2015
International
Year of Soils

RheinlandPfalz

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Vineyard Soils of Rhineland-Palatinate

Rocks. Soils. Terroir.

Ministerium für Wirtschaft, Klimaschutz, Energie und Landesplanung Rheinland-Pfalz

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1. English edition, January 2015

Foreword

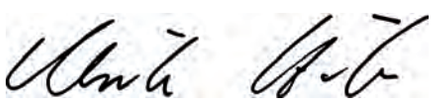
Dear ladies and gentlemen,

for ten years now, the "Soil of the Year" for the upcoming year is announced on December 5th, the International World Soil Day. When the vineyard soil was selected for 2014, the federal state of Rhineland-Palatinate, as the largest wine-growing state in Germany gladly assumed patronage for this soil. The brochure "Vineyard Soils of Rhineland-Palatinate" introduces the large diversity of soils of the wine-growing areas Ahr, Mittelrhein, Mosel, Nahe, Rheinhessen and Pfalz. Six of the thirteen German wine-growing regions are located in Rhineland-Palatinate and characterize large areas of our state.

Wine has been grown here since Roman times. Wine production has created unique cultural landscapes in Rhineland-Palatinate and is an important economic factor today. This is not only a result of wine production alone, which generates nearly a third of the total agricultural production value of our federal state, but is also due to the growing number of tourists who come here because of the wine.

With this brochure we would like to encourage visitors to become more acquainted with the "WineLand Rhineland-Palatinate" and also inspire the wine lover to discover this fundamental factor of wine production. It is a matter of recognizing the diversity and uniqueness of the soils and raising the awareness for the importance of the soil in the creation of a successful wine. Many winemakers have recognized the significance of the soils and terroir and use the "taste of the soil" in wine marketing. Our soils are a scarce resource that cannot multiply or grow. This is why it is our duty to treat our soils with care and preserve them for future generations. All in all we expressly welcome the resolution by the UN-General Assembly to declare 2015 the International Year of Soils.

Eveline Lemke
Minister of State for Economic Affairs, Climate Protection, Energy and Spatial Planning Rhineland-Palatinate



Ulrike Höfken
Minister of State for Environment, Agriculture, Nutrition, Viniculture and Forestry Rhineland-Palatinate

Contents

Vineyard hut near the Nahe cycle route

WineLand Rhineland-Palatinate

Six of the thirteen German wine-growing regions are found in Rhineland-Palatinate:

- Ahr (Eng.: Ahr)
- Mittelrhein (Eng.: Middle Rhine)
- Mosel (Eng.: Moselle)
- Nahe (Eng.: Nahe)
- Rheinhessen (Eng.: Rhine-Hesse)
- Pfalz (Eng.: Palatinate)

Each region is unique in itself, characterized by a distinctive vinicultural landscape and looks back on a long tradition of winemaking. Innovative and internationally renowned wine estates, historic attractions, top-class cultural events and celebrated chefs form an unsurpassed symbiosis where nature is at its most beautiful.

The varied vinicultural landscapes together with the wine itself form a unique selling point for marketing Rhineland-Palatinate in the highly competitive tourism sector. Wine is an excellent theme, which can be combined with culture and food, but also with activities such as hiking and cycling, to create special tourist packages. In its capacity for making regionality a trait that can be experienced, wine brings an emotive aspect to tourist offers and moulds the national and international image. Wine is the central identity factor and the key for branding the wine-growing regions in Rhineland-Palatinate as a destination for tourists and turns a visit of the WineLand Rhineland-Palatinate into an unforgettable experience.

For more information please visit:
www.romantic-germany.info

Romantic Germany
RHINELAND-PALATINATE

Mosel cycle route near Neef

Terroir

Soil
is the firm basis of the terroir. It supports the vine and provides nutrients and water. The thickness and profile of the soil space in contact with the vine roots, the water and air supply as well as the natural nutrient content are the most important soil properties. These are influenced by parent material, topography, length of time for soil development, climatic factors and human intervention.

Climate
determines the suitability of a region for quality wine production, because vines place high demands on the ambient temperature. Climate describes the long-term characteristics of the meteorological conditions of an area: temperature profile, duration and intensity of solar radiation and precipitation. In addition to these factors, phenomena such as humidity, cold air pockets and the presence of drying or cooling winds also play an important role.

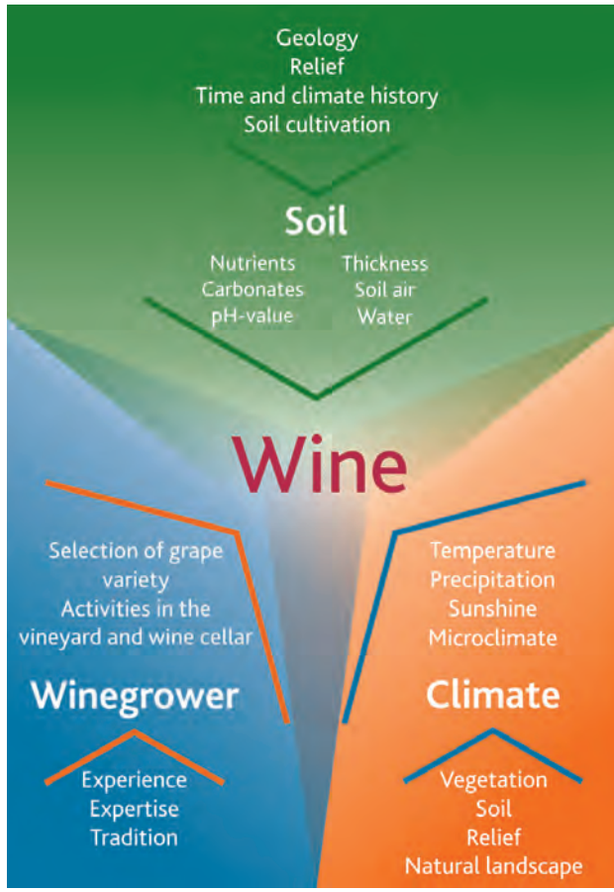
The microclimate within a vineyard may vary from the regional climate. Microclimates differ according to local topographical characteristics, slope and aspect, the orientation of the site with respect to prevailing winds, vegetation and the soil as a heat store. Annual climate is responsible for the characteristic vintage of the wine.

The environmental conditions of a site influence the formation and storage of aroma-active compounds in the grape and therefore the quality and typicality of the wine.

Winegrowers
shape the wine according to production objectives and the correlated decisions they make, which are based on their knowledge, experience and winemaking skills. This begins with the selection of the grape variety. The specific conditions of the wine year dictates the type, timing and execution of the work in the vineyard and wine cellar. These controlling measures also have a sustained effect on soil and microclimate. Soil management and fertilization or the construction of terraces can have a profound effect on soil properties. Changing the topography and the vegetation modifies the microclimate of the vineyard and within the stand.

Terroir
describes the summed effects of these framework conditions on wine production. The French word terroir can be loosely translated as “soil, location or origin”. In essence it means that the taste and aroma of a wine reflects the location and therefore its origin. Terroir encompasses the holistic interaction of natural environmental factors and the influence of the winemaker. The unique origin, the terroir, is expressed in the variety of wine styles.

Terroir is not interchangeable. The terroir of the vineyards in Rhineland-Palatinate, the geological and climatic diversity of the landscape, the local soil types and topography are unique and cannot be reproduced anywhere else. These authentic wines are an expression of their origin and cannot be compared to the anonymous mass products.



The wine in the glass is a product of numerous influences: the natural environmental conditions, the philosophy of the winemaker (how a wine should taste), consumer demands, the economic framework and vinicultural politics.

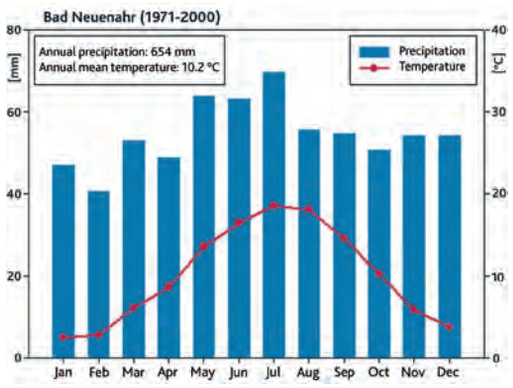
Climate and Wine

Western Europe lies within the temperate climate zone, which is characterised by relatively cool summers and mild winters. In the northern hemisphere, high quality wines are produced between the 30th and 51st degrees of latitude. The wine-growing regions of Rhineland-Palatinate are located along the northern edge of this zone.

We must thank the Gulf Stream for making West Europe suitable for growing wine. Our climate is determined by Atlantic air masses brought to us by the prevailing westerly and southwesterly winds. However, this climate zone is situated in a transitional area characterised by contrary weather and rapid changes between oceanic, sub-tropical and continental air masses. Annual climatic fluctuations are typical for the temperate climate zone. Individual years can vary widely with respect to the duration of sunny periods and precipitation. This leads to an annual variability of the growth and ripening conditions for the vine, which is expressed in the characteristic vintage of the wine.

In our latitudes, the largest volume of rain falls in the summer, just when the water demands of the vine are especially high. The rainfall usually declines during the ripening period.

The growth period of the vine is temperature-controlled. Cool phases are important for producing fresh and fruity wines. Slow sugar production prevents wines from becoming too alcoholic and flabby. Cool nights delay the conversion of acidity and a higher acid content means a fresher wine with improved ageing potential. Our climate is just perfect for the "King of White Wines", the Riesling. The grapes ripen slowly and therefore the distinctive element of the wine is its fruity acidity. Riesling prefers cooler climate and is therefore ideally suited for northern wine-growing regions. Climate parameters such as precipitation and solar radiation also vary within a wine-growing region.



The microclimate is chiefly affected by topography (height above sea level, exposure, slope, relief position) and soil conditions.

All these factors create a huge variety of growing conditions. However, it is the temperature that plays the dominating role. It is the decisive factor for the optimal development of the vine and the production of aroma-active compounds in the grape.

Weather station

The past decades has seen a development towards warmer conditions in the wine-growing regions. Between 1951 and 2000, the temperatures in Southwest Germany have increased between 0.7 and 1.4 °C. At the same time, the number of late frosts and frost days has decreased significantly.

Constantly hot periods can have a harmful effect on wine production. Similarly, a decrease in precipitation and extreme solar radiation can also lead to negative outcomes. High temperatures can cause an acceleration of development cycles, an increase in sugar and alcohol levels and a decrease in acidity. This can impede the formation of aroma-active compounds and pigments and impact the balance and taste.

As temperatures increase persistently, it will become possible for winegrowers to stock their vineyards with cultivars suited to warmer climates. Already at the beginning of the new millennium, winegrowers in Rhineland-Palatinate began planting varieties more commonly associated with southern regions such as Merlot, Chardonnay or Cabernet Sauvignon.

Soil

Soil is the outermost covering of the earth surface, varying in thickness from just a few centimetres to several meters. The soil provides support for the vine and is a source of both nutrients and water. The invisible part of the vine, the root, lives in the soil. Quite often it produces more mass than the vine itself.

The juvenile vine relies heavily on an adequate quality of topsoil as the young and tender roots find their way through the soil in their search for water and nutrients.

This works best in loose, meaning not too heavy or stony, soil.

Soil also has a profound effect on the microclimate, which influences the growth of the vine and grape ripening. The capacity for absorbing, storing and radiating solar energy varies according to the composition of the soil. Moist and heavy soils require a lot of solar energy to warm, but they are also capable of storing this heat for long periods. Light and dry soils warm quickly but also cool just as fast.

Soils are a mixture of minerals and organic matter, organisms as well as water and air.

The mineral components are formed by the weathering of the underlying parent rock. They are a source for many important plant nutrients such as potassium, magnesium and calcium.

Organic components such as decaying plant residue or the detritus of soil organisms also supply plants with nutrients, especially nitrogen and phosphor. Soil organisms break down organic material making many nutrients available to the plant.

