MONITORING and ASSESSMENT of SOIL POLLUTION

AAUE1003 SOIL POLLUTION
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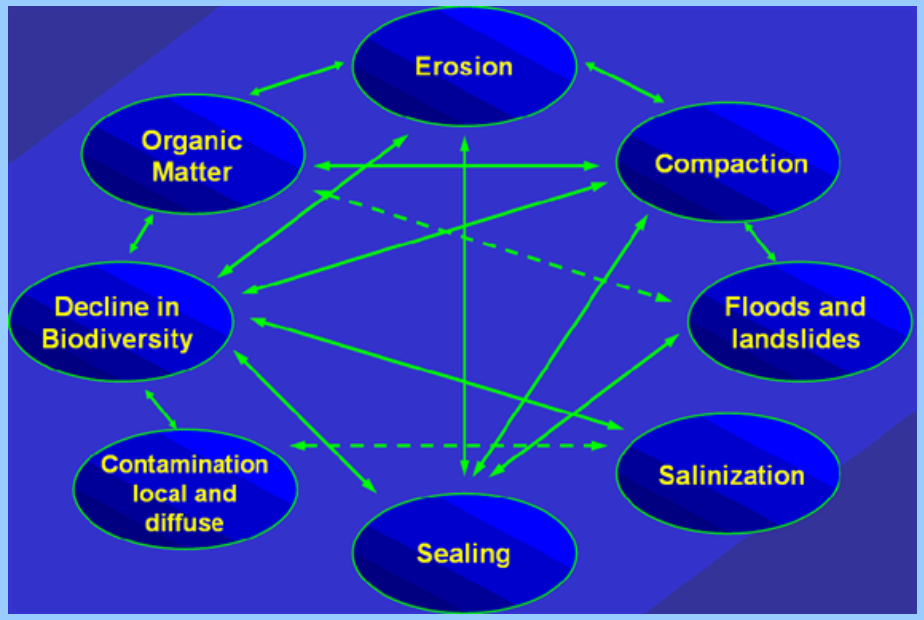
Soil Protection Strategy

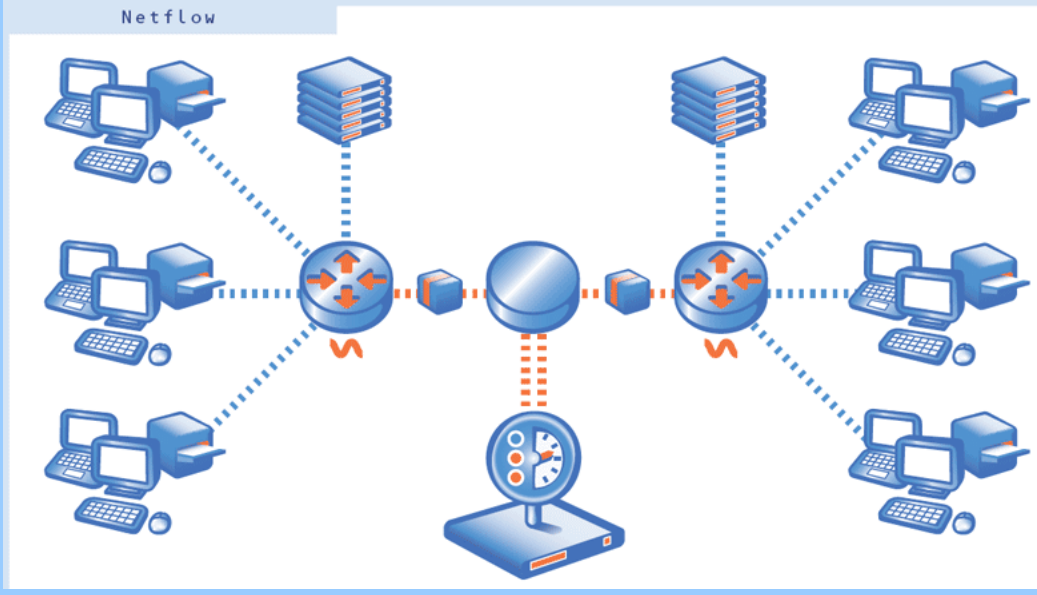
- “Soil Conservation Strategy” (Thematic Starategy for Soil) for the protection and sustainable use of soil resources within the scope of the 6th Environmental Action Plan of the European Union (2002-2012) [EU COM, 2001]



Within the framework of EU environmental law, member and candidate countries are expected to make their own national policies for the prevention of soil pollution and the management of polluted sites [EU COM, 2002].

