The Action Soil of the Year in Germany

Curator ship “Soil of the Year”
Speaker: Monika Frielinghaus

„There is no matter in nature that is more relevant
and more worthy to contemplate as soil”

This sentence was already formed in1862 by Frederic Albert Fallou and it has not lost its significance until today.

Why are soils in such a focus as they are?
Soils are valuable, because they provide the basis for food, because they are habitat for many animals, plants and microorganisms, they protect water resources and store and transform nutrients. Soil are buffering climate and they tell stories and hold treasuries. This incomplete list already shows that soils are multifunctional and not replaceable. They are a limited resource which has to be special considered to be protected. Because they are threatened in their multi-functionality by pollutants and chemical substances, climate change, sealing and erosion which are caused by any wrong or mal-adapted soil use. Any human activity uses soil in a direct or indirect way. Therefore, everybody is a “soil stakeholder” and has to take over responsibility. Unfortunately, only few people are aware of the relationship between food and soil, not to mention the multiple other functionalities, which are important for the humans and the environment. However, without the awareness how valuable soils are, soil conservation can not be successful. This insight, which means the understanding of soils and their problems, has to be build by education and knowledge transfer. Bada Dioum from Senegal formed the intelligent phrase:

“In the end we will conserve only what we love, we will love only what we understand and we will understand only what we are thought”

Start of the action
This was the background for members of the German Soil Science Society and the Federal Soil Association of Germany to initiate the action “Soil of the year” in 2004.
A curator ship had prepared a concept for the start and a well documented selection about the first submitted nomination - the Chernozem.
The next task was to initiate the preparation of material and the publication of flyers, posters and CD’s for documentation.
The curator ship organized the first presentation on the World Soil Day (05.XII.2004).

Soil of the year 2005 was the Chernozem („Schwarzerde“)

Submitted by M. Altermann, I. Merbach,
M. Körschens, J. Rinklebe,
UFZ Halle – Leipzig

Characteristics

How these thick black humus horizons were formed?

The enrichment with high-quality humus down to 80 cm leads to a large horizon with dark brown to black colour. Black soils (“Schwarzerden”, Chernozem) were developed under continental climate conditions with hot summers and cold winters based on aeolian sediments rich in calcium carbonate. Dry conditions at the lee side of highlands impeded the development of natural forests. Instead, an ample steppe vegetation was established by grass and herbs with insular groves. This vegetation cover produced large amounts of organic material. The plant cover shrivelled during the drought summer period. The dry summer conditions and the cold winter temperatures reduced the decomposition of the dead organic material due to a rapid increase of organic matter and to the accumulation of humus in soils. The soil fauna, mainly earthworms, hamsters and the European ground squirrel brought the organic material deep into the ground and jumbled the deep horizon. In the present time we can recognize the filled ancient pathways and burrows of the small animals, the so-called “Krotowinen” (see profile picture).

What is the functional relevance of these soils for humans and environment?

Black soils are very valuable arable soils. For example: such soil has the highest benchmark of 100 based on the German Soil Quality Ranking (Bodenschätzung) (Eickendorf, Magdeburger Boerde). This means that more than 10 tons per hectare of winter wheat can be produced. Additionally, these soils have extraordinary attributes for filtering, buffering and storage and a very high biological activity and biodiversity. Many archaeological places of discovery attest to the early settlement since the Younger Stone Age.

What are the risks for these soils?

Risks are mainly the increased sealing of these valuable soils. Moreover, their high silt content led to an increased risk for wind and water erosion.

Where these soils can be found in Germany?

In Germany, the loess landscapes Magdeburg and Hildesheim Boerde with black soils are well known. Additionally, they appear in the arable areas around Halle and Köthen/ Saxony-Anhalt and in the in the region of the Querfurt plate/Thuringia and the Thuringian basin. In other parts of Germany, black soils occur only sporadically, mostly in a modified relict form. The best described profile is the Chernozem in Bad Lauchstädt nearby Halle/ Saxony-Anhalt.
More information are available in the special Soil Museum Eickendorf/ Saxony-Anhalt

Soil of the year 2006 was the Albic Luvisol (“Fahlerde”)

The proposal was submitted by K. Billwitz, Greifswald, and P. Kühn, Tübingen

Characteristics

How these soils were formed and got their name?

