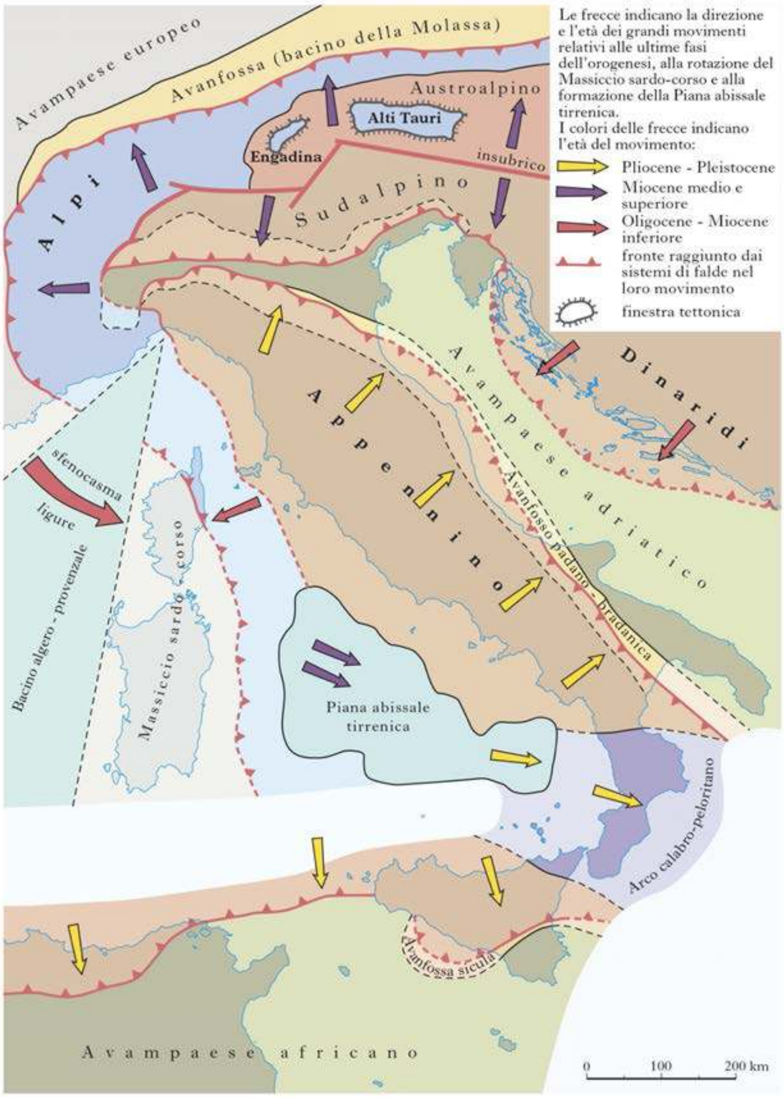


fig.4 - Map of the Italian Peninsula (Treccani - http://www.treccani.it)

During the Paleogene Period, 66 million years ago, collision was no longer occurring between oceanic crusts, but between entire continents, and the movement was ultimately transferred to mainland.
The collision line between the two continents (Laurasia and the African Plate) formed part of the mountainous range of the Alps and continued until Piedmont and Corsica. A microplate that had broken away from the African Plate, called the "Adriatic Platform", did not stop. It moved anti-clockwise and towards north-east; as a consequence, the Apennines emerged from the northern coast of the Tethys Ocean (the future Mediterranean) .
Subsequently, the Sardinian-Corsican microplate was also pushed towards north-east, making space for the Tyrrhenian Sea.

The folded structures that formed following the tectonic compression then underwent tectonic extension (from the Tortonian onwards), which led to faulting, with the creation of horst and graben structures (fig. 5).

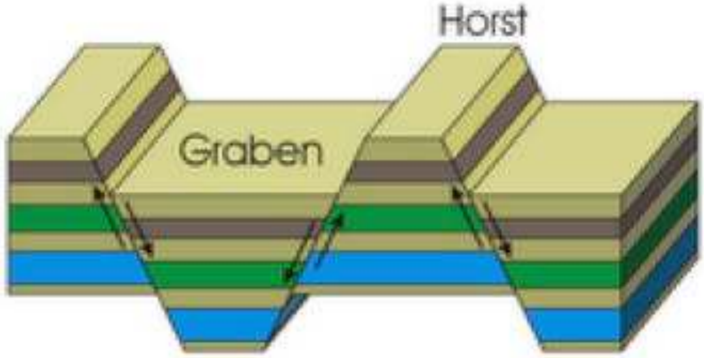


fig. 5

The area that goes from the current Tuscan coast in the west to the Apennines in the east thus hosted the formation of a wavy landscape, composed of partly emerged and partly submerged land. The relatively shallow depressions (graben) that formed at the same time as the Apennines did in north-west and south-east were repeatedly flooded with water; the closer to the coast, the more often they were flooded with water from the sea; on the contrary, in the inland, freshwater lakes prevailed.

