

Method of Soil Monolith Preparation



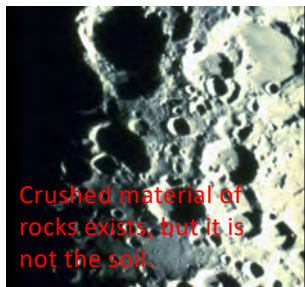
Loess deposit in Hamburg

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What is soil ?



Does soil exist on the surface of
Mars or moon ?



Crushed material of
rocks exists, but it is
not the soil.

Regolith

What is soil ?

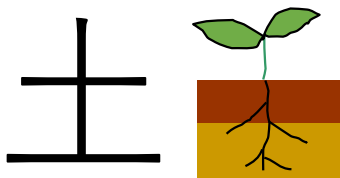
Soil is not merely the powder of rocks.

Is it because there is no air or water in
the moon ?

Soil is not only the mixture of rock,
water and air.

Soil always exists with life.

According to the Chinese classical
old dictionary, “Shu-rei”, soil is:



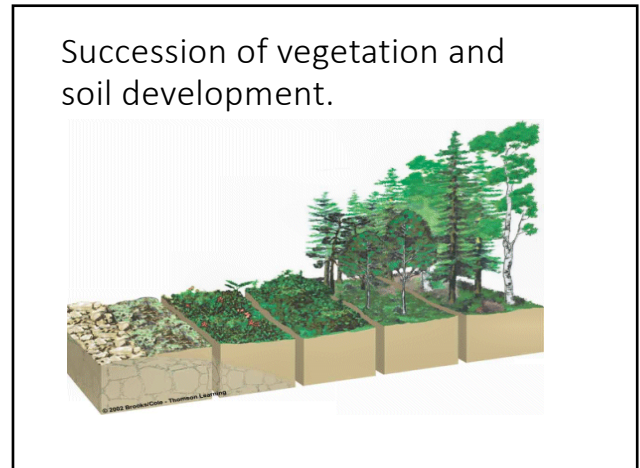
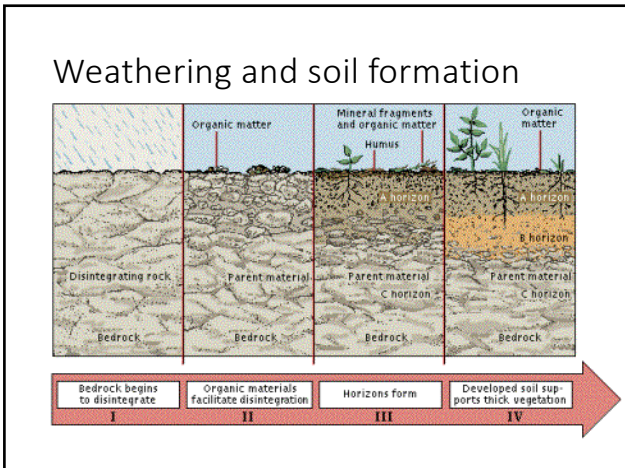
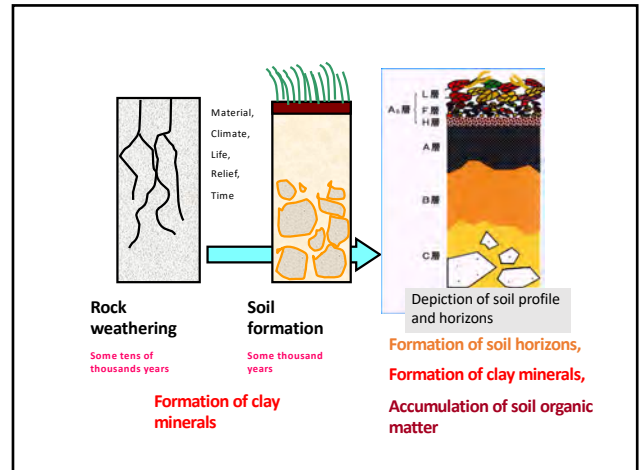
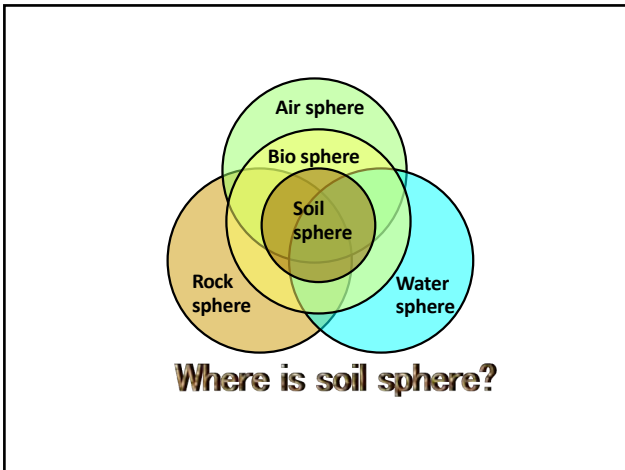
Soil is where all creatures emerges.

