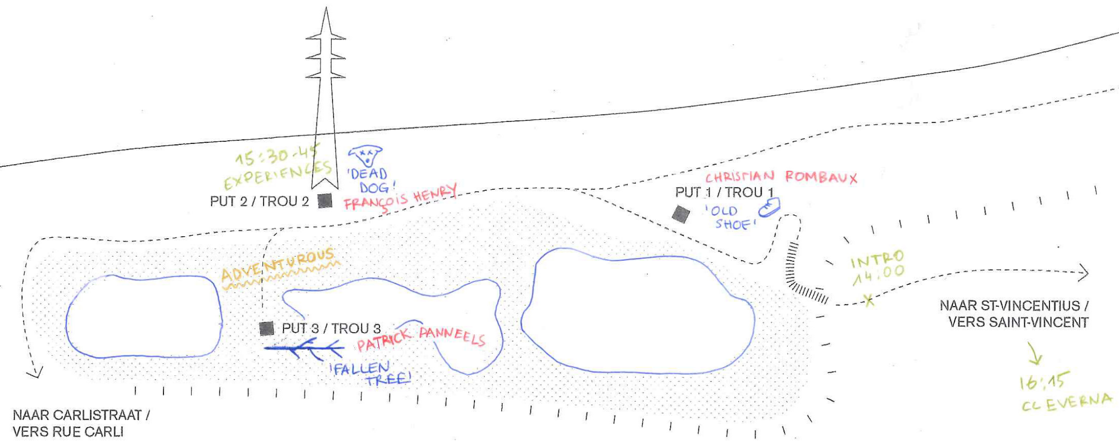
CHROMATOGRAMS

First findings in the Moeraske soils



PROGRAMMA / PROGRAMME

13:30: START
14:00: INTRO
14:30: BEZOEK EEN EERSTE PUT / VISITE D'UN PREMIER TROU
15:00: BEZOEK EEN TWEEDE PUT / VISITE D'UN DEUXIÈME TROU
15:30: SAMENKOMST @ PUT 2 / RÉUNION @ TROU 2
15:45: ERVARINGEN / EXPÉRIENCES
16:15: NAAR CC EVERNA / VERS CC EVERNA
17:15: DRINK + CONCLUSIES / DRINK + CONCLUSIONS

X COLLECTIEF MOMENT / MOMENT COLLECTIF

A (W)HOLE NEW WORLD
12/03/2022

WHICH HOLES?

On Saturday 26/02/2022, the CEBE guided us in the Moeraske and indicated the most suitable places to make holes during the first action of SUPER TERRAM. We identified three possible locations: the marsh, an old landfill (or «stoort» of St. Vincent, condemned in the 1960s), and a site at the foot of an electricity pole, where we could see the beginning of a hole. The owner of a dead pit bull had attempted to bury the corpse here, not foreseeing that a fox would come after to unbury it and retrieve it as prey.

The following Saturday, we were together with our ground expert, Patrick Paneels, to test the first holes and examine their interior. The first hole we made was the one at the foot of the landfill (HOLE 1). Broken bricks, stones of all sizes, and pieces of glass and reed roots became obstacles to digging with the spade. Funny objects such as a tin box reminiscent of the poison used for ants, a piece of an ashtray «pied de boeuf» (a brand of table beer with low alcohol content), and a shoe sole became all clues to the old landfill. A first humic horizon of 15-20 cm, presenting organic detritus (litter, roots), was followed by a horizon made of rubble around 40 cm thick (we did not manage to dig deeper than these 60 cm approximately), mixed with the roots of the reeds and characterized by a sand-loamy soil relatively dry.

The second hole (HOLE 2) was the one in the marshes. A first humic horizon of 30 cm, formed by organic detritus (roots), was followed by black soil, very clayey and fat (therefore, with abundant organic matter), and filled with water. Digging with the spade, releasing pressure in the lower layers, caused the water to emerge very quickly from the bottom, reaching the same level of the water of the neighbouring basin, which flows towards the Kerkebeek. The soil smelled slightly of decomposition, but in a pleasant way, between the smell of damp earth (the «petrichor») and humus (with a high content of CO_2). This hole was straightforward to dig, like butter.