This process continued on a constant basis from the Oligocene (approximately 33 million years ago) to the Pliocene (2 million years ago), when the basins filled with debris from the erosion of the surrounding mountains and hills.
Marine sandstone and marlstone slid in the basins, forming alternated sediment layers and thus generating flysch. The latter partly originated in Ligurian rocks and partly in the rocks from the Tuscan-Umbrian Domain, depending on where the erosions and landslides in underlying depressions occurred. In spite of its different origins, flysch should be held in particular consideration, given it is widespread in the territory of Montalcino.

Another event resulted in a considerable sedimentation process and gained, from a contemporary perspective, an important role in the characterisation of the ground: at the end of the Miocene, 5 million years ago, the passage between the Atlantic and the Mediterranean closed. The closure of the Mediterranean basin produced a massive evaporation that was not adequately compensated by the inflow of river water that was fed into the basin. The saline content of the water thus increased enormously and influenced rock formation, because enormous layers of sulphur salts and calcium, like anhydrite and chalk, subsequently deposited locally.

After the tectonic uplifting and lowering movements, some basins in central Tuscany were repeatedly exposed to marine ingression and regression. The resulting deposits were mainly composed of sandy clays and conglomerates, sometimes combined with anhydrite and chalk in shallow water conditions.

In the Pliocene, the passage to the Atlantic reopened and, after approximately 3 million years, the saline state of the Mediterranean normalised.
In this stage, marine ingression in some of the basins located in southern Tuscany produced deposits of clay, silty clays, and sandy clays with a high saline content. These clayey sediments nowadays emerge in the famous Crete Senesi.

However, in viticulture, these compounds show the vine farmer their limits. Vines planted in this type of sediment are poorly expressive and their life expectancy is not long, as the strong tendency to retain water and the abundant saline content leave no space to vine root development. These clays are perfect to make beautiful terracotta, but that is a different matter.

Although the evolution of the geological processes and tectonic movements that occurred over time is not very easy to follow, the extremely long period of time of over 150 million years saw the development of a highly geologically diverse Tuscany; this diversity becomes evident in the differences and varieties that characterise the ground in Montalcino, where our vines are rooted.

Specifically regarding the territory of Montalcino, the following geological complexes can be concretely defined and ordered (from top to bottom) in a chronological sequence of layers (stratigraphic sequence; fig.6).

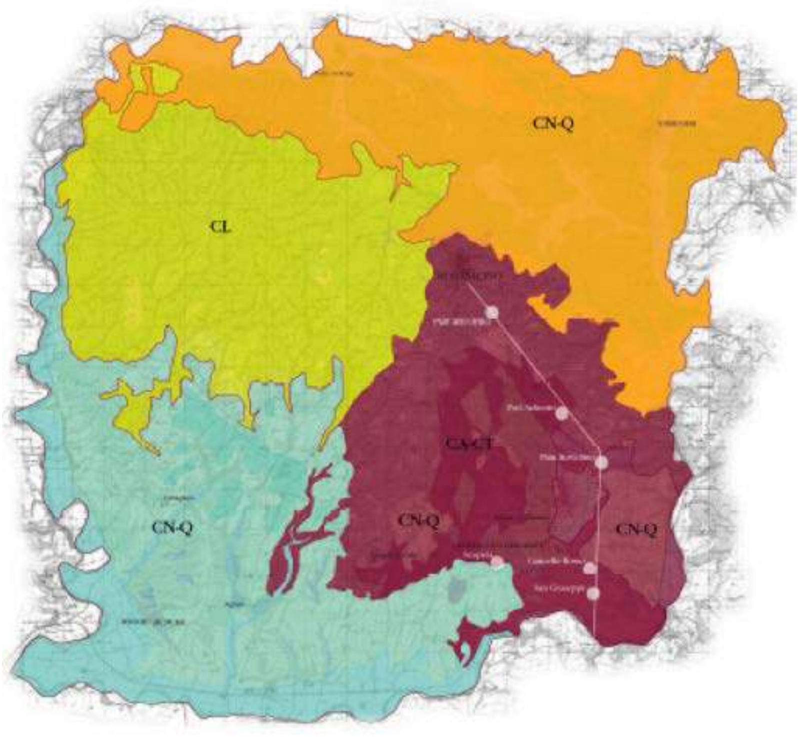
Età in milioni di anni	**Era**	**Periodo**	**Epoca**	**Sedimenti**	**Complesso**
2 – periodo attuale	Cenozoico	Quaternario	Pleistocene	Arenarie e strati con clasti grossolani	Complesso dei sedimenti continentali (Q)
23 - 2		Neogene	Pliocene	Sedimenti marini (argille)	Complesso Neoautoctono (CN)
65 - 28		Paleogene	Pliocene	Sedimenti marini (argille)	Complesso Neoautoctono (CN)
145 - 66	Mesozoico	Giurassico	Cretaceo	Ofioliti e argille a Palombini	Complesso Unità Liguri (CL)
200 - 150			Giurassico superiore / medio / inferiore	Unità di Santa Fiora e Unità di Calcare e Argille	Complesso Unità Australpine (CA)
251 - 203			Triassico superiore / medio / inferiore	Macigno	Complesso Unità Tosco-Umbro (CT)