Another Chinese character for the
soil is:

壤

「壤」 is where
human cultivates
crops.





- ### Various ways of soil formation:
- Rock weathering.
 - Deposit of mud and soil transported by river.
 - Accumulation of volcanic ash and pumice.
 - Formation of new land by regression of the sea.
 - Formation of peat land by the accumulation of aquatic plant debris.

- ### What is soil (1)?
- Soil is a natural product.
 - On the surface of earth, minerals, water, air and living things interact physically, chemically, and biologically, reflecting the environments of the site, it is how the soil is developed.
 - Soil is one of the bases for the activities all lives on the terrestrial earth.

Soil is a product of natural environment.

- Geology
- Relief
- Quantity and quality of water
- Climate and meteorological conditions
- Vegetation
- Soil microbes, soil animals, hetero-trophic biota
- Time

Definition (interim) of soil by the Japanese Society of Soil Science and Plant Nutrition

- Soil exists on the terrestrial surface of earth or under the shallow water.
- It is naturally composed of organic and inorganic materials, under the interaction of rock weathering, transportation and accumulation by water and wind, as well as living things.
- They support the lives of plants and animals, have functions of holding and recycling materials, and change themselves influenced by the surrounding environments.

What is soil (2)?

- Soil is an artificial product. It is one of the basis for agriculture.
- Human can work on the soil, and change the properties of soil so that he can get the desired products from the soil.

For human beings, soil is also an artificial product.

- Depending on how mankind treat it, soil may deteriorate.
- The reasons for it are the bias in the purpose of mankind and the absence of long perspective on the future.
- Humankind can not create soil. He can just modify it.

Soil is controlled by the man-made environment.

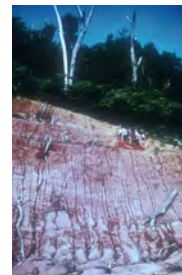
- Development of agricultural land, irrigation and drainage.
- Cultivation of crops.
- Plowing (man power, animal power, machine power)
- Organic matter application
- Fertilizer application
- Weed and pest management
- Soil pollution (fertilizer, pesticide, radioactivity)
- Ranking of agriculture in the policy and in the society.

Soils are diverse.

- Soils are different all over in the world.
- They reflect different climates, vegetation, and human activities.



Chernozem
Germany



Ferralsol
Malaysia



Peat soil (Histosol)
Ireland

Soil changes with time.

- Accumulation of new parent materials (volcanic ash, aeolian dust, Tsunami deposit, flooding of rivers, peat land)
- Growth of vegetation and progress of weathering.
- Loss of soils by erosion.
- Climate change (affects to the kinds of vegetation and the rate of weathering.)
- Change in terrestrial land due to progression and regression of ocean.
- Soil profile preserves the history of land.

Soil is extremely vulnerable.