At this point, one of the priority issues is a "soil monitoring" that will clarify the current state of soil pollution.

Soil monitoring is the assessment of soil quality characteristics influenced by mainly human activities and environmental factors for a sustainable soil management

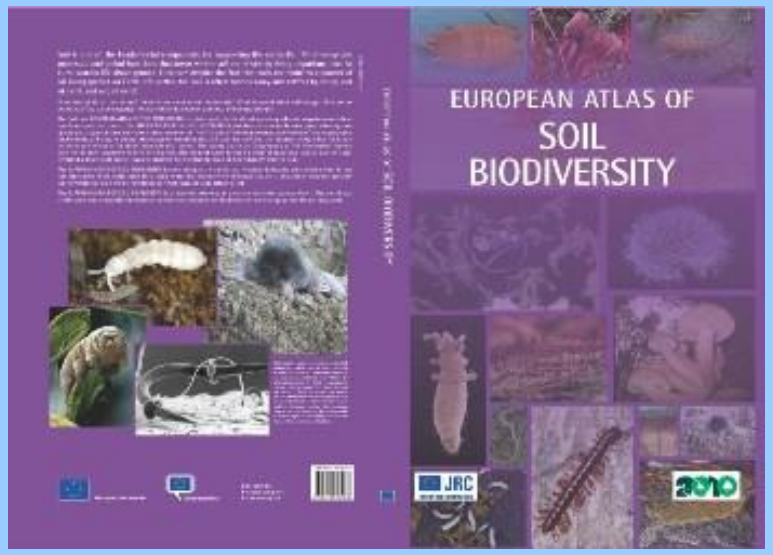


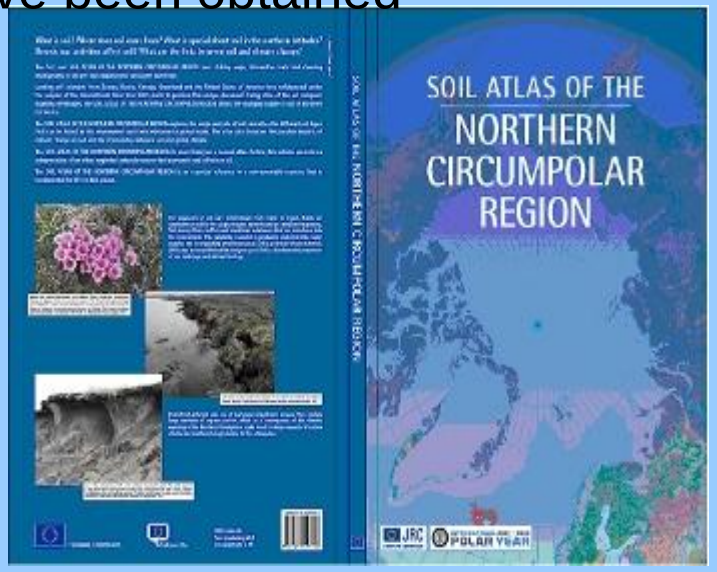
European countries have various soil monitoring networks operating dependently or independently.