fig. 6

The Continental Sediment Complex and Neo-autochthonous Complex formed after Tuscany had almost already acquired its current shape; in other words, they formed on site (hence the name "autochthonous sediments"). Having deposited inside or on the edges of basins, they emerged following an uplifting that is still ongoing today and that was caused by the emplacement of the nearby magmatic body of Mount Amiata during the Quaternary.
This geomorphological uplifting also explains the phenomenon of frequent landslides.

Another agent shaping our landscape is water. Rainwater finds its way creating trickles, which turn into streams and then into rivers. The Ombrone and the Orcia, the two rivers that dug their beds around the hill of Montalcino, are still transporting sediments ranging from ultra-fine clays to material composed of coarser clasts nowadays. The erosive action of these rivers continuously shapes the morphology of their courses.
The considerable processes of erosion sometimes transport recent (young) sediments downstream, carrying them to the valleys and towards the sea; this way, they allow older rocks deeper down to emerge.

The geological study of the whole territory of Montalcino, carried out with the help of professional geologists, has led to the identification of four, relatively uniform macrozones. As shown in fig. 7, they are positioned in a fairly symmetrical manner inside a square that is divided into four parts by two orthogonal axes with N-S and E-W orientations respectively. These four macrozones (NW, NE, SW, SE) are the first attempt of a descriptive classification of the territories of Montalcino with an exclusive focus on geological characteristics.
The proposed classification is undoubtedly incomplete and was formulated with the awareness that factors described in the chapter "The terroir - climatic factors" - which were not held into account during this stage - are at least as important as the geological factor to achieve an exhaustive classification of the territory with regards to its vocational traits for viticulture.



Key:
Torrenieri - Badia Ardenga hillside (N.E.)
Salceta - Montosoli hillside (N.W.)
Tavernelle - S.Angelo Scalo hillside (S.W.)
Castelnuovo dell'Abate - S.Angelo in Colle hillside (S.E.)

NC-Q Q: Continental deposits from rivers and lakes and fault detritus (Oleocene - present).
NC: NEO-AUTOCHTHONOUS COMPLEX: marine deposits composed of sand, clays, and conglomerates (Pliocene - Late Miocene)
AC-TC AC: AUSTROALPINE UNIT COMPLEX: graded calcarenite, thin sandstone and siltstone, marly lime-stone, and marlstone (Late Cretaceous Early Paleocene); slate and foliated argillites with calcarenite intercalations (Middle Eocene - Paleocene).
TC: TUSCAN UNIT COMPLEX: Fine- and medium-grained arenaceous deposits (flysch) intercalated with silty clayey levels (Early Miocene - Late Oligocene)
LC: LIGURIAN UNIT COMPLEX: dark-grey and brown foliated argillites and marlstone alternated with layers of limestone (Tithonian-Cretaceous); undifferentiated ophiolite igneous rocks; marly limestone and marlstone as-sociated with arenaceous-silty and argillitic banks (Late Cretaceous - Paleocene).

fig. 7 – the relatively uniform macrozones of Montalcino

The Macrozones

From a geological perspective, the territory of Montalcino is characterised by several macrozones presenting a relative geological homogeneity.
The hilly zone of Montalcino rises between the Orcia and the Ombrone valleys, with Poggio Civitella at the point of highest elevation (659 m above sea level).
Two rivers, the Ombrone flowing from north-west and the Orcia from north-east, surround the hill of Montalcino with their courses before the Orcia river flows in the Ombrone in the most south-western corner of the territory of the commune, at an elevation of 55 m.
Given their symmetrical configuration, which determines a division of the territory of the commune of Montalcino into four parts, the decision was made to define the four macrozones as the "Amiata", "Ombrone", "Orcia", and "Asso" hillsides respectively.