- Thickness of the soils in the world in average is only 18 cm.
- As the radius of the earth is 6371 km, thickness of the soil is 0.0000000283 times of it.
- If the earth is compared to a ball with 1 m radius, thickness of the soil is only 0.0283 μm .
- Some thousands of years were necessary to develop such thin soil.
- Recovery is very difficult if the soil is once lost.

Functions of soil (FAO)

- Soils deliver ecosystem services that enable life on Earth.

Soil functions (1)

- Provision of food, fiber and fuel.
- Carbon sequestration (stabilization).
- Water purification and soil contaminant reduction.
- Climate regulation.
- Nutrient cycling.
- Habitat for organisms.

Soil functions (2)

- Flood regulation.
- Source of pharmaceuticals and genetic resources.
- Foundation for human infrastructure.
- Provision of construction materials.
- Cultural heritage.

Soil functions (3)

- Supply nutrients to plants, animals and human.
- Place where plant root elongate.
- Decomposition of organic matter (Completion of cycling).
- Keep moisture.
- Adsorption of harmful substances.
- Amenity (good feeling in human life).
- Burial and preservation of natural and archaeological record.

Making light of soil

- Soil is taught little in the compulsory education in Japan.
- Soil education is not described in the governmental guideline for elementary and middle school education.
- Soil education is entrusted to each teacher. However, without guideline it is difficult. Time is also not inadequate in the curriculum.

Why ?

- Though soil is universal, it differs in every place.
- Soil is composed of various elemental factors.
- Soil is so complicated that it is difficult to design uniform education methods or investigation method.
- Functions of soils are considered to be replaceable by other measures.

Significance of the specimen of soil profile

- Diversity of soil can be shown.
- Situation below the ground can be visualized, and the history of the soil development can be shown.
- Natural calamities and human activities in the past are recorded in the soil profile.
- A good measure for soil education.

Soil exhibition in the National Science Museum in Tokyo

Typical brown forest soil. Fudoh-ji, Ohtsu, Shiga prefecture.
Warm temperate region



From the Web site of NSM.

Soil exhibition in the National Science Museum in Tokyo

Typical allophanic Kuroboku soil (Ando soil). Memuro town, Hokkaido
Sub-boreal region



From the Web site of NSM.

Exhibition in the Hokkaido Museum

Specimen showing the repeated Tsunami deposition in the past.

Urahoro town, Hokkaido



Urahoro Museum

Specimen showing the repeated Tsunami deposition in the past.

Toyokita, Urahoro town, Hokkaido



Churui Nauman Museum

Soil profile at the excavation site of Nauman elephant

Bansei, Talki town, Hokkaido



Centennial Museum of Obihiro

Various soils in Tokachi plain

Tokachi, Hokkaido



Nemuro Museum of nature and history

Soil profile recording Tsunami deposits

Nanbu-numa, Nemuro



Akkeshi Water bird Observatory

Peat soil profile in Bekanbeushi wetland

Itoizawa, Akkeshi town, Hokkaido



Kushiro Museum

Shell mound by ancient Jomon people in Higashi Kushiro

Kushiro, Hokkaido



National Institute for Agro-Environmental Science, Tsukuba



National Institute for Agro-Environmental Science, Tsukuba



Giant soil monolith at the National Institute for Agro-Environmental Science, Tsukuba



Soil Science lab., Tohoku University
Soil profiles showing the past Tsunami deposits

十和田a火山灰(AD915)の下に貞観地震(AD869)の厚い津波堆積物が確認された。



Tsutsuki laboratory before retirement at Obihiro University of Agriculture and Veterinary Medicine



Tsutsuki laboratory before retirement at Obihiro University of Agriculture and Veterinary Medicine



Tsutsuki laboratory before retirement at Obihiro University of Agriculture and Veterinary Medicine



別科圃場 (左2つ) と精密圃場 (右)

Tsutsuki laboratory before retirement at Obihiro University of Agriculture and Veterinary Medicine



Briefing on the specimens of soil profiles

- Specimens hung on the wall of corridor were made by lack film method from the soils in Obihiro University of Agriculture and Veterinary Medicine.
- These 1 m thick soil layers have been accumulated in the past ca. 20,000 years.
- At the bottom of soil profiles, there is a gravel layer transported by the river flow.
- It is overlain by various volcanic ash layers and loess layers transported from continents.
- The top 30 – 40 cm part is the soil plowed for agriculture by human.