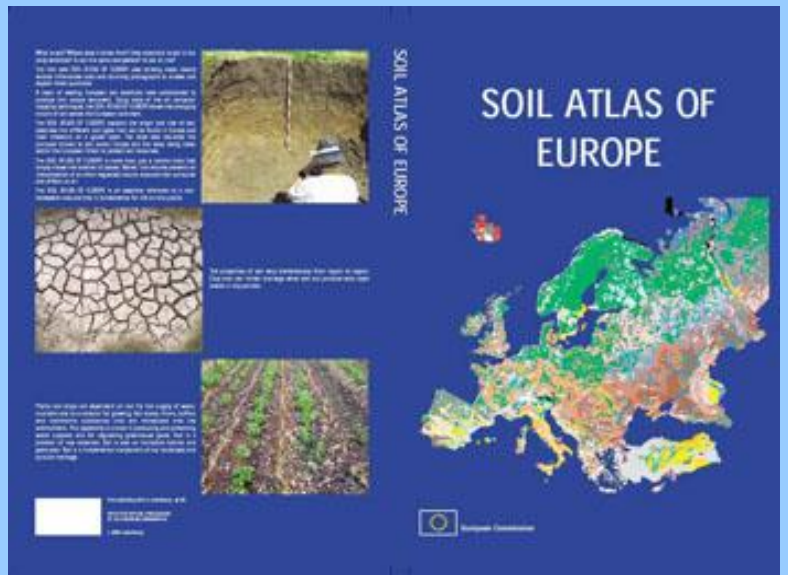
Soil pollution is a “transboundary” problem. This is the reason for “inter-country/continental scale” monitoring projects such as ENVASSO *

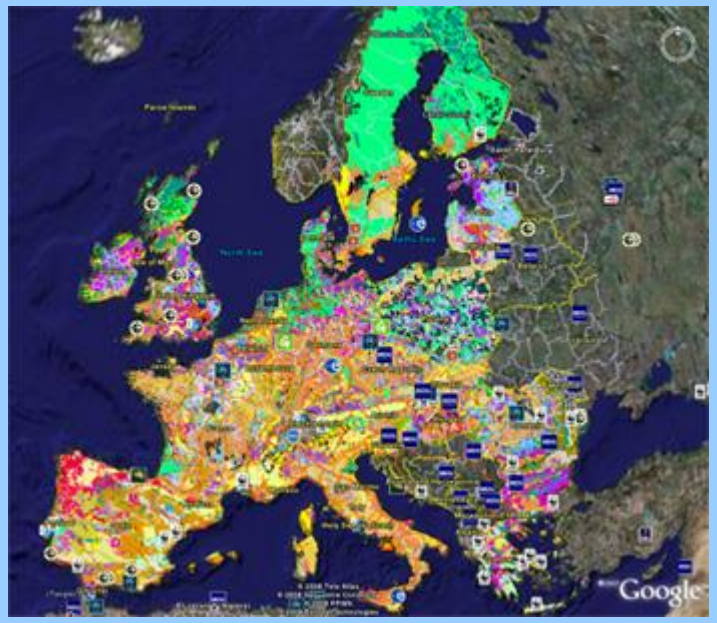
(*Environmental Assessment of Soil for Monitoring)
http://eusoils.jrc.ec.europa.eu/projects/envasso/

In the light of the information gathered from soil monitoring activities followed within the scope of ENVASSO, different atlases showing the various characteristics of all European Soils have been obtained