Using an example of the soils occurring at Mecklenburg-Western Pomerania the history of their origin should be described. During the late Vistula Glacial period the advance of the glacier passed this area. About 11.000 years ago, the melting ice left behind the boulder clay, which formed the so-called „Velgaster Rückzugsstaffel“.

The development of the Albic Luvisol was initiated already at the end of the last glacial period. The boulder clay was mixed with wind borne sand to become boulder clay sand, with a present thickness of about 5 dm. The main driver for this mixing was cryoturbation through alternating thawing and freezing. At the same time carbonates were leached out. The decalcification depth has reached about 150 cm presently. The establishment of first pioneer plants created the first input and accumulation of organic matter in the top soil. After decalcification soil forming processes followed: clay formation, browning, depletion of bases, and clay movement. Warming climate promoted the expansion of beech-oak-forests and enhanced the soil forming processes.

Typical and eponymous for the Albic Luvisol is the brightened “pale/albic” horizon in the top soil caused by the leaching depletion of clay. Today, these soils under forest cover are strongly acidified. Therefore, clay movement has been stopped and mould is the primary humus form.

What is the functional relevance of these soils for humans and environment?

Today, Albic Luvisols are fertile soils with stable yield potential. They are mainly used for arable or forest land use. They are suitable for oilseed rape, winter barley and winter wheat and beet crops. Usually, the water holding capacity and drainage properties are well and the soils show a stable biodiversity.

The soils show some evidence for the different phases of the glacial period and human settlements with arable land use since about 4000 years.

What are the risks for these soils?

Sealing is the predominant risk for these soils, but they are also endangered by soil erosion, which are often caused by soil compaction and tracks.

Where these soils can be found?

Albic Luvisols can be widely found in Mecklenburg Western Pomerania, Schleswig-Holstein and Brandenburg and occur sporadically in Baden-Württemberg, Saxony-Anhalt and Hessen where they are sometimes developed on loess.

Soil of the year 2007 was the Podzol (“Podsol”)

Podzol with Calluna vulgaris in North Germany
The proposal was submitted by H. Sponagel, Hannover †, Foto: Pietrzok

Podzol in mountain region of South Germany
The proposal was submitted by D. Sauer and K. Stahr, Hohenheim, Foto Ehrmann

Characteristics

How do Podzols look like and how they got their name?

The name Podzol origins from Russia and can be translated as „ash coloured soil”. Under a raw humus layer and a thin humic horizon a bleached, violet to grey coloured horizon follows as the typical and eponymous horizon.. Humus and iron are leached out from this layer. In the underlying horizon they fall out and form the dark brown or red brown horizon. This horizon is often very concrete, so called “Ortstein”. A soil-specific form like a cone can be observed along root pods, often accompanied by black-brown or red-brown bands in the deeper soil layers.

How Podzols were formed?

Poszols are developed at sites with poor substrates (sandstone, granite, drifting sands, etc.), with sufficient precipitation, high humidity and a relative low average temperature.

The podzolization process is linked to a strong acidification. The litter of heath and coniferous forests are very resistant to microbial decay processes, which leads to thick organic cover layers. Organic acids were leached out from this litter layer, which make iron and aluminium from weathering minerals water soluble and transportable to deeper layers. There they fall out again under different chemical conditions. This created the typical horizon sequence of the podzol.

The historical reforestation of ancient natural oak-birch-forests with pine and the expansion of heath areas as a result of the sod cultivation by humans promoted the formation of podzols.

What is the functional relevance of these soils for humans and environment?

Podzols fulfil common soil functions for humans, plants and animals. They are natural habitats for undemanding plant species. Podzols often show a low water holding capacity with high drainage rates and high groundwater recharge. Therefore, they are important for the water balance of the landscape. Many drinking water catchments are Podzol areas. Podzols are also important as archives for nature and cultural history, because they provide relevant information on the development of landscapes, settlement structure and cultivation technique.