Asso/Ombrone hillside

1. Torrenieri — Badia Ardenga macrozone (north-east)

This macrozone stretches along the Ombrone river, in the north of Montalcino, all the way to Torrenieri in the north-east. Aside from the sediments from the Pleistocene (AI) a predominance of neo-autochthonous sediments (NC), particularly of those from the Pliocene (5 million years ago, labelled with the suffix P), can be observed along the river course and streams that flow into it. They are characterised by clayey and sandy clayey deposits from a relatively deep sea (Pa) on which vineyard grounds developed.
Around the village of Torrenieri, there is a predominance of sandy and clayey-sandy sediments from the Pliocene with fossils such as crustaceans and algae that lived in a shallower sea (Ps). These layers are present from the lower (150 m) territories in the west, to Badia Ardenga (140 m), and Altesino (210 m), and then in the direction of Torrenieri (250 m), while southwards, they are present along the slope up to the highest point (340 m), only slightly below the ramparts of Montalcino.
More recent continental sediments from rivers have also been detected (Q - abbreviation for Quaternary, the Age of Man).
Pleistocene sediments (from 2 million to 100,000 years ago) are characterised by alluvial material (AI), and are found along the Ombrone river course and along the streams that flow into it.

Ombrone hillside

2. Salceta — Montosoli macrozone (north-west)

This macrozone borders with the Torrenieri — Badia Ardenga macrozone in the north and with the Tavernelle — Sant'Angelo Scalo macrozone in the north-east and south, on a line that goes from Pianacci to Bolsignano; in the east, instead, it borders with the Castelnuovo dell'Abate — Sant'Angelo in Colle macrozone, on a line that heads from Tavernelle to Villa Le Prata, and continues all the way to the village of Montalcino.
The highest point is located at the small church of San Michele, at an elevation of 561 m, while the lowest point is located towards west, in the direction of the Ombrone river, at an elevation of 145 m. Vineyards in the east of this macrozone are located at an elevation of 292 m (Montosoli), all the way to Colombaio, near the village of Montalcino, at 356 m, and southwards towards Podere Poggiolo and Villa Le Prata, at 511 m. The southern border extends at an elevation of 350 m through Bolsignano and westwards, down to the borders of Galampio, at 130 m.
The geological borders of this macrozone, located in the north-west, are easy to determine, given their highly uniform composition. Here, sediments formed at the beginning of the Cretaceous, when the Piemont-Ligurian Ocean started to close. Because of the complex tectonic movements that the Ligurian Domain underwent over the course of time, and that contributed to the genesis of the Apennines,

Galestro (LC), a calcareous marlstone rich in clays and silica with a fine, stratified structure, can be found in our area. The colour of this type of rock varies from dark grey to brown, with intercalated layers of (sometimes siliceous) limestone called "Palombini" or "Colombini". This rock layer is normally thinner than a metre.
Small portions of this zone also include significantly younger sediments from the Neo-autochthonous Complex (NC) and, in the western margin, continental sediments (Q) too. The neo-autochthonous zones stand out for the presence of sandy-clayey rocks from the Miocene, with a higher percentage of coarse clasts (pebbles) and, in certain points, marine sand from the Pliocene.
On these hills, flora is characterised by a vast Mediterranean Maquis and evergreen oak forests.

Amiata hillside

3. Castelnuovo dell'Abate — Sant'Angelo in Colle macrozone (south-east)

This zone is undoubtedly the most difficult to define and describe, as it includes several types of irregularly alternated geological formations. On top of this, the very high proximity of volcanic mount Amiata influences soil composition with effusive volcanic rocks (ignimbrites), which are commonly found among clastic sediments.
The latest tectonic movements such as the emplacement of Amiata have caused landslips and strong erosion of present rocks, leading to the formation of detrital masses that compose the basis for the development of certain vineyard grounds.
This macrozone also includes sediments that are typical of the Austroalpine Domain and of the Tuscan Domain, in particular:

- The Austroalpine Unit Complex (AC), characterised by the formation of Santa Fiora (or M. Morello or Alberese formation), consisting of limestone, marly limestone, marlstone, and sandstone (Late Palaeocene - Middle-Late Eocene) and by the Argille e Calcari formation (Kalk-Ton Series or Canetolo Complex), consisting of slate and foliated argillites with calcarenite intercalations (Palaeocene - Middle Eocene).