Air and water are also important components of the soil system.

Air circulates through the large pores (coarse pores) that are too large to hold water. This is where soil organisms find ideal conditions for living.

Rainwater infiltrates the soil surface. A portion of this water will percolate downwards through the coarse pores until it reaches the groundwater table. The remaining water is held against the force of gravity in the fine and medium pores. Plant roots can only absorb water retained in the medium pores. They cannot produce the suction needed to retrieve the water from fine pores. The volume and distribution of pores varies between soils and depends on the texture and density of the soil.

Soils are multilayered

Cultivating the soil with a deep tillage plough

The actual soil formation process involves the transformation, accumulation or removal of substances. The process ends with the cessation of external influences. The characteristics of the soil are determined by parent material, topographical location and climate during the development period.

Nearly all present-day Central European soils have been affected by human use. Before restocking a vineyard, the soil is subjected to intensive deep tillage measures to improve aeration and the water storage capacity and loosen the subsoil to facilitate root penetration. In Germany the deep tillage procedure is known as “Rigolen”

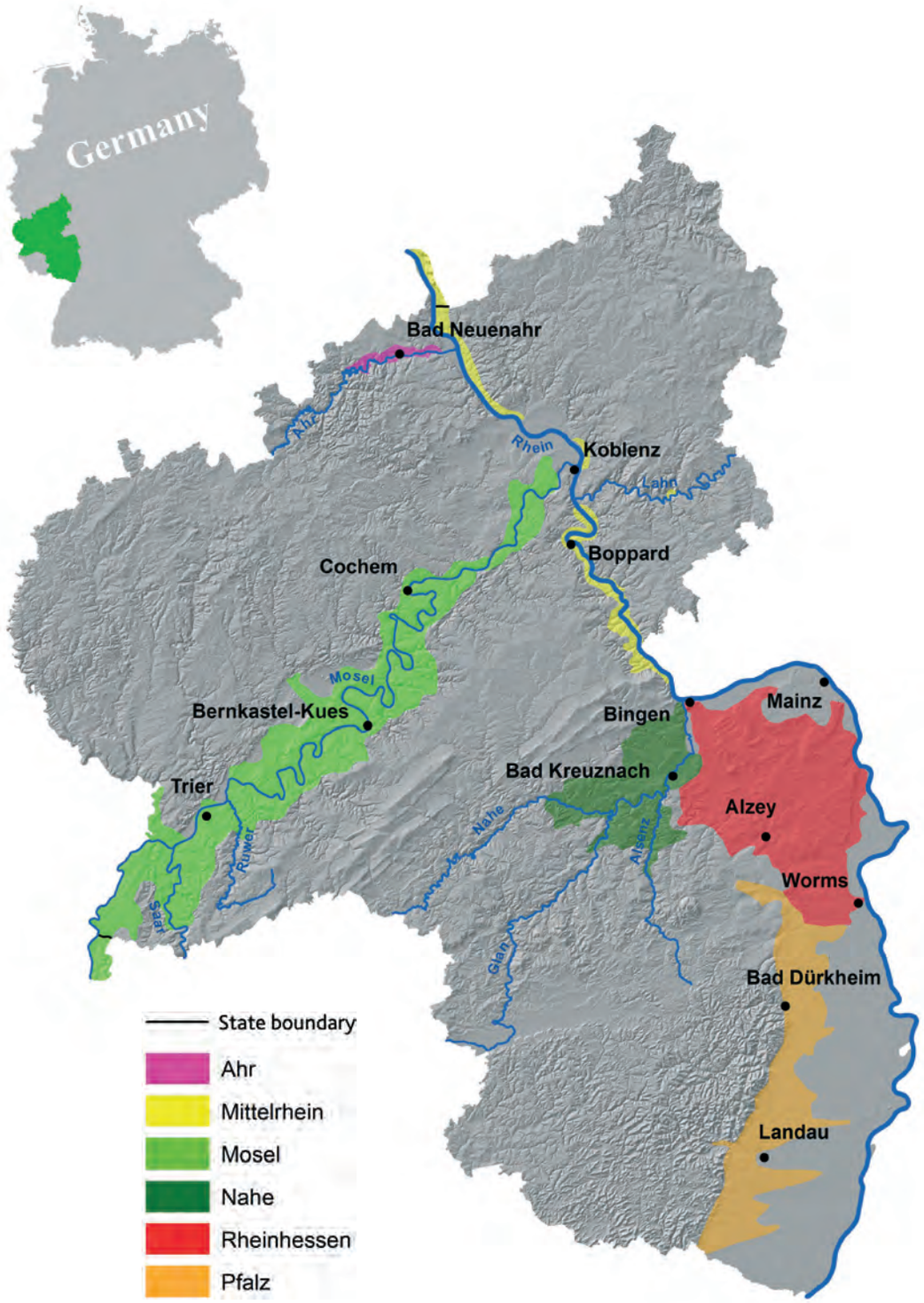
The Wine Landscapes

Rhineland-Palatinate is the number one wine-growing state in Germany. The Wine-Land Rhineland-Palatinate stretches from the northern to the southern state boundary – from Bad Neuenahr to Bad Bergzabern. Six of the thirteen German wine-growing regions for quality and superior wines are found along the river valleys over a distance of 170 km as the crow flies: Ahr, Mittelrhein, Mosel, Nahe, Rheinhessen and Pfalz.

Around 10000 companies produce between 6.0 and 6.5 million hectolitres wine, which amounts to about 65 to 70 % of the total German harvest. About 90 % of the total volume of wine exported from Germany is produced in Rhineland-Palatinate.

Rhineland-Palatinate possesses best conditions for producing interesting high-quality wines. The subsurface of each wine landscape is characterized by a unique mosaic of different rocks. Recent unconsolidated deposits, sedimentary rocks, metamorphic and magmatic rocks have produced soils with a variety of properties.

Sheltered by the surrounding low mountain ranges, these regions are favoured by benign climatic conditions. Finally, the varied topography within the wine regions causes a wide range of microclimates. Thus the vines are exposed to completely different growth and ripening conditions. The objective of the winegrowers of Rhineland-Palatinate is to ensure that this natural diversity can be tasted in the wine glass.



View of Walporzheim

Ahr

The Ahr region lies in the Northern East Eifel low mountain range, which is part of the Rhenish Massif. The wine-growing region Ahr is situated on 50° 30´ North making it the most northerly and, with a vineyard area of just 560 ha, also the second smallest wine-growing region of Rhineland-Palatinate.
Wine is grown mainly on the steep terraced slopes along the 18 km section of the river Ahr between Altenahr and Bad Neuenahr. 69 % of the vineyards are located on slopes exceeding 30 %. These are mostly found in the gorge between Altenahr and Marienthal. The vineyards of the eastern part of the region are usually located on gentle slopes and level river terraces.
Located along the southern edge of the Lower Rhine Lowlands and protected by the wind and rain shadow of the Eifel, the Ahr region is favoured by a mild Atlantic climate. The east-west orientation of the wine-growing region means that most vineyards are found on the northern side of the river valley, facing south towards the sun. The steep slopes and the dark rocks are quick to warm. The stored heat is slowly radiated back onto the vines, which ensures milder night temperatures.
The Ahr Valley is divided into two climatic regions. The lower Ahr is open towards the Rhine and profits from the wider valley. Protected from the winds from the plateaus, the high solar radiation in the narrow upper Ahr Valley causes humidity levels and soil temperatures to increase rapidly. Here the microclimate varies considerably due to the differing orientation of the Ahr loops.

Climate
Annual mean temperature: 9.8 °C
Annual precipitation: 650 mm
Direct solar radiation: 645000 Wh/m²
Sunshine hours: 1425 - 1500 h

Vineyard area (2011)
approx. 560 ha, including:
348 ha Pinot noir
45 ha Riesling

A mosaic of small microclimatic zones have developed between the loops and the rocks.

Ahr – the red wine valley

The Ahr is the wine-growing region with the highest proportion of red wine varieties (approx. 80 %) and is the most famous red wine region in Germany. The steep slopes and small-scale structures of the steep locations pose a severe restriction on the mechanisation of vineyard management procedures. Consequently, producing wine involves a high degree of manual labour. The intensive management has a stabilizing effect on the yields and enhances harvest quality.
Wine from the Ahr region is characterised by high minerality and intensive primary fruit aromas depending on the grape variety. For example the Frühburgunder developes aromas of blueberry, cherry and dried fruit while Pinot noir offers strawberry, cherry and dried fruit aromas.
The protected appellation Ahr encompasses the vineyards located in the communities Ahrbrück, Altenahr, Dernau, Grafschaft, Mayschoss, Rech and Bad Neuenahr-Ahrweiler.

Picturesque Mayschoß

Quarternary river, wind and slope deposits

- Floodplain and terrace deposits
- Loess and weathered loess

Tertiary volcanic rocks

- Basalt and basaltic tuff

Devonian marine deposits

- Sandstones
- Sandstones, deeply weathered
- Slate
- Slate, deeply weathered

The steep rock faces of the Ahr Valley were formed as a result of the folding of the earth's crust to form mountains and subsequent deep erosion by the river. The folding process created the Ahr Mountains. Hundreds of millions of years later, the juvenile river Ahr followed a zone of geological weakness on its course towards the Rhine. The erosive force of the water carved a spectacular landscape into the Ahr Mountains.

The wine-growing region is located on the northern flank of the Ahr Mountains, mostly on fine sandstone also known as "greywackes" with minor outcrops of Lower Devonian slates.

Ahr terrace gravel

Typical rocks and soils

42 % non-calcareous sandy loam soils on sandstone (grey Devonian sandstone)

25 % non-calcareous loamy soils on slate (dark grey Devonian slate)

22 % calcareous loess and decalcified loess soils (Quarternary)

Many vineyards in this wine-growing region are located on the gravels and loam of the Ahr valley floodplain as well as on the middle and main river terraces. In many places, the level middle and main terraces are covered by a thick layer of loess and decalcified loess.

The impressively folded rocks are a testimonial to the enormous forces of mountain building. These hard and resistant rocks were extracted in numerous quarries along the Ahr to produce building stone especially for constructing the dry stone walls of the vineyard terraces. However, the "Ahr greywacke" was also used in the construction of many historic buildings along the Ahr.

The sandstone and slate outcrop as hard grey rocks in the western part of the region. Towards the east however, the same rocks have been deeply weathered and cover the area in a sheet of mostly multicoloured loose material (saprolite).

Jointed slate with white quartz vein

Anthrosol on sandstone (Devonian)

Sandstone

Hard rock

Sandy deposits of the Devonian ocean were compacted to quartzitic fine sandstone. The old geological name for these thick layers of grey fine sandstones is “greywacke”, a term still popular among the winegrowers.

Soils formed on these Devonian sandstones are widespread in the area between Rech and Ahrweiler. In several respects the properties of these sandstone soils are extreme and pose quite a challenge for the vine.

The soils are very stony. The thin to moderately thick sandy loams are well aerated and quick to warm. However, because of the high proportion of stones, these soils have the lowest water storage capacity in the Ahr wine-growing region. This can lead to water stress in the thin soils of the steep and steepest sites.

The nutrient content is lower than that of the slate soils. The sandstone soils are acid, which means that they require liming.

These properties can be improved by deep tillage operations, the addition of organic matter and a natural presence of loess or decalcified loess in the topsoil.

Sandstone soils produce delicate wines with an elegant perception of fruit. The wines are lively and stimulating.

Soil properties

- moderately deep, sandy loam to loam, very stony
- restricted root zone and rooting depth
- adequate water storage capacity
- high permeability
- good aeration
- adequate nutrient supply
- acid soil pH
- exellent heat adsorption

Sandstone debris

Soft rock

The Devonian sandstones of the broad valley near Bad Neuenahr and on the plateaus of the western part of the wine-growing region were deeply weathered and softened during the subtropical phases of the Tertiary period. Sometimes the resulting rock is multicoloured but quite often it has been bleached.