Using special cultivation techniques like breaking the concrete layer and expanded irrigation allow farmers to achieve relative good yields despite the poor properties. However, this is coupled with an immense risk for groundwater resources through leaching of nutrients and agro-chemicals.

In mountainous regions Podzols are mainly used by forestry. The suitability depends on the degree of acidification and the depth and density of the concrete layer.

What are the risks for these soils?

Podzols are mainly sandy soils. Under arable land use with incomplete soil cover during the year they are often endangered by wind erosion. Unfortunately, Podzols are widely cultivated by deep ploughing for arable land use in North-West Germany which disturbs basically their natural properties and functions.

Where these soils can be found?

Podzols are widely distributed in Germany ranging from the coast and the humid hilly regions to the Alps, even above the forest border at 2200 m.

On the dunes and drifting sand covers of the North-German lowlands (Emsland, Oldenburger geest, Lüneburger heath land, western Schleswig-Holstein, Brandenburg, Mecklenburg-Vorpommern) iron-humus podzols can be found under coniferous forests and scotch heather vegetation. On silicate rich glacio-fluviatile sands Iron Podzols were formed under coniferous forests. On wet sites with shallow groundwater level under bog-heather humus Podzols were developed. In the

mountainous regions Podzols were formed on granite and gneiss (Harz Mountains, Fichtel Mountains, Ore Mountains, Southern Black Forest, Bavarian Forest), on bunter (Northern Black Forest, Solling), on chalk-sandstone (Teutoburg Forest), on keuper sandstone (South-Germany) or on quartzite (Rhenish Slate Mountains).

Outside Germany, Podzols are widespread in Scandinavia and the sub-polar regions, where they are the dominant soils.

Soil of the year 2008 is the Cambisol/ Arenosol („Braunerde“)

Cambisol based on gneiss from the region Waldviertel/ Austria
Proposal: A. Pehamberger, Viena)
Foto H. Bauer

Cambisol based on granite from the region Bavarian forest/Germany
Proposal and foto:: H. Förster

Characteristics

What are Cambisols and how do they look like?

Cambisols have a humic A-horizon above a browned B-horizon and the parent material (C-horizon). They are formed on different hard and soft sediments, e.g. drifting sands, loess or basalt, granite, gneiss, sandstone or stone rich colluvial material. Their main characteristic is a visible brown horizon.

How Cambisols were formed?

Beside the humus top soil, the browning is the dominant process to form the characteristic profile in a moderate-humid climate. The weathering of iron containing minerals release iron oxides which are accumulated and give the characteristic brown colour. Weathering is also linked to the new formation of clay minerals. Under forest cover, the soils are often acidified and transition forms versus Podzols occur.

What is the functional relevance of these soils for humans and environment?

Depending on the different parent materials Cambisols can be rich or poor in their nutrient content. Cambisols fulfil relevant soil functions for humans, crops and animals. Due to their high stone content and their shallow rooting zone in the mountainous areas and their low base content in the northern lowlands they were mostly used as forest sites and serve as recreation areas.

Sandy Cambisols are also used for agriculture. In dry summers, they suffer from drought, but with sufficient precipitation and fertilization input they have the potential to produce moderate to high yields. Fertile deep Cambisols were associated with Para-brown earth on loess or marl material. They are rich in bases and nutrients and have a high water holding capacity due to their high silt content. In favourable climatic regions these soils provide very high yields, e.g. in the pre-Alps and the Pannonian basin in Austria.

What are the risks for these soils?

The filter and buffer characteristics of sandy and base-depleted Cambisols are relatively poor. That is why pollutants can be easily leached out to the groundwater. In pending regions the Cambisols are endangered by water erosion, while wind

erosion could be a problem on the wide open plains. Soil compaction caused by intensive tillage and management with heavy machinery affects negative crop growth and water balance.

Where these soils can be found?

Cambisols can be found in many different forms associated with other soil types. In the lowlands, Cambisols were associated with Podzols soils and Para-brown earth or Chernozems. In mountainous regions they were associated with by raw soils or Rendzina without a B-horizon. Often Cambisols are found in natural deciduous forests. They show podzolic characteristics under heath vegetation and coniferous forests.