The third hole (HOLE 3) was the dead dog one. A predominantly sand or sand-silt horizon followed a thin humic horizon of 10-15 cm. Digging was more problematic than the previous hole because of the soil compaction.

THE PROTOCOL

Chromatograms were developed for each hole. The adopted protocol is known as the Pfeiffer circular chromatography (PCC), first used by Ehrenfried E. Pfeiffer in 1953. The method was conceived to provide insights into the biological activity and health of soil and compost. However, not all chromatogram features show consistent responses in different soils, suggesting context-dependent processes. However, it is an inexpensive, unfussy option to assess soils.

In PCC, soils are mixed in a sodium hydroxide solution and absorbed by filter paper that has been treated with silver nitrate beforehand. The soil mixture is poured into a petri dish and is sucked through a wick inserted in the middle of the filter papers. The different elements of this soil mixture move through the paper at different speeds by capillarity, resulting in distinctive patterns.

The soil samples from the three holes of Moeraske were taken immediately below the humic horizon and placed in a plastic bag for transport. Then they were dried for 9 hours (3 hours per day) in a domestic oven at 55-60°C. Once completely dry, the samples were first sieved to remove the larger particles and then finely ground with a mortar. Then, 5 g of soil was placed in a container with 50 ml of 1% sodium hydroxide solution (1 g of NaOH in 100 ml of homemade water with inaccurate tools). The solution was then shaken at 5, 15, and 60 minutes intervals, and let it rest for another five hours. The solution of hole 1 was bubbling and released a layer of foam, while the solution of hole 3, similar in colour, did not present this foam. This effervescence can signal the presence of metals such as zinc (Z) or aluminium (Al), because sodium hydroxide releases gas as it reacts with zinc and aluminium.

Surprisingly, the soil of hole 3 was the one that lost the most volume after passing through the oven. This is due to its considerable water and organic matter content (which evaporates into the oven as CO2). In addition, this soil was the only one that, after drying, remained glued, forming a shiny plate. This shine indicates soil with more than 30% clay. The other two showed a rather loose texture. In the case of hole 2, the sieving resulted in sandy soil, with some black particles in between, indicating a content of <18% clay. As for hole 1, a black soil, with a mealy touch, revealing silt. The soils of holes 1 and 2 contained quite some coarse elements, whose size was bigger than 2 mm in diameter.

In the meantime, we impregnated the circular filter papers (cellulose paper)

HOLE 1

Soil samples dried and sieved

HOLE 2, originally a dog’s burial

The paper in the silver nitrate solution

HOLE 3

The soil solution penetrates the filter paper

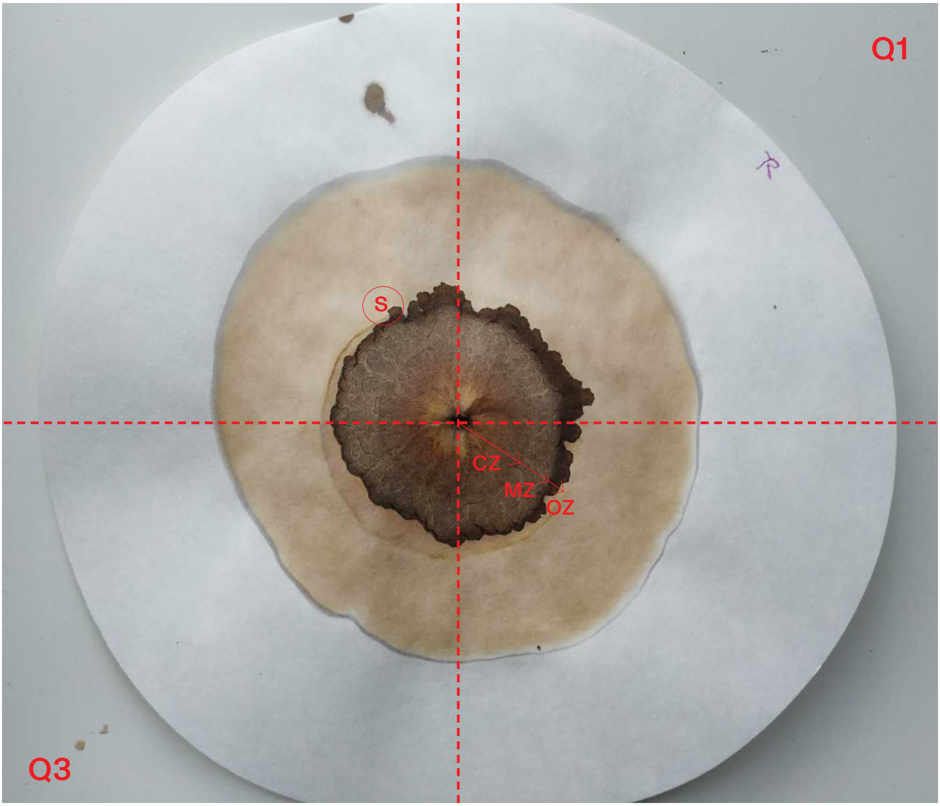
Testing the plasticity of the soil of HOLE 3

