

Central Otago Semi Arid Soils

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This article relates to the soils defined as “semi-arid” in Central Otago - being the soils commonly found in the grape growing sub-regions of the Cromwell basin and Bendigo, and the Alexandra basin.

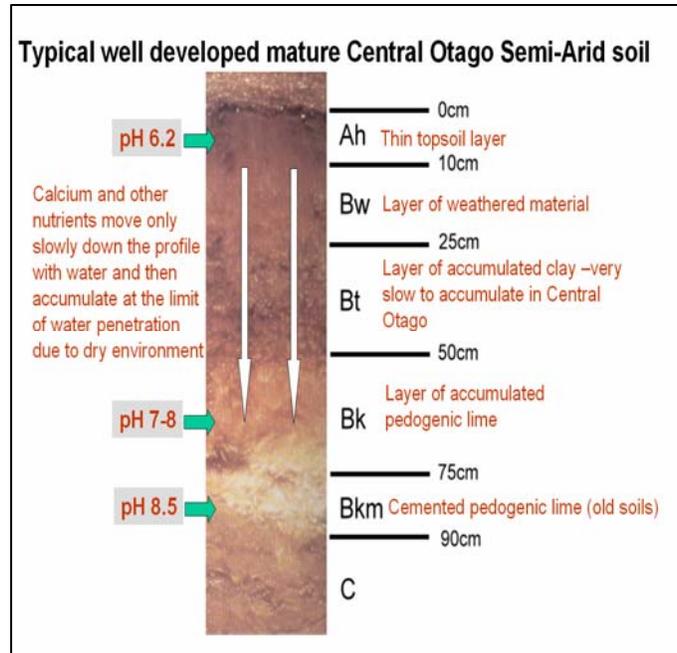
Are the Semi-arid soils of Central Otago distinctive?

The short answer is yes and the short answer as to why is “climate”. The majority of Central Otago is classified as “semi arid” that means it is dry – very dry actually, less than 400mm per year for the majority of grape growing areas (excluding Gibbston and Wanaka) and hot in the summer. If we think about the key factors in soils formation we have

- **Climate**
- **Time**
- **Parent Material**
- **Topography**
- **Biology**

Of all of these it is climate that is unique to Central Otago – at least within NZ.

Central Otago and perhaps a few limited areas in South Canterbury are the only places in NZ where we can find semi-arid landscapes. Although it is also important to understand the other factors in Central Otago, the dry conditions mean our soils develop some properties not found elsewhere – some of these can be surprising and give our soils some features that one might not immediately expect for soils developing from the parent materials found in Central Otago. Following Climate is the influence of time – all things take time and soil development is no exception so these two are focused on here.



Typical attributes of Central Otago Semi-arid soils in their unmodified state include

- **Accumulation of pedogenic Lime**
- **Accumulation of soluble salts.**
- **Limited weathering**
- **Low organic matter**
- **Low clay content**
- **Free draining**

What on earth is Pedogenic Lime?

So how can Lime be a feature of Central Otago soils when the parent material is Schist not Limestone? It's a result of the dry climate! Pedogenic simply means "soil created", the lime in Central Otago soils whilst being chemically identical to the lime in Limestone has nothing to do with the marine origin of Limestone. Pedogenic Lime is created in the soil when Carbon dioxide dissolved in water in the soil meets up with Calcium released from the parent material (Ca is found in most parent materials) as it weathers and is chemically broken down. This weathering process happens very slowly in Central Otago as the climate is so dry. When the two (Calcium and dissolved Carbon dioxide) get together they react to form Calcium carbonate – normally this is washed right through the soil profile and down into ground water in a process called leaching but in the dry environment of Central Otago it is very rare for enough rain to fall for this to happen, so leaching is incomplete and the lime accumulates at the depth to which it gets washed by the wetted front of the water. This means that over a very long period of time - usually several 10,000's of years or even 100,000's of years - the lime builds up and can even cement the sediments together. As a result soils are alkaline at depth with pH's in excess of 8 despite the topsoil being naturally slightly acid (pH 6.2-6.5).

So the interesting thing about all this is despite a lack of Limestone in Central Otago (often spoken of as being essential for top Pinot Noir production) - a feature of the Semi-Arid soils of Central Otago is the accumulation of lime in the profile and an alkaline or high pH – the end result is a profile with similarities to one formed from Limestone despite the absence of limestone.

Soluble salts?

Soluble salts can also be found in patches throughout the dry parts of Central Otago. These are salts that have formed from the products of the nutrients weathered from the parent material.

In a wetter climate, soluble salts (salts that dissolve readily) are usually completely leached through the soil profile, but in a drier or Semi-arid climate these salts accumulate.

Typically the main salt is Sodium chloride and pans of the salt can result – these areas can be problematic for growing grapes and are avoided.

So are all the Semi-arid soils the same?

No of course not, because apart from anything else age plays a big part. As all soil formation takes tens or hundreds of thousands of years the position on the landscape is very important. As the soils age the formation of horizons in the soils – the result of accumulation of nutrients or other particles in the profiles - becomes more pronounced. The older the soil the more time there has been available for weathering and release of nutrients and creation of clay particles in the soil, and the for the leaching/horizon formation process to have taken place. Understanding the history of the landscape allows us to read it and then understand what level of soil development we might expect.