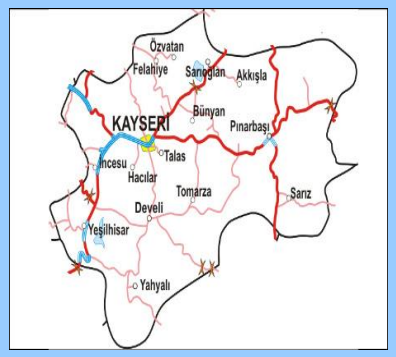


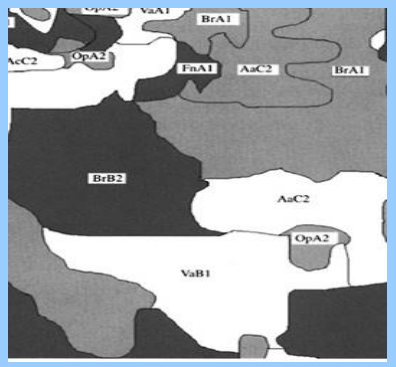


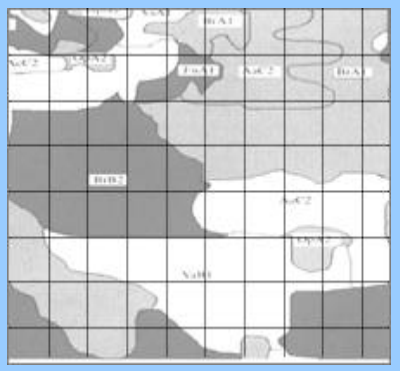


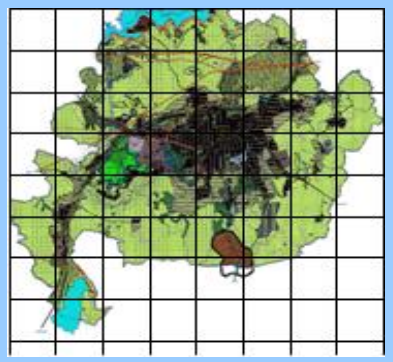


How to monitor soil?



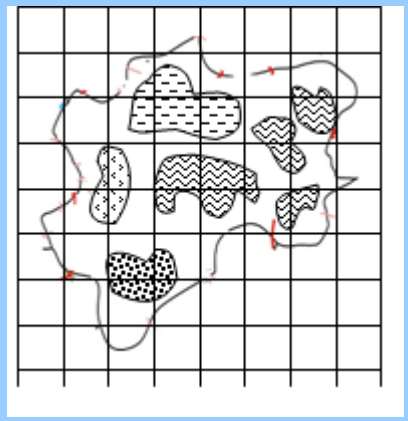






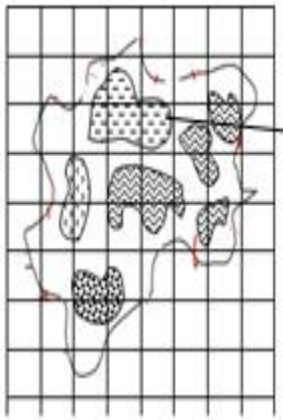
Kayseri district → Kayseri soil type map → 20x20km grid sys-soil type → 20x20km grid-Kayseri land use

1- Wide scale (20 x 20 km grid sys)
2- Special scale (small areas selected depending on specific reasons i.e. Soil erosion, pollution or urbanization

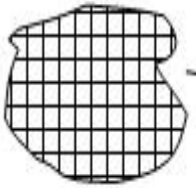


Here is a sampling design obtained by overlaying ‘’soil type-topography maps

A Standart Sampling Strategy



Kayseri ili



Çalışma alanı örnekleme

Alanı temsilen 0-15 ve 15-30cm'den (soil core kullanarak) 4-60/70 noktasal örnekleme ve paçallama (örnek miktarı min. 2-3kg)

TOPRAK ARŞİVLEME-K.HANE
Alınan toprak örneklerinin bir merkezde toplanması, analiz türüne göre tasnifi, hazırlanması ve depolanması

Sampling Period

- Wide scale sampling once or twice every one/two years
- Specific scale seasonal sampling for several year

Ocak							
	Pa	Sa	Ça	Pe	Cu	Cu	Pa
1			1	2	3	4	5	6
2	7	8	9	10	11	12	13
3	14	15	16	17	18	19	20
4	21	22	23	24	25	26	27
5	28	29	30	31			

Şubat							
	Pa	Sa	Ça	Pe	Cu	Cu	Pa
5					1	2	3
6	4	5	6	7	8	9	10
7	11	12	13	14	15	16	17
8	18	19	20	21	22	23	24
9	25	26	27	28	29		

Mart							
	Pa	Sa	Ça	Pe	Cu	Cu	Pa
9						1	2
10	3	4	5	6	7	8	9
11	10	11	12	13	14	15	16
12	17	18	19	20	21	22	23
13	24	25	26	27	28	29	30
14	31						