The series of HOLE 2 chromatograms

The chromatograms against the light

with a 0.5% silver nitrate solution (0.5 g of $AgNO_3$ in 100 ml of distilled water). Holding only the edges of the paper, we first perforated a small hole in the centre of the paper. Then we inserted a wick 1.5 cm long, made by rolling a piece of filter paper and placed it in a small petri dish (or on the lid of a jam jar) filled with the silver nitrate solution until it covered the filter paper over a radius of 4-6 cm. These filter papers were kept in a box for 6 hours, until dried, and separated by absorbent paper.
Subsequently, we repeated the same operation by placing the circular filter paper, infused with silver nitrate, with the wick in the petri dish, this time in contact with the soil solution. A priori, we kept the wick together with the filter paper and reused it with the soil solution. However, tests with soil samples from hole 2 proved this problematic: the high mineral content circulated very slowly through the paper and the wick, still saturated with the silver nitrate from the first impregnation, hindered the spread of the soil solution. Therefore, we redid the test for this hole with newly made wicks in the smaller circular papers. Even though the patterns obtained are very similar, the absorption process went much faster.
We waited until the soil solution had >p.12

HOLE 1

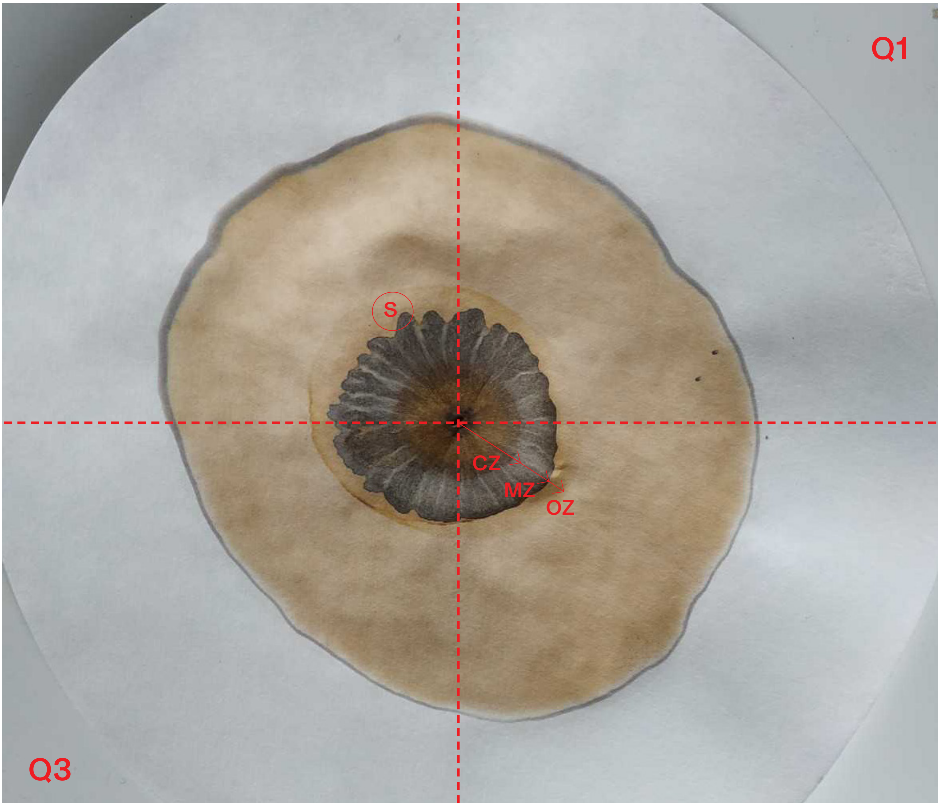


Q1 = quadrant
CZ = central zone
MZ = middle zone
OZ = outer zone
S = spikes or teeth

The overall picture is cloudy in the centre, with spikes on the ends. The concentric rings in this area indicate the presence of soluble minerals (Ca, K, Na, Mg, P). Some of these minerals can come from construction waste thrown into the old landfill (during visual observation, we encountered traces such as shoes, bottles, bricks, pieces of leather, stones, etc.). In these landfill soils, other heavy metals, such as zinc or aluminum, could explain the superficial effervescence once the soil was mixed with the sodium hydroxide solution.