The landscape we see today in Central Otago is a young landscape. Although the Schist rocks are greater than 250 million years old, the mountains built from the rocks have only been pushed up mostly in the last 8 million. Remnants of a large lake known as Lake Manuherikia that existed prior to the recent mountain building and more than 15 million years ago can be found all over Central Otago



Lowburn terraces looking towards Pisa Range

and contains fossils of tropical plants, snakes and crocodiles! The most recent surfaces and most relevant when understanding grape growing are the surfaces created by the glaciations over the last 2 million years and in particular the very last few ice ages that occurred several times in the last few hundred thousand years. It is on these mostly younger surfaces that we find grapes. The soils of these surfaces generally have soils that are still developing their profiles. Because of their youth they tend to have low amounts of clay and are free draining but of course the very young soils may not retain much moisture particularly if they do not have much depth of wind-blown silt (loess) on their surface. So by understanding how old the surfaces are and reading the landscape that we look at we can predict some of the properties of the soils and realize that even soils in close proximity may have very different ages. This makes it very difficult to relate wine characters back to the influence of the soils in sub region.

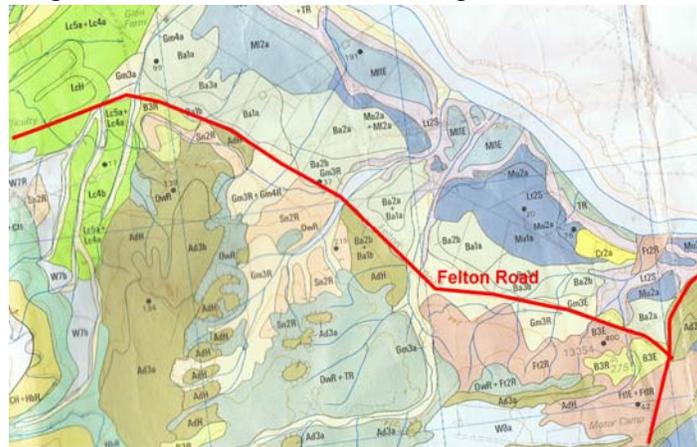
The challenges the different soils present to the viticultural manager especially with regard to irrigation and nutrient management can be very different. How sensitive the manager is to these and how well they manage the challenges will perhaps have the most influential effect on the end product . Thus management will have



a masking effect on the pure expression of the soil in the wines. An aspect which will make it very difficult for anyone to ascribe wine characters directly to the soil as perhaps can be done with greater ease in places such as Burgundy where irrigation is not undertaken.

Is it realistic to be able to identify sub-regional wine characters based on soils?

There is certainly a logical basis for suggesting there are unifying features of the Semi-Arid soils of Central Otago and identifying characters of the wines grown on those soils. There is also a logical expectation that individual vineyard wines may have characters that are the expression of the soils the vines are grown on. But to identify sub-regional wine characters within the Semi-Arid soil zone of Central Otago and be able to relate those to soils? – a much greater challenge. Once we take into account differences of ages of surfaces within sub-regions, differences in the influence of positions in the landscape and the effect that has on loess deposition as well as differences in management history and of course finally the influence of current viticultural practice, then most sub regions will demonstrate much greater variation in soils and their management within each sub-region than they do between the sub-regions.



Take for example this piece of soil map of the Bannockburn area either side of Felton Road. Without the key it may not mean much, but we can certainly see from the colours that the pattern is complex. Especially so if we add the information that within the “sub region” we have vines growing on gold miners’ tailings (both clay and gravel based), remnants of Lake Manuherikia (15 million years old), and then a variety of glacial outwash terraces and fans with a range of ages from only a few 10’s of thousands to several 100’s of thousand years old, as well a range of previous management histories for those soils.

It may well be that one day we will be able to relate wine character to soil types- that is we will be able to classify together similar soils from the various sub-regions and then identify unifying characters of those wines but even then it must be remembered that viticultural management and even wine making practice may continue to mask those differences.

In summary there are definitely unifying features of the soils in Central Otago that make them different from elsewhere in New Zealand, but soil differences within

the semi-arid Central Otago winegrowing sub-regions may be greater than the differences between the sub-regions, (due to the factors of age, climate, parent material, topography, biology) and so differences in sub-regional wine characteristics may be more easily attributed to other factors such as climate (heat summation, growing degree days), viticultural management, wine making styles or a combination of all these.

This article has been written by Roger Gibson of Lowburn Ferry Wines. Roger Gibson holds a Bachelor of Science and a Master of Applied Science with first class honours in Plant and Soil Science from Lincoln University and has worked as a Landscape Ecologist for Landcare Research Ltd in New Zealand, as well having undertaken consultancy work overseas. He now teaches Viticulture at the Otago Polytechnic as well as manages the family vineyard -Lowburn Ferry, in Central Otago. He can be contacted for further information at the following email roger@lowburnferry.co.nz or phoned at +64 3 4450846