Although this so-called saprolite still retains the original sandstone structure, it is easily penetrated by the vine roots, where they find water and nutrients.

In many places the saprolite is covered by several meters redeposited saprolite. This sandy loam is even easier for roots to penetrate. The root zone of these soils is especially deep and such sites are very fertile.

Sandstone loams are also found on the steep slopes with unweathered Devonian rocks. These are talus deposits comprising hard sandstone fragments mixed with loess or decalcified loess.

The wines produced on the lighter sandstone loams are lighter and more elegant with a clear presence of fruit. The wines of the loess-affected sandstone loams are heavy, deep and dense.

Soil properties

- deep, sandy loam to loam, gravelly
- deep root zone
- large water storage capacity
- moderate permeability
- good aeration
- adequate nutrient supply
- slightly acid soil pH
- moderate heat adsorption

Anthrosol on saprolite (Devonian)

Red wine paradise Ahr

The romantically wild Ahr Valley is one the most beautiful of the Rhine tributaries and is a magnet for nature and wine lovers alike. This wine-growing region boasts the highest proportion of red wine varieties (approx. 80 %) and is known as the most famous red wine district in Germany. The "king" of the Ahr red wine varieties is the Pinot Noir.

Hiking along the Red Wine Trail, you can watch the grape harvest and many busy winegrowers working in the vineyards. Marvellous walks through the vineyard terraces provide fantastic views of the landscape and deep insights into the most famous red wine districts of Germany.

This picturesque hiking trail between Altenahr and Bad Bodendorf through the "Paradise of red grapes" also presents a wealth of local information. Over a distance of 35 km, the path connects the wine communities high above the romantic course of the river Ahr.

Side trails link the main pathway to the towns below, where walkers can enjoy a glass of wine or take a well-earned break. Here nature and wine lovers will find cosy inns, rustic wine cellars and famous wine cooperatives.

A "Vinicultural trail" with 31 informative panels has been installed just below the Hotel Restaurant Hohenzollern between Walporzheim and Ahrweiler above the Red Wine Trail. This route is 4 km long and presents interesting facts about winemaking in the Ahr Valley. At irregular intervals the walker will learn about climate, grape varieties, soil characteristics and management and the winegrower's work in the vineyard.

Today, hikers and nature lovers can also enjoy the new blue and red Ahrsteig hiking trails, two recently certified quality trails along both sides of the Ahr Valley. Both present the hiker with an attractive combination of trails through idyllic forests and quiet meadows, gentle plateaus and narrow rock tracks. Lonely plateaus contrast with lively wine towns. And there is more: the unique blue and red Ahrsteig impress with spectacular views of the romantic Ahr Valley, the Eifel and the mountains of the Siebengebirge.

View on Hohenzollern

The western Ahrsteig is marked with a blue AhrSteig-Logo (length approx. 58 km), and begins at the source of the Ahr in Blankenheim and ends just before Altenahr. The eastern trail is marked with a red AhrSteig-Logo (length approx. 30 km) and begins in the wine town Walporzheim, passes the spa town Bad Neuenahr and continues to Ahrweiler until it ends at Castle Sinzig.

For more information please contact:

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View of Castle Katz near St. Goarshausen

Mittelrhein

The Middle Rhine Valley is the narrow gorge carved into the Rhenish Massif by the river Rhine. The wine-growing region Mittelrhein stretches from Bingen to Koblenz and from Andernach to the mountains of the Siebengebirge just before Bonn. This fascinating landscape is characterised by steep vineyards, jagged rock precipices and a wealth of castles. This unique river landscape attracts visitors from all over the world.

The Rhine enters the Rhenish Massif from the Upper Rhine Rift Valley near Bingen and Rüdesheim. Between Bingen and Koblenz the Rhine flows through the Upper Middle Rhine Valley. Here the river has carved a deep gorge into the Devonian rocks. After Koblenz, the Rhine flows into the wide, hilly landscape of the Neuwied lowland until it reaches Andernach where it enters the Lower Middle Rhine Valley. This section is morphologically quite similar to the Upper Middle Rhine Valley. Once again the river is forced to flow through the deep narrow valley between the slate precipices. On the right side of the Lower Middle Rhine Valley, the river passes a geological highlight – the ancient volcanic cones of the Siebengebirge, which sit on top of the Rhenish Massif.

Wine is grown in the Middle Rhine Valley vineyards at elevations between about 55 and 350 m above sea level. The vineyards of the valley slopes are almost all steep with gradients between 30 and 60 % or very steep (gradients > 60 %). Level or gently inclined vineyards are found only in the floodplain and lower terraces of the river valley.

Climate

Anual mean temperature: 8.7 - 10.5 °C

Annual precipitation: 570 - 770 mm

Direct solar radiation: 690000 Wh/m²

Sunshine hours: 1350 - 1575 h

Vineyard area (2011)

approx. 440 ha, including:

300 ha Riesling

40 ha Pinot noir

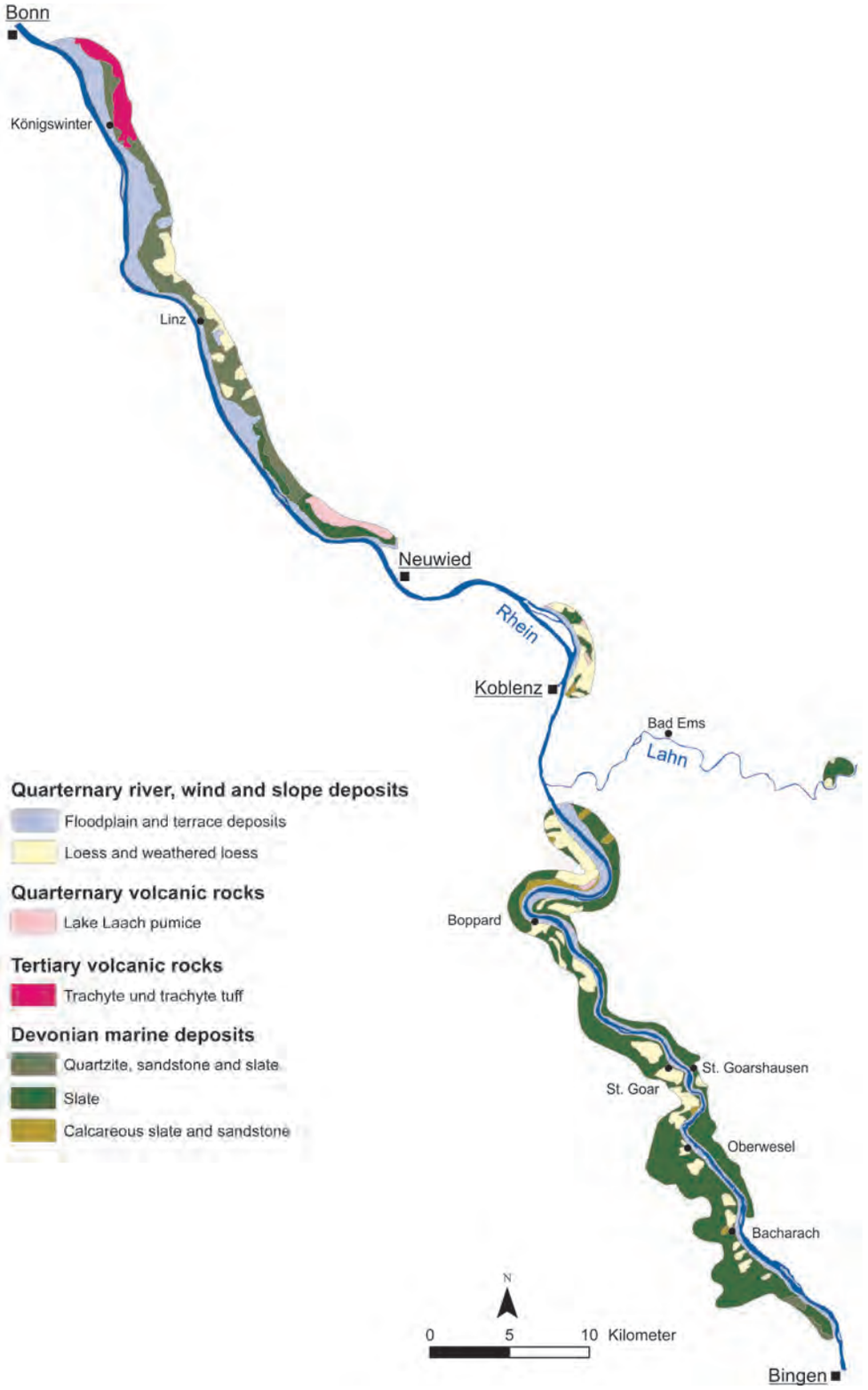
Loreley – legendary rock of the Middle Rhine

The vineyards of the Upper Middle Rhine Valley are mostly oriented southeast to southwest, while those of the Lower Middle Rhine Valley face south to southwest. The total vineyard area is 440 ha, of which around 70 % are stocked with Riesling.

The deeply incised valley protects the vineyards from the cool winds from the high plateaus. The mean annual precipitation is 600 mm and the mean temperature 9 °C. The almost Mediterranean climate of the steep slopes provides the ideal environmental conditions for warmth-loving animals and a type of vegetation that is usually found in southern Europe. Maximum mean temperatures of 19 °C are measured during the summer months.

The extremely stony soils retain very little water. This means that there is a real danger for water stress for vines in summer. However, since most of the rain falls between May and August, the vine is usually ensured an ample water supply.

Vineyard near Rhöndorf



Typical rocks and soils

70 % non-calcareous loamy slate soils (dark grey Devonian slate)
7 % calcareous loamy slate soils (dark grey Devonian slate)
6 % calcareous loess and decalcified loess soils (Quarternary)

The Middle Rhine Valley is dominated by rocks that were formed in the Devonian ocean (about 400 million years ago).
While sand and silt particles are deposited in the shallow shelf sea, clay is indicative of deep ocean environments. The most prominent rocks found here today are quartzitic sandstone and slate with minor outcrops of siliceous nodule and iron nodule slates as well as quartzite.
The Rhine Valley evolved during the most recent geological period, the Quaternary glaciation. As the Rhenish Massif continued to uplift, the alternation of warm and cold periods forced the Rhine to carve a channel through the mountain range forming the steep gorge of the Middle Rhine. The Rhine river terraces were formed during the cold period. Even today these are found at different elevations along the valley. The gravel

Typical slate soil

Slate with sandstone interlayer

loams and sands of the river terraces are often covered by young loess deposits. Mudflows were a typical occurrence in the permafrost soils of the steep slopes during the summer thaw. This mass movement caused intensive mixing of the loess and decalcified loess with the debris of the bedrock producing the loamy, partially calcareous slate debris flows.
The youngest sediments were formed during the Holocene and are found in the floodplains of the Rhine. These consist of several meter thick layers of sand and loam, which are often calcareous.
The non-calcareous loams and stony soils of the Devonian slates or quartzitic sandstones have produced cambisols, leptosols and regosols.
Luvisols are widespread on the fertile loess and decalcified loess, which supply the vines with ample nutrients and water. Unusual soils containing pumice are found north of Boppard.

Anthrosol on slate (Devonian)

Slate debris

Folding a low mountain range

Hunsrück slate as well as siliceous and iron nodule slate accompany the narrow Rhine gorge. These beds were severely deformed to produce large gentle folds often spanning distances of several 100 m, but also very small and agitated chevron folds.

The soils of the steep middle and upper slopes especially near rocky outcrops are stony and contain a high proportion of slate debris and only very little loam. Since the coarse fraction (stones and debris) is the dominant component of these soils, they are only able to retain a limited fraction of rainwater. The suitability of a site for wine production decreases with diminishing thickness of soil covering the slate bedrock. In dry years the water supply for the vines is very meagre. This can only be compensated on deeper soils.