Briefing on the specimens of soil profiles (continued).

- There is a word, "Soil is living".
- Soil is the source of all the lives including plants and animals. Even in a clod of soil, countless (billions) numbers of microbes are living.
- Soil itself was born from rocks and then developed to fertile soil breeding the lives.
- With time, with the change in climates, and if human treat it too harshly, it will die like a desert soil.
- Such cases can be seen in various places in the world.
- We should wish that it will not occur in our place.

House of Soil (Tsuchi no Yakata)



Giant soil monolith taken in Hayakita town, Hokkaido.
Four different volcanic ash layers from Mt. Tarumae are

House of Soil in Kami-furano town.



Mud flow after the eruption of Mt. Tokachi (1926)

House of Soil in Kami-furano town.



Explanation on agricultural engineering such as under drainage are given in detail.

World Soil Museum
(Wageningen, Holland)



World Soil Museum
(Wageningen, Holland)



World Soil Museum
(Wageningen, Holland)



World Soil Museum
(Wageningen, Holland)



World Soil Museum
(Wageningen, Holland)



Method of Soil Monolith Preparation

As actually carried out by K. Tsutsuki in OUAVM.

Dig soil profile.



Preparation of soil profile, observation and description.



Used materials: Tomac NS-10, mesh cloth, brush, disposable plastic beaker, disposable rubber globe, face mask, purchased from Sankou Company, Japan.



Applying NS-10 resin, and pasting the mesh cloth.



Peeling off the soil specimen, drying, and removing the extra soil.



Surface treatment with water soluble transparent varnish.



Other material such as diluted "Bond" glue or "Paraloid" can be used for the surface treatment. However, I prefer the water soluble transparent varnish from "Washin paint" company.

Trimming the specimen.



Cutting the plywood board and wood frame.



Applying "Bond" glue on the plywood and pasting the soil monolith specimen.



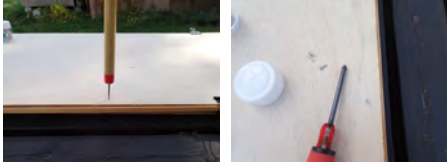
Fixing the soil monolith on the plywood.



Wood frames are attached and fixed.



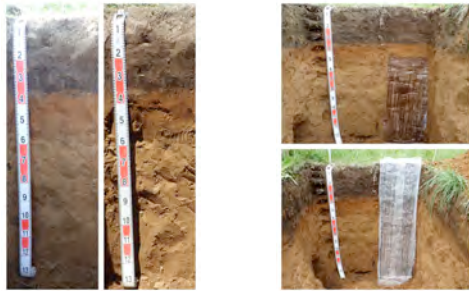
Plywood and frames were fixed with wood screws.



Completed soil monolith.



Soil monolith prepared in 2018 (1)



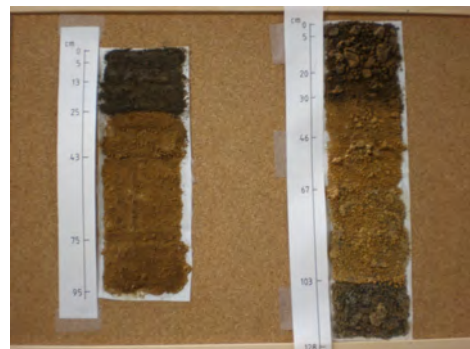
Soil monolith prepared in 2018 (2)



Preparation of mini soil monolith (1)



Preparation of mini soil monolith (2)



Preparation of mini soil monolith (2)