The MZ, following a concentric pattern, indicates the presence of organic carbon and organic matter. Since the brown colour evolves throughout the area continuously, the organic matter is integrated with minerals and available to plants.
The clouds at the boundary also indicate the presence of nutrients and humus. The cooler colour suggests a soil with limited microbial activity or more precisely, disturbed by the existence of lignin (present in the roots of reeds), making it difficult for microorganisms to decompose organic material.

The pH of the soil = 9 (a soil has a basic tendency, explainable by the presence of bricks and limestone integrating the landfill)

HOLE 2



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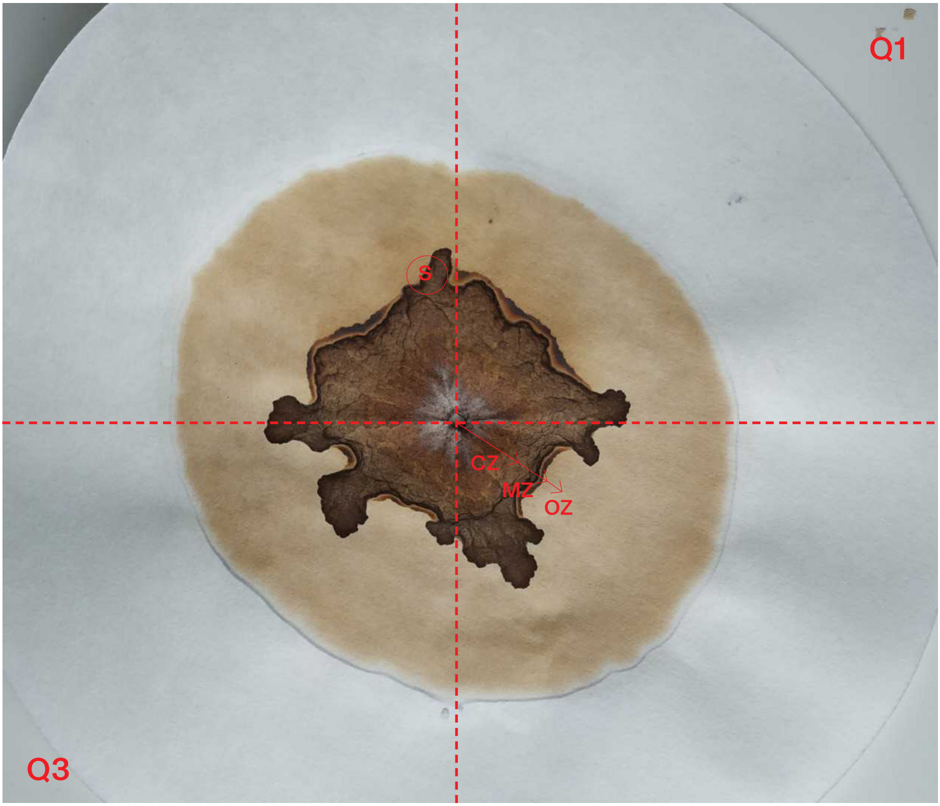
The centre of the chromatogram is dark, indicating a soil with low oxygenation, characteristic of compacted soils. The purple radials indicate increasing mineralization and limited organic substance, confirmed by the fact that the OZ is not darker than the rest. These radials extending from the centre to the periphery confirm an integrated biological and mineral activity. The warm, yellowish colour of the CZ, 3 cm radius, very close to the colour of the samples' sand, identifies the soil's mineral content and fungal activity.
On the one hand, the fact that this chromatogram took longer to make reveals a high mineral content: minerals prevent other substances from moving through the paper, especially lighter organic materials. In addition, the warm colour on CZ can indicate good microbial activity (by bacteria and fungi operating in anaerobic environments). The «clouds» at the end of the teeth or spikes on OZ indicate the availability of nutrients. The brown coloration on MZ is disconnected from the more inner, yellowish mineral area, meaning that the organic matter present in the soil is immobilized, hardly integrated with minerals, and little available to plants.