It takes some time for the spicy and finest Riesling fruity aromas of the wine to unfold. Very acidic wines require several months to achieve their full harmony. This acidity is accompanied by a fine minerality, which gives these wines length and expressiveness. Young wines are often still characterized by their fruity acidity. Very mature wines display a sense of smooth sweetness and an excellent ageing potential.

Soil properties

- moderately deep to deep, clay loam to sandy loam, very to extremely gravelly, stony
- moderate to deep root zone
- moderate water storage capacity
- high permeability
- good aeration
- adequate nutrient supply
- neutral to acid soil pH
- good heat adsorption

Calcareous slate

Calcified rocks

The Lower Devonian rocks of the Rhenish Massif are usually non-calcareous. One exception is found in the collective vineyard Bopparder Hamm Feuerlay, where the bedrock layers are calcareous. However, calcareous slate and sandstone soils are also found on non-calcareous bedrocks. On the one hand this calcareous material originates from the mixing of loess into the soil during periglacial mudflows. On the other, percolating rainwater leached the calcium carbonates from the loess cover. The dissolved carbonates precipitated onto the rock surfaces in the slate soils as calcareous sinter. Even today many of the debris flows covering the area are calcareous. Calcium carbonate alters the chemical properties of the soil, increasing the pH to weakly alkaline. The loss of nutrients is therefore much lower and consequently the nutrient supply much higher in these soils than in those of the non-calcareous slate. Calcium carbonate also promotes the formation of a friable topsoil structure, which improves soil water properties and aeration.

Slate wines present a convincing display of power and length and, after a certain delay, develop aromas of a wide range of ripe yellow fruits. The wines are accompanied by a subtle sense of minerals.

Soil properties

- moderately deep to deep, clay loam to silt loam, very stony, gravelly
- moderate to deep root zone
- good water storage capacity
- moderate permeability
- good aeration
- excellent nutrient supply
- alkaline soil pH, calcareous
- good heat adsorption

Anthrosol on calcareous slate (Devonian)

Wine culture and Rhine culture! Visiting the Middle Rhine Valley

Vineyards are a characteristic feature of the romantic Rhine. Over a course of more than 116 km this mighty river flows past an eye-pleasing display of castles, forts, interesting towns and a vast number of steep slopes all planted with vines. There are several innovative projects concerned with preserving this setting of which we would like to introduce a few.

You can take an "Öchsle-Tour" with local winegrowers or explore the region on your own along the numerous wine trails such as the Rhine Wine Trail near the Loreley-Castle Road or the Wine trail at the Bopparder Hamm. Interesting wine museums bring the history of winemaking in the Middle Rhine back to life. Exquisite wine tastings, open wine cellars and traditional wine festivals: pure wine culture along the Rhine.

Competent hosts

Gastronomes bring together wine and culinary highlights in a number of appealing thematic events. Foremost among these is the "Middle Rhine Moments", an impressive potpourri of fascinating events, which take place throughout the year. Many gastronomes offer a wide choice of regional food. The "World Heritage Hosts" are established experts of the region and official ambassadors of the Upper Middle Rhine Valley.

Winegrower's initiative "Gipfelstürmer" of the Middle Rhine

Four pioneering winegrowers have joined forces under the name "Gipfelstürmer" (Eng.: high flyer) to continue an important legacy: to revitalize the historic wine culture on the extremely steep vineyards between the castles. This calls for real pioneering work: searching for and cultivating the best soils, restocking the vineyards, and accepting no compromises in the wine cellar, with the ultimate objective of creating a typical Middle Rhine wine. They are convinced that the blend of new and old vines will yield exceptional wines. The first vintages have already clearly shown the potential of the slate and greywacke soils. These four are on their way to the top – real high flyers!
www.gipfelstuermer-mittelrhein.de

Handstreich, Felsenspiel and Meisterstück

Distinctive names, modern design and a sympathetic marketing campaign: Handstreich, Felsenspiel and Meisterstück are the names of the three top wines of the Middle Rhine Riesling Charta. Yet each wine represents a specific style: Handstreich is a modern Riesling with a delicately fruity aroma. Felsenstreich is a balanced Riesling suitable for all occasions. The Mittelrhein-Meisterstück is an accomplished, dry Riesling, full-bodied with a long finish. The Middle Rhine Riesling Charta is the result of a team process, which has actively involved all driving forces in the region. The 38 Charta-Winegrowers represent more than half the total wine-growing area.
www.riesling-charta.com

Weinnase & Tropfenzähler

The Romantischer Rhein Tourismus GmbH offers a range of special tourist arrangements in the category Wine and Delight. The whole world of wine waits to be discovered by visitors: in the wine estates or while enjoying a wine tasting or a walk through the vineyards.

The arrangement "Weinnase & Tropfenzähler" (Eng.: Wine nose and drop counter) includes a wine tasting, as well as a boat trip up and down the Rhine, a four course surprise menu accompanied by regional wines, a three-day leisure card Rheinland-Pfalz/Saarland as well as a wine present as a souvenir for home.

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Mosel meander between Ediger-Eller and Bremm

Mosel

The Mosel Valley with its numerous meanders is an impressive wine-dominated cultivated landscape. A nearly uninterrupted stretch of vineyards accompanies the river along its 250 km course. The Mosel wine-growing region covers a number of natural landscape units: the Upper Mosel (Remich to Konz), the Open Valley of Trier (Konz to Schweich), the Middle Mosel (Schweich to Moselkern) and the Lower Mosel Valley (Moselkern to Koblenz), as well as the two areas Saar (Konz to Serrig) and Ruwer (Ruwer to Sommerau).

Morphologically, the Mosel can be divided into two sections. The Upper Mosel and Open Valley of Trier consists of the Mesozoic rocks (Bunter Sandstone, Muschelkalk and Keuper) of the Trier Lowlands. Here the Mosel flows in drawn-out bends in an up to two kilometer wide valley. In contrast, the river follows a course through a narrow gorge in the areas Middle and Lower Mosel. This deep and steep valley has been carved into the Devonian rocks of the Rhenish Massif. The valley is exceedingly narrow, except on the terraces of the slip-off slopes.

The vineyards along the Mosel, Saar and Ruwer are located at elevations between 65 and 375 m above sea level. Around 33 % of the wine-growing area is level (gradient < 10 %) and 44 % is moderately steep (10-30 %). The remaining 23 % of the vineyard area is located on steep to very steep terrain. The level and moderately steep vineyards are mostly found on the slip-off slopes. The steep and steepest vineyards dominate the sheer rock faces lining the Mosel gorge. Most of the vineyards face SE to SSW.

Climate

Annual mean temperature: 8.5 - 10.5 °C

Annual precipitation: 620 - 925 mm

Direct solar radiation: 652000 Wh/m²

Sunshine hours: 1400 - 1500 h

Vineyard area (2011)

approx. 8700 ha, including:

5288 ha Riesling

1156 ha Müller-Thurgau

530 ha Elbling

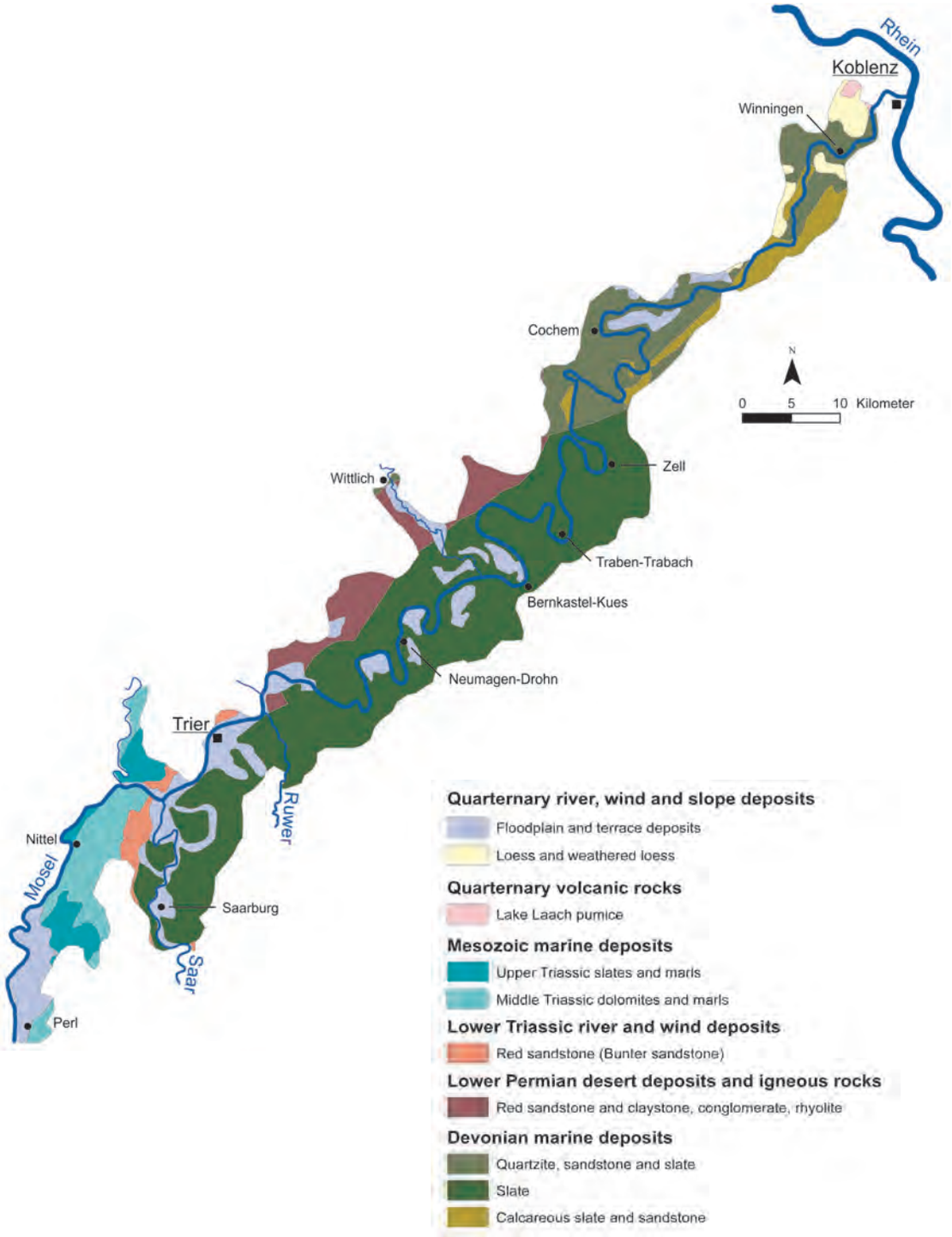
The benign climate of the sheltered Mosel, Saar and Ruwer valleys stands in contrast with the heights of the Hunsrück and Eifel mountains.

Along the north boundary of the wine-growing climate zone, solar radiation is one of the most important factors determining the quality of a vineyard. The deeply carved Mosel valley with its numerous river bends and tributaries is characterised by very steep, highly structured slopes exposed to different intensities of sunshine. This results in a dense mosaic of microclimates, which govern the site-dependant character of the Mosel wines. The distribution of precipitation also varies within the region. Annual precipitation for the Saar Valley is 900 mm. Of this, around 60 % (on average 450 mm) falls during the vegetation period.

The climatic situation of the different natural landscape units shows that the temperatures increase from southwest to northeast, while precipitation decreases in the same direction.

