

Minerality in Wines – the bio-dynamic perspective
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A vine, like most other plant, is designed to transform air into matter, using a very elaborate mechanism called photo-synthesis. This is perhaps the biggest energy producing factory on earth. With the use of sun energy, light, water and different gases present in the atmosphere, plants are producing huge amount of carbohydrates. The result is that almost 98% of the weight of a vine is actually made from water and gases (carbon dioxide, oxygen, nitrogen... to mention only the most important ones). In the grapes, most of the ingredients necessary to make good wines (tannins, sugars, acids...) are the direct result of photosynthesis. This works so well, that today many fruits or vegetables are grown in hydroponics units. The roots grow in shallow sandy/gravelly containers which are irrigated. The micro-elements necessary to the plants are brought into the water used for irrigation: mostly potassium, phosphor, iron... and of course some more nitrogen to obtain abundant crops. The soil, as purveyor and capable to feed plants, is not any more necessary. And yes, it is also possible to grow vines like this! Is it interesting? Certainly, on an economic angle, it may reduce quite a few costs, but I hope to demonstrate that it does not permit to produce quality wines. I take this comparison, because I feel that most vines are growing on soils that aren't capable to feed naturally the plants and not capable to supply a unique composition of minerals that would produce unique wines.

What is minerality in wines?

Minerality doesn't smell. I often use the word 'minerality' to describe a wine that shows a strong sense of place and soil character on the nose. Some descriptors like 'flinty', 'petroly', 'earthy'... are used to describe a mineral sensation on the nose. Unfortunately I am partly wrong, because minerals have no odours. Chemically, there is no volatile radical associated to minerals, so they do not evaporate and it is impossible to smell them. It is possible that some minerals can be associated to some other elements that are volatile and therefore have an aroma that can be detected. For example, some iodine mixed with salt will give the salt some sea breeze character. In wines, the mineral nose of some wines can often be associated with certain wine making techniques (long lees contact, more reductive vinification, sometimes sulphurs or sulfites) or the absence of some strong varietal characteristics (for example, a Riesling nose will always appear more mineral than a gewürztraminer because it is less aromatic...). There is definitely something there that makes a wine qualify as 'mineral' on the nose, but it is mostly a sensation or association of elements that makes us think of minerality.

On the palate, this is another story. Minerals in their globality have a taste and will without doubt influence the palate, length and structure of a wine. Their presence will first alter the pH or expression of the acidity on the palate and change the compositions of many molecules in a wine. More importantly, they will leave a saline savour, enhancing the touch of the wine on our taste buds and transforming its length and character. This 'minerality' will also make salivate and will increase the desire to take another sip. As a

wine grower, it is this expression of minerality that I am looking for in wines. It makes a wine unique in its character and is a formidable sign of quality, because only great viticulture and careful winemaking can bring this taste in the bottle.

Where do minerals come from?

The soil! but only if the soil is capable to produce them and store them, and if the roots are capable to find them. Minerals are directly linked to the composition of the soil and the mother rock. Different type of soils/mother rocks combination will produce different kind of minerals in different quantities. A granite containing black and white mica (like the Grand Cru Brand in Turckheim) has the possibility to produce small amounts of high surface clay, capable to fix all the interesting minerals which are originating from the decomposition of the black mica. So a granite made only with white mica, which is pure silicium, will produce much less minerals and these minerals will be washed away quickly, because there is no clay/marl there to store them. Already there, it is possible to see that some soils have a specific composition that will allow them to produce interesting minerals. It is possible, just on this criteria, to classify them on a quality scale... Some might be too poor on a mineral point of view to be considered interesting for viticulture and would not be granted Grand Cru status.

The decomposition of the soil is the result of erosion, the action of the water, animal and plant life but mostly micro-organisms present in the soil (mostly bacteria) that 'feed' themselves on some elements present in the rocks and eventually release minerals. These minerals will eventually be captured by the very small elements in a soil, described as clay and very fine silt. Each rock base has a different potential for producing these elements. A limestone rock may produce more clay than a granite soil for example, and a gravelly soil only produces silt and almost no clay. These fine elements, clay and silt, are very fragile in a soil. They can be drained away by water, heavy rainfalls, erosion or bad viticulture, but in a normal soil, they will combine with the humus to form an organic-mineral structure, which becomes much more resistant to erosion and will constitute the mineral reserve of the soil. Humus is the result of the transformation of unstable fresh organic matter (compost, leaves, branches, dead roots, animal's residues...) into stable organic structure by the micro-organisms present in the soil (starting with the worms, through fungi and finishing with bacterias).

A soil which is lying on top of an interesting rock base and contains a rich organic-mineral structure, enhanced by numerous and active micro-organisms, has the potential to produce, store and keep for the plants use many interesting minerals.

How plants do finds the minerals in a soil?