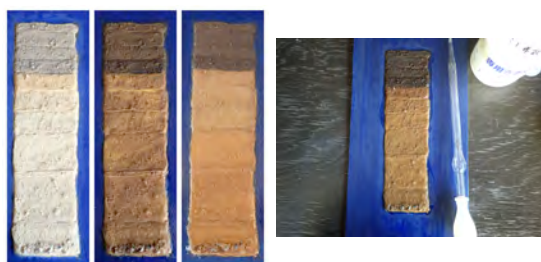


"Bond" glue is applied on section paper, plywood, or cork board layer by layer. Soil samples are placed on glue carefully. After one layer is dried, the next layer is applied. After all layers were applied and dried, the surface is coated with water soluble transparent varnish to represent the wet color.

Preparation of mini soil monolith in 2018



Preparation of mini soil monolith in 2018



Completed mini soil monolith in 2018



Lack film method for soil monolith preparation as carried out by K. Tsutsuki

- 1) Dig soil pit of width 1 m, depth 1-1.5 m, length 2 m with steps. Surface of soil profile is made flat.
- 2) Tomac NS-10 is applied on the surface of profile using a brush.
- 3) Meshed cloth is attached on the surface and fixed with bamboo sticks. Tomac NS-10 is applied further on the cloth.
- 4) Leave the soil profile for more than one day.
- 5) Hardened thin film specimen of the soil profile is peeled off from the soil pit using knife, spade and scissors.
- 6) Transport the thin film to safe place suitable for further works.

Lack film method for soil monolith preparation as carried out by K. Tsutsuki

- 7) Extra soil and stones are removed by brush. It can also be done washing with water without problem.
- 8) Water soluble transparent varnish is diluted two times with the special solvent and applied on the soil surface with a brush.
- 9) Repeat the varnish treatment confirming all surface has been treated.
- 10) Dry the varnish by leaving the specimen for one night.
- 11) Plywood board is cut into the size of width 45cm and length 180 cm.
- 12) Wood frames are made by cutting the lumbers with width 3 cm, thickness 5 mm, and length 180 cm.
- 13) Both sides and base of the soil monolith are cut in size to fix it on the plywood with frames. Width of the specimen will be 38 - 39 cm considering the width of the frame.

Lack film method for soil monolith preparation as carried out by K. Tsutsuki

- 14) Plywood is cut to the size of +8 cm longer than the length of the soil monolith.
- 15) "Bond CH-18" is applied on the plywood.
- 16) Lumbers for frames are attached on the peripherals of the plywood. Then the soil monolith is placed within the space surrounded by the frames.
- 17) Many rag cloths are placed on the soil monolith. Another plywood is placed on them, and heavy things such as buckets filled with water are placed on the plywood to help fix the soil monolith.
- 18) Frames and plywood are fixed with double clips.
- 19) Leave 3 days until the glue is dried.
- 20) Frames and plywood are fixed with wood screws from the back side.
- 21) After completed, it is displayed in a proper place.

Reference literatures

- Walter Hähnel, Hamburg. Die Lackfilmmethode zur Konservierung geologischer Objekte. Der Präparator - Zeitschrift für Museumstechnik. 7(4), (1961)
- 浜崎忠雄・三土正則 土壌モノリスの作製法 農技研資B 18, 1-27 (1983)
- 浜崎忠雄・三土正則・小原洋・中井信、土壌モノリスの作製法改訂版 (2002), <http://www.naro.affrc.go.jp/archive/niaes/inventory/soil/Document/method.pdf>
- 三恒商事、遺跡断面等の剥ぎ取り転写セット 説明書

My internet home page

- Powerpoint of this lecture is uploaded in the form of pdf file on my home page. <http://timetraveler.html.xdomain.jp/lecfile.html>
- Briefing of soil monolith specimens. <http://timetraveler.html.xdomain.jp/special.html#special65>
- Display of soil monolith <http://timetraveler.html.xdomain.jp/special.html#special53>