Typical Mosel – blue-gray Hunsrück slate

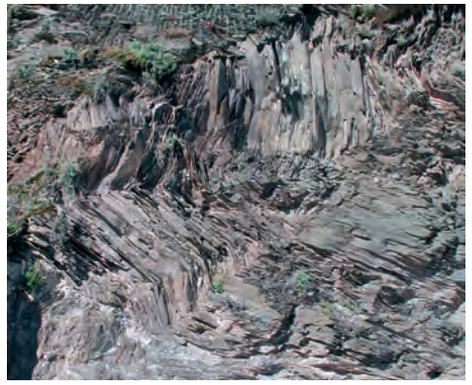
Rock face in dolomite – Nittel, Obermosel



The Mosel wine-growing region is dominated by the Devonian rocks of the Rhenish Massif. These are mainly quartzitic sandstones, quartzites and slate. The Rotliegend trough of Wittlich is a Permian graben structure that was formed in the Rhenish Massif. Eroded material from the surrounding mountains filled the structure and formed clastic sedimentary rocks (silt- and sandstones, conglomerates and breccias). During the Lower Triassic period, river and wind-blown deposits accumulated to form the red sandstones found in what is today the Trier Lowlands. During the Middle and Upper Triassic (Muschelkalk and Keuper), this area was blanketed by calcareous marine sediments. Today, the marl and dolomite bear witness to the presence of an ancient ocean. The development of the present-day Mosel Valley began around 15 million years ago. However, the rate of downward erosion was highest during the ice ages, when the rivers cut deep into the mountains leaving terraces covered in sand and gravel deposits. Some areas were covered by wind-blown loess. The floodplain deposits are a product of the Holocene. Most of the rocks and soil parent materials are Devonian. Sometimes these are associated with river deposits and/or weathered loess. The Middle and Upper Triassic rocks are only found in the Upper Mosel. The soils of the Mosel Valley south of Trier are formed on Middle and Upper Triassic dolomite and marl.

Typical rocks and soils

50 % non-calcareous loamy slate soils (Devonian slate)
9 % non-calcareous loamy sandstone soils (Devonian sandstone)
7 % non-calcareous loam, sand and gravel soils (Quarternary river deposits)
6 % calcareous loam and clay soils on marl and dolomite (Muschelkalk and Keuper)



Small kink fold in slate

The typical soils of the Devonian and Lower Permian parent materials are low to high base nutrient content cambisols. The base nutrient content of most of the cambisols found on the Bunter Sandstone is low. In contrast, the soils of the areas dominated by the Mesozoic rocks are much more diverse. Regosols, leptosols and cambisols have developed on the carbonate rocks of the Middle Triassic and leptosols and vertic cambisols on the Upper Triassic marls.

Regosols, cambisols and stagnosols formed on the loam covered Pleistocene river terrace deposits of the Mosel. The characteristic soils of the insular areas covered by loess are luvisols and stagnosols.

Anthrosol on slate (Devonian)

Slate

Old and wrinkled

The Hunsrück slates are among the oldest rocks of the Rhenish Massif. They were formed around 400 million years ago at the bottom of the Devonian ocean. Thick layers of fine marine mud were later compacted to form clay- and siltstone. Mountain building processes severely deformed these rocks to produce slate. Soils formed on weathered slate consist of non-calcareous clay loam with a high proportion of stones. The thickness of the rooting zone over the bedrock and the stone content varies according to the relief position. The original thickness of the soil is very thin over the bedrock on the upper slopes and extremely steep locations. Winegrowers endeavour to compensate this by increasing the ploughing depth considerably. Precipitation percolates quickly through the profile but very little is retained. Important on steep locations: a plant cover reduces soil loss by erosion during strong rainfall events.

Slate soils produce fresh, spritzy and delicately fruity Riesling wines displaying aromas of peaches and apricots and in some cases, an exotic note of mango or passion fruit. A sense of minerality gives these delicate wines elegance and a long finish. Their ageing potential is exceptional.

Soil properties

- moderately deep to deep, sandy loam, very stony, very gravelly
- moderatly thick root zone, good root penetration
- adequate water storage capacity
- high permeability
- good aeration
- adequate nutrient supply
- acid soil pH
- good heat adsorption

Dolomite marl

Marine mud

Around 235 million years ago, during the Keuper, multi-coloured marls were deposited together with dolomite in the shallow depths of an ocean. The current landscape of the Uppper Mosel is characterised by light coloured dolomite rocks, which are revealed in the conspicuous sharp steps in the slope profile. Most of the vineyards are located on the less steep areas above and below these steps, which correspond to the underground presence of marls with dolomite banks. The clay loams consist of a mixture of marl and dolomite debris in a dense matrix of clay. Typically, these soils have a high carbonate and nutrient content. The clay impedes root penetration and therefore restricts permeability and aeration. Cultivating the soil improves these conditions. Clay soils can retain a lot of water, however a large proportion is bound so strongly at the so called “wilting point” that it is unavailable to the vines.

The main grape variety grown in the Upper Mosel is the Elbling. To a lesser extent Pinot blanc and Rivaner are grown. The wines of the marl soils are creamy with a balanced acidity and a restrained sense of soil. The aromas are somewhat reticent. These contrast with the powerful and full wines produced in vineyards where a layer of dolomite debris covers the marl.

Soil properties

- moderately deep, silty clay to silt loam, stony, gravelly
- restricted root penetration and root zone
- adequate water storage capacity
- adequate permeability
- restricted aeration
- high nutrient supply
- alkaline soil pH, very calcareous
- moderate heat adsorption

Anthrosol on dolomite marl (Keuper)

On the Calmont-Via Ferrata

Moselland – variety and enjoyment

The landscape of the Moselland is exhilerating: the river has carved a deep canyon with countless meanders and bends into the mountains of the Eifel and Hunsrück. Sheer rock faces of slate, limestone and light coloured or red sandstone flank the Mosel Valley until the river joins the Rhine at the Deutsche Eck in Koblenz. These rocks are an ideal store for heat in the sun-kissed landscape of one of the warmest regions in Germany. The results are first-class: the vines growing here produce world-famous wines.
Along the Mosel, the pleasure of drinking wine and the exciting river landscape are intrinsically linked together. This is a wine-growing region of superlatives with the steepest vineyard in Europe, the Calmont, and the oldest wine town in Germany – Neumagen-Dhron.

The Calmont-Via Ferrata between the wine towns Bremm und Ediger-Eller is an exciting adventure for those with the necessary fitness. Climbing over ladders, iron steps or narrow steps hewn into the bare rock, this trail takes you through the steepest parts of the vineyards. The reward for this strenuous exercise is a fantastic view of the Mosel Valley, across steep vineyards and the rugged landscape. Knowledge-seeking climbers will find information panels along the via ferrata presenting a wealth of knowledge about wine-growing, nature, culture and geology in connection with Europe's steepest vineyard.

Stone Age settlements show that life could be enjoyed along the Mosel a long time ago. The Romans founded the cities of Trier and Koblenz around 2000 years ago. Here they met Celtic tribes who quickly embraced the luxury and art of living of the Mediterranean invaders.

Travellers to the Mosel region can still admire the results today: no other region north of the Alps boasts so many well preserved ancient sites. The architects of the Middle Ages have left us with a wealth of splendid structures: uncountable castles and castle ruins and numerous old wine towns with winding streets and profusely decorated half-timbered buildings. Today, the larger towns are full of life, busy places melding century old history with modern lifestyle.
South European flair and long warm summers add to the appeal of the Mosel Valley. This warm climate not only pleases the people that have settled here. Nature flourishes and grape vines dominate the landscape. But other Mediterranean plants such as oleander, figs or palms can be seen growing in the yards of the wine estates. A unique paradise for orchids awaits you along the Upper Mosel. Rare animals such as the Apollo enjoy the ideal conditions of the abandoned steepest vineyards.

Mosel near Cochem with the Reichsburg

Enjoy the fresh air – cyclists, hikers, canoeists and fans of other outdoor activities, will find the Mosel a land of endless opportunities. Cycle routes, hiking trails or the Mosel water trail are perfectly organised for your action-packed holiday, which will leave you fit and let you forget the pace of everyday life.
We welcome you to an all-round feel-good package for athletes and walkers, for nature lovers and culture fans, for wine lovers and gourmets!

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Vineyard wall made of rhyolith – Rotenfels, Bad Münster am Stein

Nahe

Vineyards accompany the river Nahe and its tributaries Guldenbach, Gräfenbach, Glan and Alsenz between Martinstein and Bingen where it joins the Rhine.

The region touches three natural landscape units: the Hunsrück foothills (Soonwald) in the northwest, the Northern Upper Rhine Lowlands in the north and the Saar-Nahe hills (North Palatinate Hills) in the south. This division in natural landscape units broadly reflects the underlying geology. The north-western part of the wine-growing region consists of Devonian rocks. The remaining area is dominated by Lower Permian sedimentary and volcanic rocks. In the east these are often covered by Tertiary sediments.

The lowest vineyards are located in the lower Nahe Lowlands at an elevation of around 90 m above sea level. In the transition to the Soonwald and in the North Palatinate Hills wine is cultivated up to elevations of over 300 m above sea level. Only a few steep or very steep vineyard locations are found along the Nahe. Examples are the Rotenfels near Bad Münster am Stein or the Steinberg near Niederhausen. As a rule, wine is grown in level or gently sloping terrain. The average gradient of the slopes is 12.5 %.

The heights of the Soonwald, Hunsrück and North Palatinate Hills protect the region in the north, west and south. The region opens up towards the east into the Rheinhessen Hill Country and the Mainz Basin. This topographical situation determines the climate. The highest temperatures are achieved in the north and east.

The mean annual precipitation is 580 mm, of which 350 mm falls during the vegetation period. This low precipitation has a beneficial effect on grape health. The risk of an inadequate water supply for the vines is offset by the presence of deep, fine soils with good water holding capacities.

Climate

Annual mean temperature: 8.2 - 10.3 °C
Annual precipitation: 520 - 650 mm
Direct solar radiation: 665000 Wh/m²
Sunshine hours: 1500 - 1575 h

Vineyard area (2011)

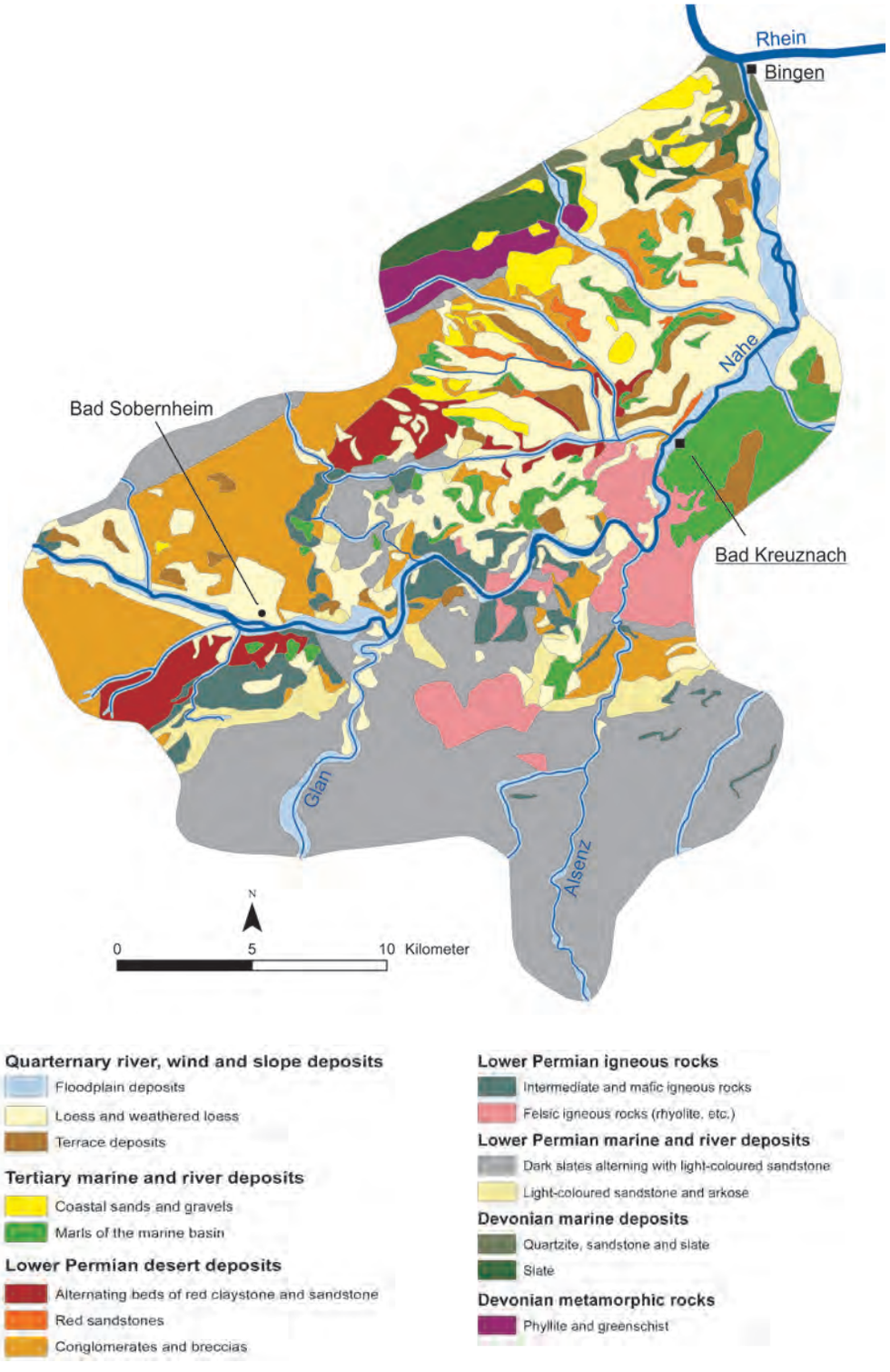
approx. 4150 ha, including:
1145 ha Riesling
547 ha Müller-Thurgau
446 ha Dornfelder
259 ha Pinot noir