Soil pH = 7 (balanced soil, neither acidic nor basic)

HOLE 3



Q1 = quadrant
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Although the colours resemble those of the first chromatogram, their gradation is reversed: if in hole 1 the colours evolve from light yellow to dark brown, passing through light brown, in hole 3 the yellow and light brown are arranged radially and intermingled on MZ, starting from an area with white coloration. These integrated rings and the fact that the colours are continuously changing indicate that the minerals are in equilibrium and present in the form of humus-clay complexes. But the dark colour could mean a soil poorer in terms of its content of inorganic nutrients such as potassium (K), magnesium (Mg), calcium (Ca), and phosphorus (P) but rich in organic nutrients (carbon).
On-site observation showed a very fat, clayey soil, smelling slightly of decaying organic matter. Normally, these clay particles serve as a reservoir for nutrients. In addition, in soils with a high presence of soluble nitrogen, the centre of the chromatogram takes on this white coloration.
Also, the shape of the spikes on OZ is very pronounced, bifurcating and multiplying at the same time as these spikes move away from the centre. These spikes tell us about the humus in the soil, as well as possible bacterial enzyme activity. The bacteria are responsible for releasing nitrogen (N) and carbon (C) into the soil in the form of nutrients.

Soil pH = 7 (balanced soil, neither acidic nor basic)

<p. 5 spread over 4 cm on these filter papers and exposed them directly to the sun (it was already 6 pm, just before sunset). Usually, these papers are left to dry overnight before exposing them to light. Also, they usually stay 7 to 10 days exposed to the light for the silver nitrate to develop the pictogram, but we only had two and a half days left.
This pictogram of what happens in the soil, called a chromatogram, varies in shape, colour and pattern depending on the quality of the soil. The circular image typically displays three distinct areas (inner, middle, and outer regions). The inner region or CZ reflects the mineral content. The middle region or MZ, the presence of organic carbon and organic matter. And the outer region or OZ, the humus content. A priori, the formation of separate areas with few irregularities or «interactions» reveals lower-quality soils, while more complex, convoluted drawings are supposed to indicate better-quality soils.
The difference between organic matter and humus is their degree of stability. Humus is unstable, easily changing shape and mass as microorganisms decompose it. In contrast, organic matter is stable in the soil, since it was broken down until it withstood further decomposition. Usually, only about 5% of it mineralizes each year, releasing nutrients. This rate, though, increases if temperature, oxygen, and humidity conditions become favourable for decomposition. For example, when the amount of oxygen is reduced (as in hole 3, where all pores are filled with water), the rate of biological activity slows down. In addition, lignin, a structural carbon compound that strengthens plant cell walls (found in oak and pine leaves and in reed roots), is difficult for microorganisms to break down, reducing the release of nutrients during decomposition. Finally, the soil's acidity impacts the decomposition process too: the higher the acidity (= lower pH), the more difficult life becomes for some bacteria or fungi using the litter as a food source and transforming it into nutrients.
The acidity of the soil was tested during our first action on site, on 12/03/2022, called «A (W)Hole New World.»

Nadia Casabella