Outside Europe, Cambisols are common in North-America and southern parts of Siberia, but can also be found in Australia and New-Zealand. Relict forms occur in the desert areas of North- and South-Africa and on the Indian sub-continent indicated on other climate condition in former time..

Soil of the year 2009 is the Calcareous Marsh („Kalkmarsch“)

Calcareous Marsh under natural waste land (l) and under oilseed rape (Foto: Filipinski)
Proposal for 2009: H.-P. Blume, R. Horn, M. Filipinski, H. Fleige, Kiel

Characteristics

What are Calcareous Marshes and how do they look like?

Calcareous Marshes are calcareous, tidal gleyic soils originated from marine sediments. Under a usually ploughed humus top soil with a porous crumbling structure a more or less rusty spotted horizon can be found in the range of the groundwater. The reduced constantly groundwater filled horizon below is characterized by its dark grey to black colour coming from iron sulphides. The subsoil is normally clearly stratified.

How Calcareous Marshes were formed and where they occur?

In regions of tidal coasts the land surface is regularly flooded with salty sea water. This leads little by little to the sedimentation of salty material containing nitrogen rich organic matter from dead organisms. Dyking is a widely used way to protect these areas from flooding and to reclaim land from the sea. Drainage by ridge and furrow, ditches and nowadays also drain tubes lead to the aeration of these soils and result in rusty coagulations. Salts are leached out from these marine sediments by percolating water and calcareous (carbonate content up to 9 %), mostly silt soils, the so called Calcareous Marshes are formed. The soils are a preferred habitat for earthworms (up to 500 per m^2), which build a porous crumbling structure and lead over the years to a mixing of sediment layers, just as tillage.

Acids originating from roots, micro-organisms and sulphur dynamics cause a leaching of calcareous material which proceeds from the top to the bottom of the profile. This leads to the development of the “Kleimarsh”.

Calcareous Marshes occur worldwide in tidal coastal zones of the sea and in estuaries, which were embanked during the last centuries. These areas are called polders.

How Calcareous Marshes are used and what is the functional relevance of these soils?

Calcareous Marshes are among the most productive sites worldwide. The organic matter content of the sediment with high nutrient resources, the slightly weathered minerals and a high water holding capacity make them very fertile. In combination with the possibility to regulate the groundwater level these soils are able to produce high yields, e.g. 10 tons of wheat or 4 tons of oilseed rape in Schleswig-Holstein in dry as well as in wet years.

In Dithmarschen in Southwest Schleswig-Holstein and in Lower Saxony the Calcareous Marshes are traditionally used for potatoes and cabbage production due to their valuable properties. Like other soils, Calcareous Marshes are archives for historical developments, which allows the analysis of ancient land use and climatic conditions.

What are the risks for these soils?

Calcareous Marshes require a careful regulation of the water balance by drainage and removal of surplus water through sluices into the recipient and the sea.

Especially those sites which are rich in silt and clay are vulnerable for pressure, which can lead to oxygen shortage due to soil compaction from heavy machinery. Silt marshes tend to be crusted if not used adequately. The high pH can lead to higher nitrogen losses through ammonia volatilisation.

Soil of the year 2010 are Urbic Anthrosols/ Technosols („Stadtböden“)

Foto: Mohsen Makki

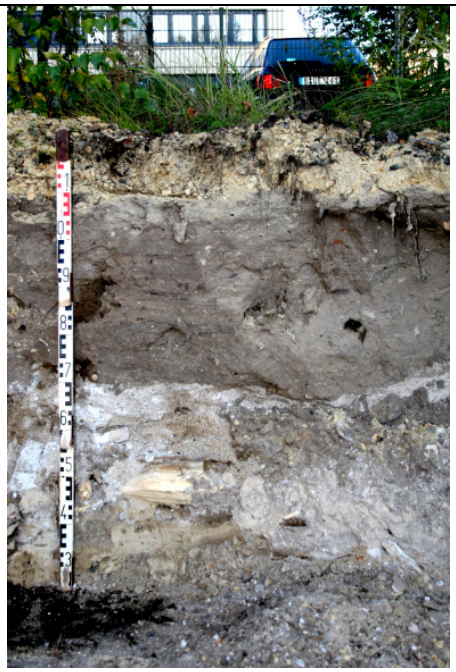


Foto: Mohsen Makki

Foto: Blume

Proposal: Curator ship Soil of the Year and Working Group: Urban Soils of the German Soil Society

Characteristics

What are Urbic Anthrosols?