- the Tuscan Unit Complex (TC), mainly characterised by the formation of the Macigno, which consists of fine- or medium-grained sandstone in flysch facies intercalated with clayey-silty levels of limited thickness (Late Oligocene - Early Miocene).

The most ancient sediments of the Austroalpine Domain stretch on two bands, placed in south-east and south/south-west direction respectively, starting from the village of Montalcino. The intermediate zone includes grounds with prevalent features from the Tuscan Domain.
The south/south-west band crosses the territory of Friggiali (455 m) and reaches Sant'Angelo in Colle, at an elevation of 430 m.
The south-east band stretches through the area of the Greppo (483 m) towards Manachiara (425 m) and descends to Casalta, at 245 m, near the bank of the Orcia river.
Upon this sediment cover is Pian dell'Orino, with the prevalence of grey-brown marlstone characterises the ground of the vineyards surrounding the estate. The soil texture consists of clay and sand (S38/L33/C29) and has a pH of 8.1.
The intermediate zone also includes lithotypes belonging to the Austroalpine Domain, although dating back to a more recent period. The Middle Eocene saw the formation of deposits of clastic sediments, calcareous clays, and marlstone rich in siltite, which can be found from Montalcino all the way to Monte Amiata Scalo in the south, along with deposits of clayey schists and calcareous sandstone inclusions. A few, small zones characterised by this type of rock are found in the south-east, for example in the Piaggione (S49/L32/A19), Teatro (S53/L28/A19) and Sorgente vineyards (S45/L30/A25) of the Salicutti farm, with a pH of 8.05, in the vineyards of Cancello Rosso (S34/L42/A24) and Scopeta (S24/L35/A41) of the Pian dell'Orino farm, and in all the vineyards of the San Giuseppe — Stella di Campalto farm.

On the west of the street that takes from Montalcino to Castelnuovo dell'Abate, the Tuscan Domain prevails, and through the hills covered with forests goes all the way to Abbazia Sant'Antimo, where grounds developed on the Macigno.
Proceeding southwards, an abrupt change in the nature of ground can be observed, with the emergence of formations that can be associated with the external Austroalpine Domain and the prevalence of very fine siltstone and flysch. Shortly after Castelnuovo, towards Mount Amiata, a landslid slope provides an impressing demonstration of this particular stratigraphy.
In the Scopeta vineyard of Pian dell'Orino, the occasional, additional presence of calcareous arenites from the Tuscan Domain provide evidence of the influence of the latter in this zone.
What has been described so far allows to easily infer the complex combination of different geological traits that characterise this hillside.

Orcia/Ombrone hillside

4. Tavernelle — Sant'Angelo Scalo macrozone (south-west)

This formation dates back to the Oligocene, as the marine sediments with fossil shell inclusions prove. Sandy clays and thrust faults caused by tectonic activity dominate the grounds of the vineyards here.
This zone includes the warmest and most ventilated microzones in Montalcino, especially at its lowest points, such as the areas sloping down towards the Orcia and Ombrone rivers, at approximately 80-100 m; the macrozone then climbs up a complex hilly landscape and reaches Tavernelle, the highest point (330 m).
The ground around Tavernelle is mainly made of continental sediments and calcareous, sandy elements with clay inclusions from the Pliocene. Here, particularly rocky soil prevails, as these neo-autochthonous sediments also include layers of rounded conglomerates that were transported for very long distances before being deposited. This increases aeration in the deeper layers of the ground and favours vine root formation, consequently outlining a particular spectrum of grape and, subsequently, wine aromas.

4. Conclusions

Although the proposed considerations, which mainly focus on the climatic and geological character-istics of the territory of Montalcino, are supported by accurate technical field observations and in-formation drawn from scientific literature, they are not intended whatsoever to be exhaustive in dealing with these topics of study.
On the contrary, their aim is to concretely encourage the development and discussion of knowledge and experiences involving the people and institutions of Montalcino for the general purpose of cul-tural growth and creation of a fundamental tool to improve the quality and image of wines born from this land.

Taking this analysis as a starting point and relating it to our experience, we have tried to identify, within the borders of our estate, the areas that, in our opinion, allow for a better and more original expression to each wine.
Theoretical criteria have thus resulted in a specific classification of the vineyards in the estate that, applied in practice over years, has led to the definition of the style of Pian dell'Orino.
This zonation translates into the basis of our work, the goal of which is to sublimate in the glass through the strength of our plants and to the typical traits and character of a ground that formed over millions of years.

For detailed information on the different parcels and their relevant characteristics, please visit the section "The vineyards" on our website.

STELLA di CAMPALTO