Two qualities distinguish the Nahe wines: their notable acidity and their minerality. Because of these characteristics Nahe wines are slow to develop and possess excellent ageing potential. All varieties are capable of producing full-bodied wines with high must weights and moderate acidity.

The vineyards further upstream and in the valleys of the northern and southern tributaries are affected by cooler air from the surrounding low mountain ranges. The grapes ripen later and produce racy, fruity and somewhat slender wines.

Andesit dome – Schloßböckelheim

Red sand- and claystone determine the soil colour – Rüdesheimer Goldgrube



Lower Permian sandstone – Guldental

The oldest rocks of the Nahe wine-growing region date back to the Devonian. These consist of ancient, compacted marine sediments (sandstones, slate, quartzite) and metamorphic rocks (greenschist, phyllite). The most abundant rocks of the region are those of the Lower Permian. Most of these are sedimentary rocks such as mudrock, siltstone and sandstone, conglomerates and breccias. Other parts of the region are covered by Lower Permian volcanic rocks (rhyolite, latite, andesite and basalt). The vines growing east of Bad Kreuznach are rooted in Tertiary deposits – fluviatile sands, coastal sands and marine marls. The most recent deposits are those of the ice age: river terrace deposits and loess. The river terraces mostly consist of gravelly sands and loams, sometimes with a loess or weathered loess cover.

The present day soils have developed during the current warm period. The loess parent material has produced luvisols and phaeozems. Acid cambisols are usually found on the rocks of the Rhenish Massif. Some parts of the quartzite ridges are covered by podzols. The Lower Permian rocks, including the volcanic rocks, produced base nutrient enriched cambisols, except the rhyolite, where the typical soil is an acid cambisol.

Typical rocks and soils

24 % mostly calcareous soils on clay- or sandstone or conglomerate (L. Permian)
17 % calcareous loess and decalcified loess soils (Quarternary)
10 % non-calcareous gravelly sand soils (Quarternary river deposits)
8 % calcareous loam and clay soils on marls (Tertiary)
3 % non-calcareous sandy loam soils on volcanic rocks (Lower Permian)

Anthrosol on claystone (Lower Permian)

Clay-/Sandstone

Red Desert

The Lower Permian (Rotliegend) around 280 million years ago was a time of desert-like climate. The landscape was dotted with ponds and salt pans in which fine clay accumulated. Crusts of salt and calcium carbonate formed whenever the water evaporated.

Together, these layers formed the topmost layer of a mud deposit, which was later compacted to form red claystones and sandstones. These are known as the Sponheim Beds and characterize the vineyards of Rüdesheim, Sponheim and Weinsheim. Vertisols or vertic cambisols are the typical soils formed on the claystone parent material. Loams develop on siltstone. Both soils have a substantial calcium carbonate content and are intensely red. Today, this vivid red colour brings a southern European feel to the landscape. The soils are exceedingly dry but quite nutrient-rich.

The wines are full of extracts, elegant and complex. Their minerality is subdued, becoming more pronounced in aged wines. Rieslings are characterised by aromas of apple, peach and apricot. The acidity is upfront and pleasantly balanced. Sweet wines also display spicy, herbal aromas.

Soil properties

- shallow, clay loam over crumbly rock
- restricted root zone
- very low water storage capacity
- limited permeability
- restricted aeration
- excellent nutrient supply
- alkaline soil pH, calcareous
- moderate heat adsorption

Rhyolite

Impeded volkano

Rhyolite is a light-coloured silicate-rich magmatic rock, formed around 300 million years ago when magma ascended through the earth's crust. The magma became stuck just under the earth's surface where it cooled to form rhyolite. The overlying rocks were eroded away during the following millions of years.

Soils developed from rhyolite parent material are found in the vineyards of Altenbamberg, Bad Münster am Stein-Ebernburg, Hüffelsheim, Niederhausen, Norheim and Traisen. The mostly shallow, coarse sandy to stony soils are well-known for their unfavourable water conditions. Because of this, fine humus-rich soil material was added to these soils when the vineyard terraces were constructed on the steep locations. This material was mixed with the rhyolite soil to improve the vineyard soil nutrient and water supply.

The wines are light and lively with a notable acidity. They take some time to develop and age very well. Because of the low water storage capacity, dry years tend to yield grapes with restricted must weights and wines with low alcohol content and discreet aromas. In contrast when the water supply is ample, the Rieslings display aromas of tropical fruit.

Soil properties

- shallow to moderately deep, very stony, sandy loam over rock debries
- difficult root penetration, restricted root zone
- low water storage capacity
- high permeability
- good aeration
- moderate nutrient supply
- acid soil pH
- good heat adsorption

Anthrosol on rhyolite (Lower Permian)

The Luitpold bridge – Oberhausen an der Nahe

Naheland – Culinary highlights

Among experts, the Nahe is regarded as an insider tip and not just for the wine. For both, the connoisseur and the individualist, the Naheland has a reputation for being one of a kind, having a contradictory character while at the same time presenting a harmonious whole. Aficionados are especially attracted to the appealing contrasts in this region between the Bostal Lake in Saarland and the Rhine near Bingen.

One is well-acquainted to exclusivity in Naheland: the gemstone mines of the Steinkaulenberg in Idar-Oberstein are the only such mines open to the public in Europe and the fascinating exhibition at the German Gem Museum in Idar-Oberstein is unique world-wide. Looking further towards the Rhine, one will find the next superlative, the Rotenfels rock near Bad Münster am Steinebernburg. 1200 m long and 200 m high, this is the highest sheer rock face north of the Alps in Germany. Furthermore, the Salinental Bad Kreuznach is the largest open-air inhalatorium in Europe boasting graduation towers covering a total length of 1100 m.

There are also numerous smaller sights and special culinary delights waiting to be discovered. The Nahe Wine Road (Naheweinstrasse) is impossible to ignore. Over 100 signs along a distance of 130 km point the way to welcoming winegrowers in 35 winegrowing communities. A tourist map indicates the outstanding sights in this fascinating landscape: to stone witnesses of the past like the Gutenburg castle ruins and places of natural beauty such as the Rotenfels. An excursion along the Nahe Wine Road with one of the culture and wine ambassadors as a scout is an unforgettable experience. They are a fountain of fascinating knowledge about wine culture, art, music and literature and are always ready to provide tips.

Weinland-Nahe, the wine promoters of the Nahe region, have published a whole range of informative brochures. These include a list of winegrowers and seasonal wine taverns, an event calendar and a pocket guide "Nahe wine – a real treat" describing culinary discovery tours of the Nahe country. The pocket guide was produced by Weinland-Nahe and supported by the German Hotel association Rheinland-Palatinate and the regional alliance Soonwald-Nahe. The 21 "Distinguished Gastronomers" take the tag "a real treat" seriously: high quality, honest regional products, good service and last but not least an excellent Nahe wine menu. This is the basis for each one to create imaginative, original and tasty compositions.

A selected variety of regional top products are marketed under the trade name "Soo-Nahe". The label stands for an authentic product range, fosters transparency and confidence. The basic ingredients of the foodstuffs are produced and processed in the region. The products meet stringent quality requirements and are GMO-free.

Bridge houses – Bad Kreuznach

Each of these highlights is a real insider tip and a good reason for becoming interested in this rich cultural landscape in the southwest of Germany.

Tip: The brochure "WeinGenuss", the culinary wine magazine for the Naheland.

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Hills and tableland of Rheinhessen

Rheinhessen

Rheinhessen is the largest of the German wine-growing regions with over 26400 hectares under cultivation. More than 100 million vines grow here under quite different soil and climatic conditions.

The Rhine knee between the towns Worms, Mainz, Bingen and Alzey is a landscape of gentle hills and tablelands surrounded by the forests of the low mountain ranges. In the south this landscape meets the Rhine plain and the Pfalz (Palatinate) wine-growing region. The Rhine marks the boundary of the rolling landscape in the north and east. Essentially, this landscape was formed during the last ice age. Today it is characterised by the alternating open plateaus of resistant limestone and the wide valleys cut into the soft marl by rivers.

Rheinhessen is regarded as one of the islands of warmth and low precipitation in Germany. Framed by the North Palatinate Mountains, Hunsrück, Taunus and Odenwald, Rheinhessen enjoys the sheltered climate of the lowlands. The mountains form a barrier against the west winds and the moist air masses they bring. As the winds are forced upwards by the mountains, some of the moisture is lost as rain. As a result Rheinhessen is less cloudy, which in turn means longer sunshine hours and higher solar radiation and foehn-like temperature increases.

The favourable climate is modified by the local topography. The annual precipitation rises to 600 mm near the mountains along the outer edge of the region. Only 500 mm fall in the islands of low precipitation in the wind shadow of Hunsrück, Donnersberg or the Rhine-Hessian Plateau.