As soils on agricultural and forestry land the urban Technosols are part of the thin crust and vulnerable skin of our earth. The name Technosols subsumes the various soils of urban industrial areas. The main element which contribute to the their genesis, like parent material, relief, climate, water balance and vegetation are strongly affected by human activities. This strong impact leads to distinct differences in their properties compared to soils of rural areas.

Urban soils have various functions

Urban soils have manifold functions which are often not evident at first glance.

Soil are mostly noticed by urban dwellers in parks, gardens and green areas. Here, soils are not only the basis of recreation but also habitat for plants and animals. Furthermore, they create together with the vegetation a well-tempered urban climate in winter and in summer. They form the green lung of the town which would not exist without soils!

The soils of the urban and suburban areas with partially extreme properties are often species-rich habitats Often they provide niches for rare plant and animal species.

Urban soils are the foundation of manifold buildings like houses, churches, shops, schools, theatres are many more. In between soils form the ground of roads, squares, sports fields, as well as for graveyards, railroad tracks and so on. Soils are crossed by a dense network of supply and disposal lines which assures our daily urban life.

Unsealed soils ensure that water can infiltrate and percolate. Therefore, soils contribute to the discharge of the public drainage system and to flood prevention. Their filtering properties provide retardation of chemicals which improves groundwater quality.

Together with their plant cover soils filter out harmful dust and aerosols and fix them into their matrix to provide a better air quality in the urban areas.

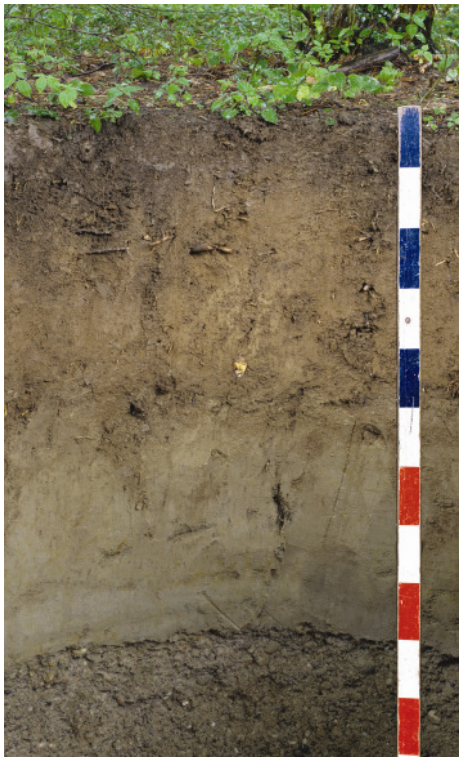
Urban soils are witnesses of history

Urban soils can tell fascinating stories. Ein Stadtboden kann spannende Geschichten erzählen. Every age of settlement leaves it´s own mark. For example urban soils can preserve more than thousand years of soil formation rubble or bear traces of middle-age town blasts. In many urban soils we can also found ruins from the two world wars and frequently bombs can be found.
Buried settlement structures, ancient waste and antique graves are witnesses of the past. They allow researchers and archaeologists to reconstruct the way of life of our ancestors.
Also trading, mining and industry leave their marks in soils. In times of uncontrolled waste disposal many soils were so heavily loaded that they lost their filtering and buffering capacity. Nowadays, these areas have to be remediated with high efforts and costs.