Nisan							
	Pa	Sa	Ça	Pe	Cu	Cu	Pa
14			1	2	3	4	5	6
15	7	8	9	10	11	12	13
16	14	15	16	17	18	19	20
17	21	22	23	24	25	26	27
18	28	29	30				

Mayıs							
	Pa	Sa	Ça	Pe	Cu	Cu	Pa
18				1	2	3	4
19	5	6	7	8	9	10	11
20	12	13	14	15	16	17	18
21	19	20	21	22	23	24	25
22	26	27	28	29	30	31	

Haziran							
	Pa	Sa	Ça	Pe	Cu	Cu	Pa
22							1
23	2	3	4	5	6	7	8
24	9	10	11	12	13	14	15
25	16	17	18	19	20	21	22
26	23	24	25	26	27	28	29
27	30						

Temmuz							
	Pa	Sa	Ça	Pe	Cu	Cu	Pa
27			1	2	3	4	5	6
28	7	8	9	10	11	12	13
29	14	15	16	17	18	19	20
30	21	22	23	24	25	26	27
31	28	29	30	31			

Ağustos							
	Pa	Sa	Ça	Pe	Cu	Cu	Pa
31					1	2	3
32	4	5	6	7	8	9	10
33	11	12	13	14	15	16	17
34	18	19	20	21	22	23	24
35	25	26	27	28	29	30	31

Eylül							
	Pa	Sa	Ça	Pe	Cu	Cu	Pa
36	1	2	3	4	5	6	7
37	8	9	10	11	12	13	14
38	15	16	17	18	19	20	21
39	22	23	24	25	26	27	28
40	29	30					

Ekim							
	Pa	Sa	Ça	Pe	Cu	Cu	Pa
40			1	2	3	4	5
41	6	7	8	9	10	11	12
42	13	14	15	16	17	18	19
43	20	21	22	23	24	25	26
44	27	28	29	30	31		

Kasım							
	Pa	Sa	Ça	Pe	Cu	Cu	Pa
44						1	2
45	3	4	5	6	7	8	9
46	10	11	12	13	14	15	16
47	17	18	19	20	21	22	23
48	24	25	26	27	28	29	30

Aralık							
	Pa	Sa	Ça	Pe	Cu	Cu	Pa
49	1	2	3	4	5	6	7
50	8	9	10	11	12	13	14
51	15	16	17	18	19	20	21
52	22	23	24	25	26	27	28
1	29	30	31				

- Most European country has soil monitoring networks for different purposes with recommended monitoring period of 5-10 yrs.
- Turkey is trying hard to collect nation-wide soil information but no network approach has been established so far.

Which soil parameters?

Wide monitoring scale

- **soil texture**
- **aggregation,**

- **organic carbon**
- **total nitrogen**
- **total or available phpsphorus**
- **micronutrients (Fe-Cu-Zn-B-Cl-Mn-Mo)**

- **exchnageable cations (Ca-Mg-K-Na)**
- **heavy metals (Pb-Cd-Cr-Ni-Co-As)**
- **pH,**
- **EC,**

- **biological activities (enzyme activities)**
- **microbial biomass (CFEM*)**

(alternatively pest residues, dioxines POPs)

Soil physical traits

Soil chemical traits-I

Soil chemical traits-II

Soil biological traits

Specific monitoring scale

- soil texture
- aggregation,
- organic carbon
- total nitrogen
- total or available phpsphorus
- micronutrients (Fe-Cu-Zn-B-Cl-Mn-Mo)
- exchnageable cations (Ca-Mg-K-Na)
- **heavy metals (Pb-Cd-Cr-Ni-Co-As)**
- pH,
- EC,
- biological activities
- microbial biomass

- Macro/meso/micro fauna monitoring
- **earthworm abundance and richnes (diversity)?**
- **nematode abundance and richnes ?**
- **bacterial /fungal abundance and richnes**