Climate

Annual mean temperature: 9.8 - 10.5 °C

Annual precipitation: 515 - 605 mm

Direct solar radiation: 650000 Wh/m²

Sunshine hours: 1500 - 1575 h

Vineyard area (2011)

approx. 26500 ha, including:

4366 ha Müller-Thurgau

3952 ha Riesling

3428 ha Dornfelder

2451 ha Silvaner

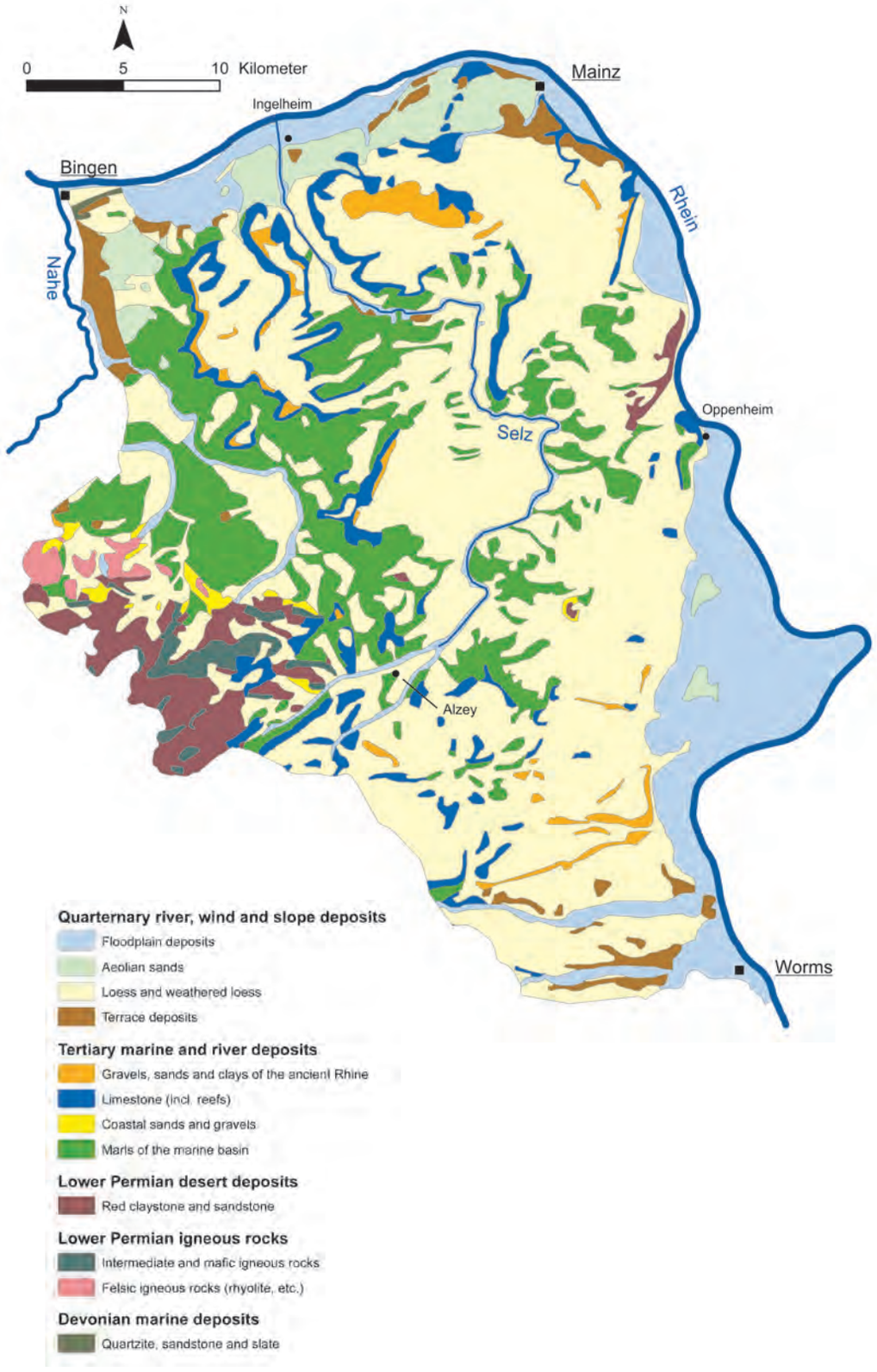
1387 ha Pinot noir

Wine is cultivated in Rheinhessen at elevations between 90 meters above sea level near the river lowlands and 250 m in the hills. The highest annual mean temperatures are found near the Upper Rhine Rift Valley.

Weinheimer Trift – Tertiary marine deposits

The slender, fruity white wines of Rheinhessen possess a fine, fresh acidity. About 1/3 of the vineyards is stocked with red wine varieties. The calcareous loess and marl soils permit the full expression of the Pinot aromas. A high lime content produces minerally wines with a high extract content – a good soil for producing red and white wines with excellent ageing potential.

Trullo – Traditional vineyard hut in Rheinhessen



Rheinhessen is located in the Mainz Basin, a northwest flank of the Upper Rhine Rift Valley. The area mostly consists of Tertiary and Quaternary sediments covering a Lower Permian base. These ancient rocks (Rotliegend) outcrop only in the far southwest of Rheinhessen and near Nierstein (Niersteiner Horst). The Rotliegend rocks are covered by Quaternary deposits (weathered loess, terrace and floodplain deposits, scree).

The morphology of the landscape is closely related to the underlying geology: the plateaus of Rheinhessen consist of Tertiary limestone, the slopes, hills and valleys are formed on tertiary marls. The plateaus are usually covered by loess, while the limestone and marl of the slopes lie underneath deposits of loess or scree. The marls in the valleys are buried beneath floodplain or terrace deposits or scree. The small outcrop of Devonian quartzites and slate at the Binger Rochusberg is a geological curiosity in this region. The most important parent material for soil development is loess or weathered loess.

Typical rocks and soils

- 42 % calcareous loess and decalcified loess soils (Quarternary)
- 27 % calcareous loam and clay soils on marl (Tertiary)
- 5 % calcareous loam soils on limestone (Tertiary)
- 3 % non-calcarous gravelly sand soils (Quarternary river deposits)
- 3 % mostly calcareous soils on clay- or sandstone or conglomerate (L. Permian)

Limestone with fossils

The resulting soils on loess are luvisols, phaeozems and chernozems. The Tertiary sediments have produced a wide range of different soils including fossil tropical soils such as cromic cambisols, cromic luvisols and rhodic cambisols (terra fusca and terra rossa).

Dust of the ice ages – Outcrop of loess

Anthrosol on loess (Pleistocene)

Loess

Ice age dust

Loess is a calcareous accumulation of wind-blown dust. It was formed in the gravel beds, end moraines and cold deserts during the ice age. Frost or changing temperatures weathered the rocks to a fine dust. Winds picked up this dust and deposited it again in sheltered areas.

Loess covers wide parts of Rheinhessen. Usually, the layers are only a few meters thick, but in some places loess accumulations can be up to 30 m thick. On the one hand, loess is capable of standing in steep banks, on the other it is very susceptible to erosion.

Loess is very fertile, has a deep root zone, is quick to warm and well aerated due to its loose structure. The deposit has a very large water retention capacity and a large nutrient supply. Vines thrive especially well on loess. In warmer regions, this leads to an early ripening of the grapes.

Loess wines are elegant and juicy, pleasant to taste, uncomplicated with a fine fruitiness. The acid appears rather subdued. These wines develop rather quickly and their ageing potential is limited.

Soil properties

- deep, light loam, silt loam
- excellent root penetration, very large root zone
- very large water storage capacity
- moderate permeability
- adequate aeration
- good nutrient supply
- alkaline soil pH, calcareous
- moderate heat adsorption
- high plant growth potential

Marl

Marine mud

During the Tertiary period, around 31 to 24 million years ago the Mainz Basin formed the floor of a subtropical shallow sea. The marls were deposited in this marine environment. These are very calcareous sediments, usually of unconsolidated clay and silt intercalated with sandy layers.

Soil formation with weathering and loss of carbonates already began in the Lower Tertiary. Erosion on the very steep slopes continuously removed the weathered marls. This process was aggravated by vinicultural practices, so that today the bare, almost unchanged marl has been exposed.

The soils are characterised by very high calcium carbonate contents and a large water storage capacity. The nutrient supply is good. Skilful soil management significantly reduces the risk of waterlogging during a cool wet spring. The favourable soil structure ensures adequate aeration.

The wines are strong, full-bodied, and expressive with a notable minerality, density and length. Riesling wines are juicy, supported by a balanced acidity. Red wines display dark fruit aromas with a smoky spiciness.

Soil properties

- deep, sandy loam to clay loam
- root penetration difficult in parts, large root zone
- large water storage capacity
- adequate permeability
- risk of waterlogging
- restricted aeration
- very high nutrient supply
- alkaline soil pH, very calcareous
- moderate heat adsorption

Anthrosol on marl (Tertiary)

Selztal-Terroir-Routes

Enjoy magnificent views and find out about the acclaimed "Terroir".

Wine tours on 5 circular routes over the hills of the sunlit wine landscape of the Middle Selz Valley.

The Selztal-Terroir-Routes are five easy one to two-hour walks through the cultivated and natural landscape of the vineyards and the lower areas of the Middle Selz Valley. You can expect an impressive introduction to the concept of the "Terroir", so highly acclaimed in wine circles. Information panels and eight walk-in soil profiles highlight the individual characteristics of each collective vineyard and its soil and give you a unique insight into the regional geology.
So-called "Wine Tables" have been installed near the soil profiles, perfect places for you to stop to enjoy a glass of wine and the spectacular view. The routes begin in the baroque wine towns Jugenheim, Stadecken, Elsheim and Essenheim.
A 3 km stretch of the Elsheim Route (STR 2), called the Adam-Elsheimer-trail, is dedicated to the presentation of selected works by the famous baroque artist Adam Elsheimer.
www.aei.stadecken-elsheim.de

Outlook Stadecker Warte

Selztal-Terroir-Route 1

7.8 km – Jugenheim

The Jugenheim Route takes you through an ocean of vines past many dry calcareous grassland sites, where orchids flower in the early summer. A magnificent panorama from the Selz valley to the far forested mountains of the Taunus awaits the walker along the edge of the Jugenheim Plateau. Along this route you will find a calcareous marl soil and a loess soil.

Selztal-Terroir-Route 2

6.4 km – Elsheim

Through the cool valley floor of the Selz this trail takes you to the "11000-Maids Mill", where it continues up a steep climb to a neo-classical vineyard hut. Now the route follows the Adam-Elsheimer-Weg along the edge of the plateau and past the Weidenborn spring. Through a dip in the landscape you will finally ascend the Hieberg to arrive at the hilltop lookout. Surrounded by the Elsheim vineyards you will be introduced to the incredibly detailed paintings of Adam Elsheimer. This route also highlights two soils: a cromic cambisol (terra fusca) and a sandy marl soil.

Selztal-Terroir-Route 3

7.8 km – Stadecken

This route passes the nature reserve "Woogwiesen/Bruchwiesen", over the Pfadberg hill south of Stadecken. The old cemetery and several carrs lie beside the path. The view from the south slope extends deep into

Rheinhessen. The west slope reveals a wonderful view of the highly structured Partenheim valley landscape. Last but not least the walker is invited to feel a clay marl soil and a soil developed from sparkling marine sands (calcareous sandstone soil).

Selztal-Terroir-Route 4 & 5

10.5 km – Essenheim

Essenheim is the starting point for two Terroir discovery routes. The 5.2 km long trail STR 4 begins southwest of Essenheim and passes through the collective vineyard Teufelspfad. The second route STR 5 is 3.1 km long and begins northeast of the town centre. Together, these routes invite the pleasure-walker to enjoy a panoramic tour with only small differences in altitude above the Selz valley and a detour through the old, typical orchards, down to a warm valley head and its well-sheltered vineyards.

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Information about the routes: www.selztal-terroir.de

View on Castle Hambach

Pfalz

The Palatinate (Ger.: Pfalz) is the second largest wine-growing region in Germany. The communities Wachenheim (northwest), Worms (northeast), Jockgrim (southeast) and Schweigen-Rechtenbach (southwest) lie along the fringes of this area. The 85 km long German Wine Route leads from Schweigen-Rechtenbach near the border to France to Bockenheim in the north of Palatinate. The natural landscape of the wine-growing region encompasses the edge of the Pfälzerwald Mountains in the west, to the Haardt Mountains and the Upper Rhine lowlands, which occupy the central and eastern areas. The lowlands are broken up into gentle low hills and plateaus as well as valleys. The fertile loess and floodplain soils of the land between the Haardt Mountains and Rhine are planted with vines as well as extensive orchards and vegetable fields.

The Haardt Mountains and the lowlands are part of the Upper Rhine Rift Valley, a tectonic zone oriented NNE-SSW.

The relief is diverse. The Pfälzerwald Mountains in the west attain heights of more than 600 m above sea level, whereas the deepest areas of the lowlands drop to around 95 m above sea level. The wine-growing areas of Palatinate are located between 100 and 300 m above sea level.