Minerals are necessary for some vital function in the plant. They might not be needed in large amounts, but if some are missing, some functions can be impaired. For example, if iron is blocked in the soil, for different reasons (excess compaction, excess water, potassium dominance...), the vine might be lacking some iron to perform the photosynthesis properly and the result will be visible on the leaves: they will turn bright yellow. Minerals are important, and if it is possible to detect a deficiency in one of them, growers will be prompt to use a specific fertilizer, into the soil or directly on the leaves,

in order to correct the problem. This is the way modern agronomy apprehend the problems! Fortunately, some viticulturists, especially biodynamic wine growers, believe that the soil should be healed first, so it regains its fertility and allow the vines to find all the elements it needs.

In a normal functioning soil, roots will adsorb minerals in their sap, in quantities which are normal for their development. Vine roots are surrounded by a microscopic fungi called 'micchorizes'. This fungi has a symbiotic relation with the roots. It feeds from the vine sap but also transforms the soil directly in contact of the roots. It changes the pH of the soil, allowing for example the roots to sustain higher pH soils and also frees some minerals that the vine can then adsorb.

No life, no minerals...

A soil is in fact a fragile mechanism. Most humane intervention will disrupt a complicated process. First, if a soil doesn't contain enough organic matter, there will be no humus there to stabilize the fragile clay and minerals. Organic matter can be brought to a soil (composts), but if there aren't enough micro-organisms, this organic matter (compost, but also dead roots or dead animal organisms) will eventually go through the process of anaerobic fermentation, which will produce CO₂, an acid gas, that will in turn invert the soil. Instead of transforming organic matter and rocks into earth, the earth will turn into rocks again through a crystallisation process of some minerals, mostly calcium turning into limestone again. This is called desertification. It is a massive problem around the globe, even more crucial in warmer and drier climate, because water and cooler temperatures help to preserve life in soils.

So, if there is no life in soils, there is less and less minerals, and more importantly, soils cannot produce them anymore and the vines will not be able to adsorb them.

What kills life in soils? Easy: herbicides, chemicals, abusive soil compaction (heavy repetitive machine use, heavy mechanical harvesters), lack of corrective ploughings, no growing plants in the soils (young growing roots help to aerate a soil), because compaction has an asphyxiating effect and when there is no more O₂ in a soil, life disappears. Just look what happens when someone always walk on the same track in a garden: it creates a path with no growth. Because when there is no life, plants cannot feed themselves and eventually die.

What brings life into a soil? Easy: the use of high quality compost, no chemicals or herbicides, allow oxygen to penetrate into the soil by ploughing it in winter, allowing plants to grow between two soil tilling and use lighter less damaging machines, and also helping the soil to digest all the fresh organic matter it gets every year by using some specific preparations made from cow dung and plants. Show the vine the direction it has to concentrate its energies... In fact, I realize I just gave some of the basics for biodynamic cultivation...

Can the winegrowers change the minerality of their wines?

When I studied agronomy a long time ago, I was taught that anything missing in a soil can be corrected. There isn't enough of one micro element in a soil? Just spray it on the vines and add some in the next fertilisation. There was never any mention why this

element was lacking in a soil and why the roots couldn't get it. This is a very perverse system, because ultimately it is possible to recreate an artificial soil. Today, most vineyards around the world would fall into this category. So many soils are dead, over compacted and have lost all their fertility if it wouldn't be for the help of modern efficient fertilizers. Why bother if the result is the same? Well, I think the result isn't the same. The complex and specific proportions of some minerals found in a soil makes it unique and has a unique influence on the way a vine will grow in this specific soil. More importantly, its delicate influence on the taste – that minerality found on the palate – will not be re-created artificially with some commercial fertilizers.

Soils that have lost all their fertility, mostly due to abusive chemical use and compaction, will also create other agronomical problems: superficial root system and over vigorous growth inducing more diseases problems (especially rot and fungus problems).

Minerals which are 'man brought' to the soil are always presented into their saline form (sulphates), so they dissolve quickly into the water in the soil and as the roots absorb water, they also absorb these minerals. The problem with this system is that it is difficult to control the amount absorbed by the vine. If it rains too much, most will be drained into the water table on cause huge pollution problems. If the temperatures are high and the vines need to perspire more, they will absorb more water that will be too rich in these minerals and the effect will be the same as if one drinks sea water to calm its thirst! Sometime, if the rains (unless there is irrigation) arrive too late, the minerals and fertilizers can be absorbed to late, too close to the harvest, and the effect can be counter productive.

In conclusion, there is nothing new! One has to choose an interesting site, capable to produce a quality soil for viticulture purpose, cultivate it naturally and allow the vines to find themselves what they need by keeping the soil in good shape and alive! The rest is done by Mother Nature.

Can winemaking change the minerality of wines?