Biodiversity indices

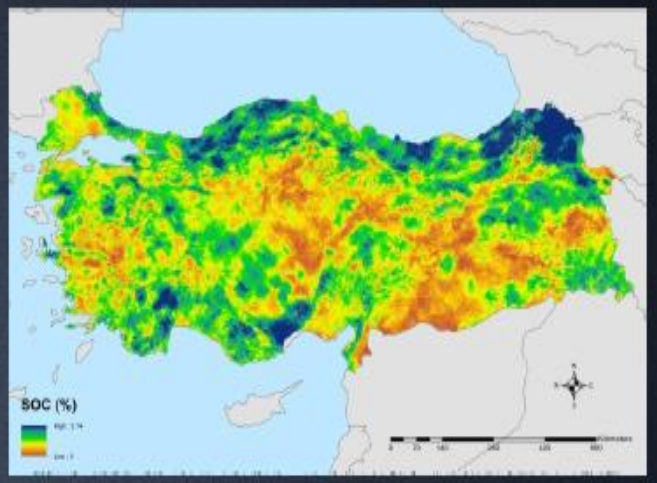
(CFEM:chloroform fumigation-extraction method

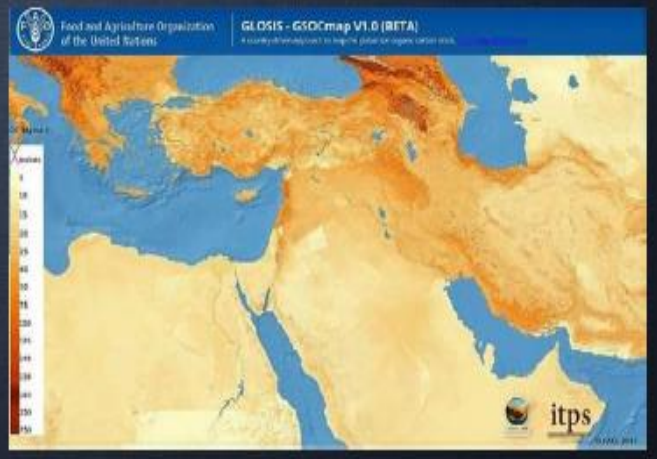
Toprak Bilgi Sistemleri-Toprak Organik Karbon Verileri

T.C.
TARIM VE ORMAN BAKANLIĞI

TAGEM
AR-GE & İNOVASYON

- **Türkiye Toprak Organik Karbon Veri Tabanı,**
- TAGEM-FAO işbirliği ile 7800 toprak örneği ile hazırlanmış olan Türkiye Toprak Karbon haritası **Dünya Karbon Haritası'na** dahil edilmiştir.
- 2019 yılında 31.000 toprak örneği karbon sonuçları harita güncellemesi **FAO işbirliği ile** başlamış olup çalışmalar devam etmektedir.



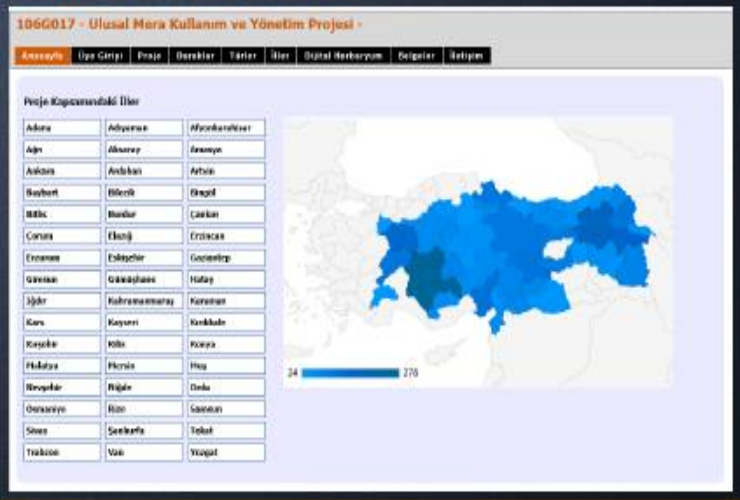


T.C.
TARIM VE ORMAN BAKANLIĞI

Ulusal Mera Kullanım ve Yönetim Projesi

TAGEM
ARGE & İNOVASYON

- 48 ili kapsayan mera alanlarında,
- 3444 durakta mera etüt çalışmaları yapılarak haritalanmıştır
- Meralarda Toprak ve Su Kaynaklarının Korunumu» ve « Tarım Toprakları ve Meralarda Arazi Bozulumu ve Erozyon Araştırmaları» Rehber haline getirilmektedir.