The Pfälzerwald Mountains effectively protect the region from Atlantic troughs and cold winds and ensure a dry and mild climate. The annual mean temperature is around 10.0 °C and 14.7 °C during the vegetation period. Temperatures rise from west (Haardt Mountains) to east (Rhine lowlands). The mean annual precipitation is about 665 mm of which 60 % (390 mm) falls during the vegetation period. Precipitation increases towards the south and the west near the Haardt Mountains.

Grapes are the dominant crop along the edge of the Haardt Mountains and the loess-covered low hills and plateaus of the lowland. Steep vineyards with gradients of up to 60 % are found in the west along the edge of the Pfälzerwald and Haardt Mountains. The vineyards on the low hills and plateaus of the lowland are mostly level. Most vineyards face southeast.

Climate

Annual mean temperature: 8.2 - 10.5 °C

Annual precipitation: 520 - 840 mm

Direct solar radiation: 665000 Wh/m^2

Sunshine hours: 1550 - 1650 h

Vineyard area (2011)

approx. 23500 ha, including:

5567 ha Riesling

3141 ha Dornfelder

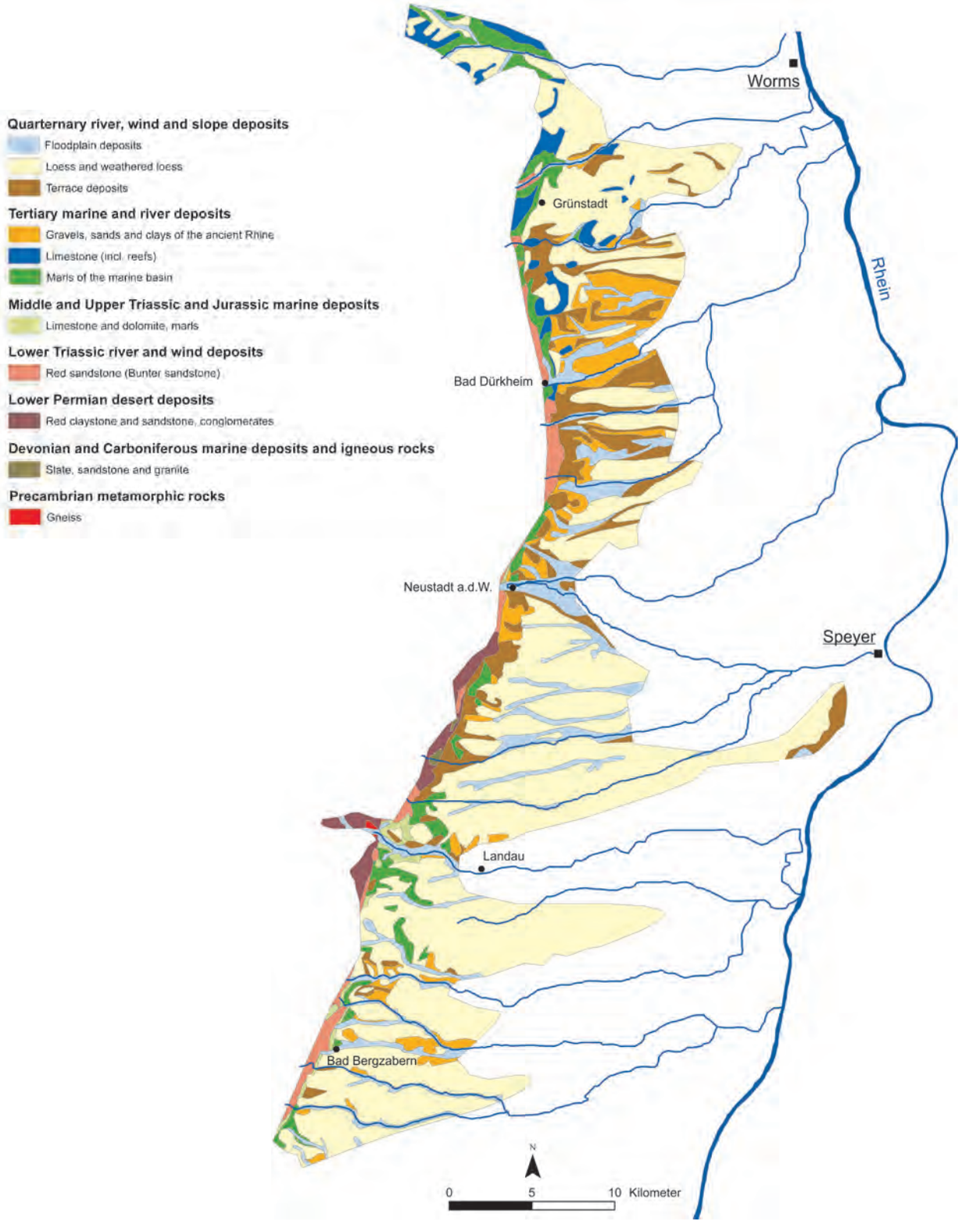
2231 ha Müller-Thurgau

1967 ha Portugieser

Limestone rock face along the edge of the Haardt Mountains

Nearly every sixth Riesling vine grows in the Palatinate region! This is the largest Riesling producing area in the world. Fertile loess, which covers about half the vineyard area, ensures good yields. The wines are big, displaying fruity aromas. The strong and full-bodied white and red wines have an excellent ageing potential.

View from the Kleine Kalmit towards the edge of the Haardt Mountains



The Pfälzerwald Mountains are characterised by clastic sedimentary rocks, mainly sandstone. Towards the east they meet the Haardt Mountains, the actual fault zone of the Upper Rhine Rift Valley. Only a few kilometers wide, the geology of this zone is very heterogenous. In addition to tertiary sediments one will find Mesozoic and Paleozoic rocks often blanketed by thick Quaternary deposits. The low hills and plateaus of the lowlands, which actually belong to the Upper Rhine Rift Valley are covered by ice age loess. The depressions here are covered by ice age river terrace sediments and Holocene sandy loam floodplain deposits.

Typical rocks and soils

48 % calcareous loess and decalcified loess soils (Quarternary)
11 % non-calcarous gravelly sand soils (Quarternary river deposits)
4 % calcareous loam soils on limestone (Tertiary)
3 % calcareous sandy loam soils on sands (Tertiary)
2 % calcareous loam and clay soils on marl (Tertiary)

Most grapes cultivated in the Palatinate wine-growing region are rooted in loess or weathered loess. But they have also been planted on the Quaternary silt, sand and gravel river deposits. The third most important parent rocks for vineyard soils in Palatinate are the Tertiary limestone and marls.

Red sandstone bed (Bunter sandstone)

By comparison, the vineyard area on Lower Permian and Lower Triassic sandstone is very small. Vines growing on Triassic and Jurassic dolomite, limestone or marl can rightly be regarded as exotic. Lastly, the vineyards on the isolated outcrops of Lower Permian and Tertiary volcanic rock and ancient Palaeozoic rocks are an absolute rarity.

Limestone (Tertiary)

Anthrosol on sandstone (Bunter sandstone)

Red Sandstone

Desert sands

The Pfälzerwald Mountains consist of sandstone, deposited 250 million years ago, during the low Triassic (Bunter sandstone), by rivers flowing through a desert landscape. Most "Buntsandstein vineyards" are located along the edge of the Haardt Mountains, where the Pfälzerwald Mountains meet this hilly landscape. Today, a great number of these steep terraced slopes lie abandoned. However, many winegrowers and wine-lovers have learned to appreciate the potential of these traditional steep sites. Here the soils contain a lot of gravel and cobbles with very little fine material. These gravelly, sandy soils are quite a challenge for the vine, being both dry and poor in nutrients. The stony subsoil is almost impossible for roots to penetrate and has a very low water storage capacity. Such disadvantages are redeemed by good aeration and capacity to absorb and store heat. This promotes the vine development and an early ripening of the grapes.

The steep slopes form an excellent basis for producing first-class wines. The Rieslings are fresh, with a slender body and notable fruity acidity. They present a range of aromas including lemon and grapefruit combined with a hint of minerality.

Soil properties

- moderately deep, sandy loam to loam, stony
- good root penetration, moderate root zone
- moderate water storage capacity
- high permeability
- good aeration
- adequate nutrient supply
- neutral to acid soil pH
- good heat adsorption

Limestone

The essence of aeons

This soil, a cromic cambisol (terra fusca), has developed from insoluble constituents of limestone. In the subtropical climate of the late Tertiary, these "contaminants" accumulated as clay and silt when the limestone dissolved.

The high proportion of clay determines the properties of this soil. It can store large amounts of water, but much of this is bound so tightly that the vines are not able to extract it. The high water content means that these soils are slow to warm in spring. The loess fraction, usually present in the topsoil, ensures a good nutrient supply and high lime contents. The rocky subsoil is difficult for roots to penetrate. However, older vines with an established root system can still obtain enough water and nutrients from the deeper layers even during dry phases. Careful soil management stabilizes the soil structure and reduces chlorosis susceptibility of the vines.

Terra fuscas produce opulent and rich Rieslings with a pronounced fruityness and gentle acidity. They can develop salty aromas or smokey notes. These wines are exciting and multilayered with an excellent ageing potential, but will require time to develop.

Soil properties

- moderately deep to deep, clay, stony
- restricted root penetration
- moderate water storage capacity
- restricted permeability
- restricted aeration
- good nutrient supply
- alkaline soil pH, calcareous
- moderate heat adsorption

Anthrosol on limestone (Tertiary)

Castle Villa Ludwigshöhe – Edenkoben

Palatinate wine experience

Hikers can discover the diversity of the soils in Palatinate along the "Palatinate Wine Trail". This 153 km long certified "Quality trail" begins in Neuleiningen with its imposing ruined castle and end at the German Wine Gate on the border to France. Again and again this diverse trail leads out of the Pfälzerwald Mountains into the vineyards where hikers can enjoy impressive views across the Rhine plains. The route passes through picturesque wine villages such as Deidesheim or St. Martin and towns like Bad Dürkheim, Neustadt, Annweiler or Bad Bergzabern. Literally every step taken on this trail means getting closely acquainted with the sandstone, the characteristic rock of the Palatinate. The sandstone is omnipresent, for example in the ruined castles Wachtenburg or Madenburg or the characteristic appearance of the towns.

The vineyards of the Palatinate are especially striking in early spring, when the opulent pink flowers of the almond trees burst into life as early as March. Autumn on the other hand, is not only the time for harvesting grapes, but sweet chestnuts are also ready to be collected.

Walking along the "Palatinate Wine Trail" also brings to life the Roman history of the Palatinate. Near Bad Dürkheim, the signposted route passes the Krimhildenstuhl, a Roman quarry. Not far off the trail near Forst lies an ancient volcano known as the Pechsteinkopf. The dark basalt led to the appellation Pechstein ("pitch stone"). If you want to explore such local curiosities, you can either walk along one of the wine trails on your own initiative (for example the "Wine and Stone" trail in St. Martin) or accompany one of the "Palatinate Cultural and Wine Ambassadors" on a guided tour of the region. Their program also includes terroir walks, often combined with a visit of a wine estate or an open-air wine tasting in the vineyard.

The hiking trail "German Wine Road" follows a course through the vineyards and the forested slopes where the Haardt Mountains meet the vineyards. This 100 kilometre long route is marked by a green bunch of grapes on a white background and begins in Bockenheim. Many famous vineyards and wine communities lie along the trail. There are innumerable places to stop and eat and the access to public transport is good. The "German Wine Road" ends in Schweigen at the German Wine gate, directly on the border to Alsace.

Cyclists can explore the landscape along the "German Wine Road" cycle route or sections of the "Kraut- und Rüben" trail. While the latter is mostly located in the plains east of the Wine Road, the cycle route "German Wine Road" repeatedly ascends to the higher vineyards. Cyclists can also take various detours from the main route to the Panorama Tour, where the arduous climb is rewarded by a fantastic view. The cycle route also ends with a view into the neighbouring Alsace at the German Wine Gate.

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