Surely! Depending on how the grapes are processed, pressed and fermented, the mineral composition will change. Minerality could be measured by analyzing the total reduced dry extract in wines. A wine is simply burnt to ashes, until there are only mineral and ashes left. The result can be amazing, because it isn't necessarily the richest wines (higher alcohol, sugar, tannins...) that may have the highest reduced dry extract. This measurement is in fact directly link to the way the vines grew in their soil, how effective the root system was, how small the crop was (higher yields = lower dry extract) and how interesting the soil was. No excessive additions of minerals into a soil will eventually increase the reduced dry extract of a wine. As a wine grower, I can of course influence the way a vine will grow in a specific location and will be able to enforce its fertility, but I will not be able to change the quality potential of a soil. In wine making, things are different. It is difficult to really increase the reduced dry extract or the total mineral composition of a wine without using debatable techniques (reverse osmosis for example), but it is easy to loose a lot in the process. Lowering the time spent on the fermenting lees, all fining techniques and filtrations (especially sterile filtrations) will ultimately affect the colloidal composition of a wine and eventually its mineral composition.

If salinity expressed on the palate will become the new way to judge quality and soil influence, I guess that it won't take long to some clever oenologists to figure out how to change/add this taste in wines. Fortunately, adding 'salts' or minerals in a wine will certainly not make it taste better and could cause other serious problems by increasing the pH too high. What makes a 'Grand Cru' vineyard tastes so much more special than a more ordinary origin is something that cannot be recreated artificially.

And Bio-Dynamie?

If life helps to keep a soil fertile and helps the vines to find the necessary minerals, and if bio-dynamie enforces life in soils, the result can only be better. It isn't easy to grow vines in general. This plant doesn't naturally have the desire to produce fruits (therefore needs to be pruned severely every winter), so it is even more difficult to force a crop, and sometimes a large one, without the drawback of excessive vigour. Bio-dynamic cultivation helps the soil to regain fertility and life without becoming over vigorous. It is a method meant for quality production, not volume. Simple soil analysis (Biodyvin experiments www.biodyvin.com) have showed that bio-dynamic soils would contain ten time more micro-organisms (measured in weight) than normal organic soils. The difference is even greater with conventional viticulture. It is only a small guess to imagine that there is also a direct influence on the minerality of a wine. The purpose of this article is not to explain how bio-dynamie functions, and that would actually be a challenge, but it is interesting to explore a system that would help the most the soils to produce a unique and unrepeatable range of minerals and show the vines the best way to capture the uniqueness of each soil.

Most of the preparations used in bio-dynamie have the aim to show the plants where they should go, concentrate their energies at the right place, not neglect some parts of the plants (and vines have the bad tendencies to neglect their root system) and increase their metabolism. Most growers who have turned into bio-dynamic production would have difficulties to explain how it works, but most would admit that the vines react differently, the leaves are more reactive to the sun movement, the stature of the vine is better and often root growth is faster. It would all tend to let think that the mineral absorption is facilitated. We moved into bio-dynamic production in 1997 on our domaine in Alsace after having done some experiments with compost production in bio-dynamie. One of the classic problem conventional grape producers encounter in spring time is chlorosis (leaves turning yellow after cold weather or too much rain). These symptoms disappeared the first year of bio-dynamic cultivation because the iron wasn't blocked any more in the soil and certainly the natural drainage of the soils were better due to soil cultivation and no more compaction. For the same reasons, it is possible to assume that global mineral consumption by the vine is better. It is important that the vines find the minerals it needs, in the right amount at the right time. This will guarantee better grapes with ultimately better dry extracts in the wines.

Two very important bio-dynamic preparation, the P500 (horn compost) and the P501 (horn silica) are used dynamised in water and then that water, which took the energy of the preparation is prayed on the soil just before a light tilling or directly on the vines (for the P500) and exclusively only on the vines before flowering or sometime before harvest for the P501. The P500 aims to give a vertical axis to the vine and is there to concentrate

the growth of the vine towards the centre of the earth. The result is that the roots grow deeper and faster, and hopefully will reach areas in the soil which are more interesting for quality. The P501 is there to bring all the centrifuge energy the vine needs and is a strong solar influence. Its aim is to help the vine to concentrate its energy on astral influences and therefore prepare the vine to the flowering process. The P501 is such a powerful preparation that if it used to close to the flowering, it can actually provoke the flowers to drop (coulture). Both preparation activate the metabolism of the vine and therefore, its mineral composition and balance. The vine becomes the image of the soil it is growing on and hopefully the resulting wine also.

Minerality is the ultimate interesting measurement in a wine. It cannot be faked and it is the direct influence of a place on the style of a wine. The taste of minerals is something delicate, that can be hidden or altered with various winemaking techniques, but respectful wine making will always allow the soil to influence a wine. Minerality is what makes the difference between a technological product and the result of a skilful art and a unique product: a wine from a great origin.