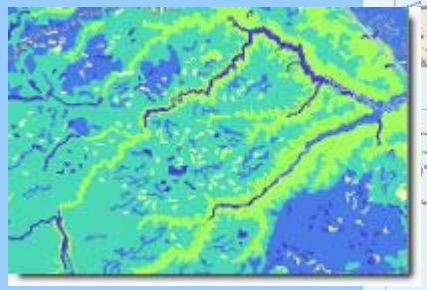
A monitoring focused on soil pollution provides us information on;

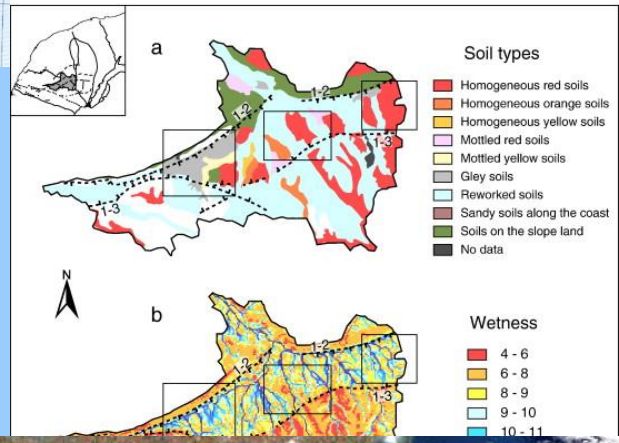
- Characteristics, quantity, source and distribution of the pollutant,
- The effect of the pollutant on society and source management
- Suitability and selectivity of reclamation / remidation (cleaning) approahes

A monitoring of soil pollution should generally include the following important steps;