Problems of Urbic Anthrosols

A central problem of soil conservation in Germany ist he consumption of land. About 12 % of the soils are covered with buildings and pavements. This seals their surface and limits their functionality regarding water infiltration and storage as well as filtering of pollutants to a significant extent. Flora and fauna are loosing their habitat. Therefore, the aim of sustainability of our Government to reduce further land consumption until 2020 to only 30 ha per day should be implicitly accomplished. At the same time as much as possible sealed areas which no further use should be unsealed.

Soil of the Year 2011: Vega –Fluvic Cambisol or Fluvisol (“Brauner Auenboden”)



Autochthonous Vega close to Bietigheim near Rastatt;

Fotos::
Otto Ehrmann.
www.bildarchiv-boden.de

Proposal for 2011:
Fiedler, S.; Fleck, W.; Glomb, G.; Sauer, D.; Schneider, J.; Stahr, K.,

Allochthonous Vega near Mannheim

Characteristics

What are Vegen and what do they look like?

Vegen are brown, fertile soils within the flood plains of rivers; they are also named as brown alluvial soils. The name Vega originates from Iberia and means “floodplain” or “fertile plain”.
Characteristic properties: dark top soil rich in humus, grey-brown, fine-textured sub soil; the latter is layered and often contains organic matter as well. Below, gravel layers of earlier fluvial sedimentation or topsoils of former alluvial soils may occur. Vegen are flooded only sporadically and are not much influenced by groundwater in their upper part. Thus, they exhibit neither rust-coloured iron oxide accumulations nor grayish-bluish colours.

How Vegen develop and where do they occur?

Brown alluvial soils (Vegen) exist along large river systems world-wide. They also occur along small and middle-sized rivers, particularly in hilly landscapes in which translocation of soil material by water erosion takes place. Loess regions, which are prone to erosion, are the main sources of the soil material constituting the present Vegen. Due to forest clearance and subsequent agricultural land use – locally already since the Neolithic period – large amounts of soil material has been eroded.

Changing sedimentation environments and varying groundwater levels produced a small-scale spatial pattern of diverse soils on the alluvial plains. Besides Vegen, also groundwater-affected soils (Gleysols) and bogs occur with increasing groundwater influence. If the groundwater influence decreases and episodic flooding does not continue, Cambisols (Braunerden) and Luvisols (Parabraunerden) develop. Two types of Vegen are distinguished according to their development. The characteristic brown colour of the “allochthonous Vega” is derived from pre-weathered brown soil material comprised in the alluvial sediments. If the brown colour develops in place, the soil is named “autochthonous Vega”.

In which way are Vegen used and what functions do they fulfill?

The soil properties of Vegen vary according to the source area of the sediments, in which they have formed. A loose crumby top soil with rich active soil fauna is mostly followed by a well root able sub soil. Usually Vegen have a high capability for chemical sorption. Thus, nutrients are stored in a form in which they are well available for plant roots, and moreover pollutants are kept from being leached into the groundwater. Besides this purification effect in the course of groundwater renewal Vegen also contribute to flood prevention because of their high water storage capability. Because of the great natural fertility of the Vegen and their generally sufficient water supply they are preferably used for agricultural production.

Sediment layers of alluvial soils tell, similar to historical archives, about the landscape and its use. The influence of the industrial era and historic mining is locally recorded in alluvial soils by increased values of heavy metals or organic pollutants.

What habitat functions do Vegen full fill?

Under natural conditions a species-rich riparian forest comprising ash, elm, linden, British oak, hornbeam and a diverse herbal layer develops on Vegen. Alluvial soils are unique habitats for animals. For instance, earthworm population density is usually very high, and river bank break-off events create ideal hatchery sites for kingfishers.

Which dangers threaten alluvial soils?

Vegen are disproportionally highly affected by land consumption because of their location on flood plains, which are generally densely populated. In addition, embankment and draw down of the groundwater table in the frame of river training, gravel mining, water catchment and intensification of agriculture bring natural alluvial dynamics to an end and hence endanger the natural soil inventory in the eco system. Projects along all major rivers, such as the Integrated Rhine Program (IRP) try to reconcile the various users, flooding prevention and flood plain restoration.

More information and material (flyer, poster, CD’s)

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