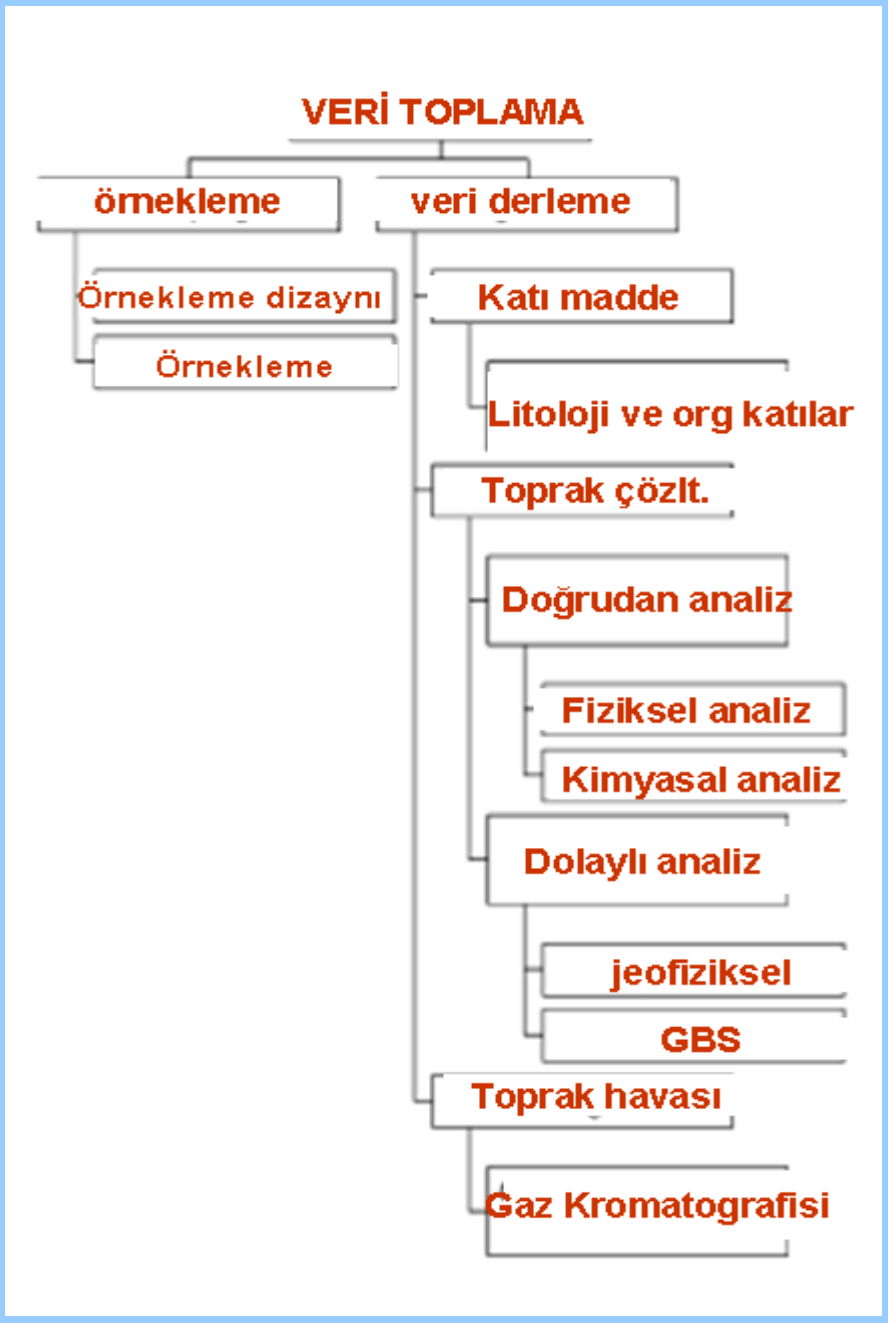
- Site characterization
- Data collection (environmental-social-economic)
- Data quality check
- Assessment
- Reporting

Cite characterization





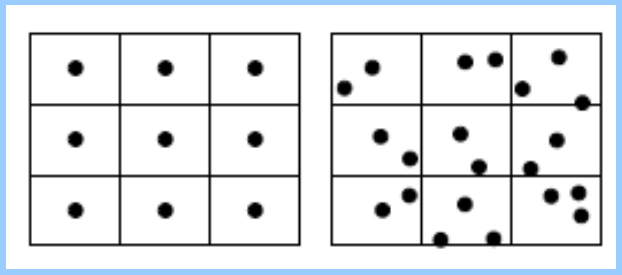
- Collecting all printed data about the field
- maps (morphological, geological, hydrological, vegetation maps
- Aerial photos and satellite images

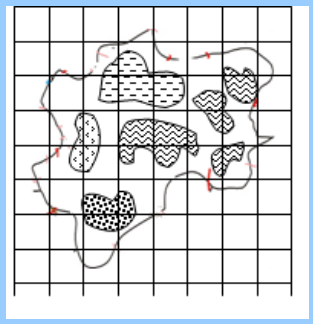

VERİ TOPLAMA
örnekleme
veri derleme
Örnekleme dizaynı
Örnekleme
Katı madde
Litoloji ve org katılar
Toprak çözlt.
Doğrudan analiz
Fiziksel analiz
Kimyasal analiz
Dolaylı analiz
jeofiziksel
GBS
Toprak havası
Gaz Kromatografisi

Soil data collection (begins with soil sampling)

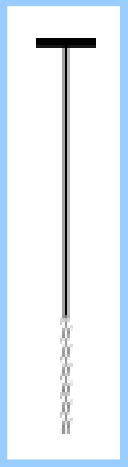
After preliminary preparation (collection of written-visual material), the second important step of a monitoring is data collection.

- Sampling planning (samplng locations)





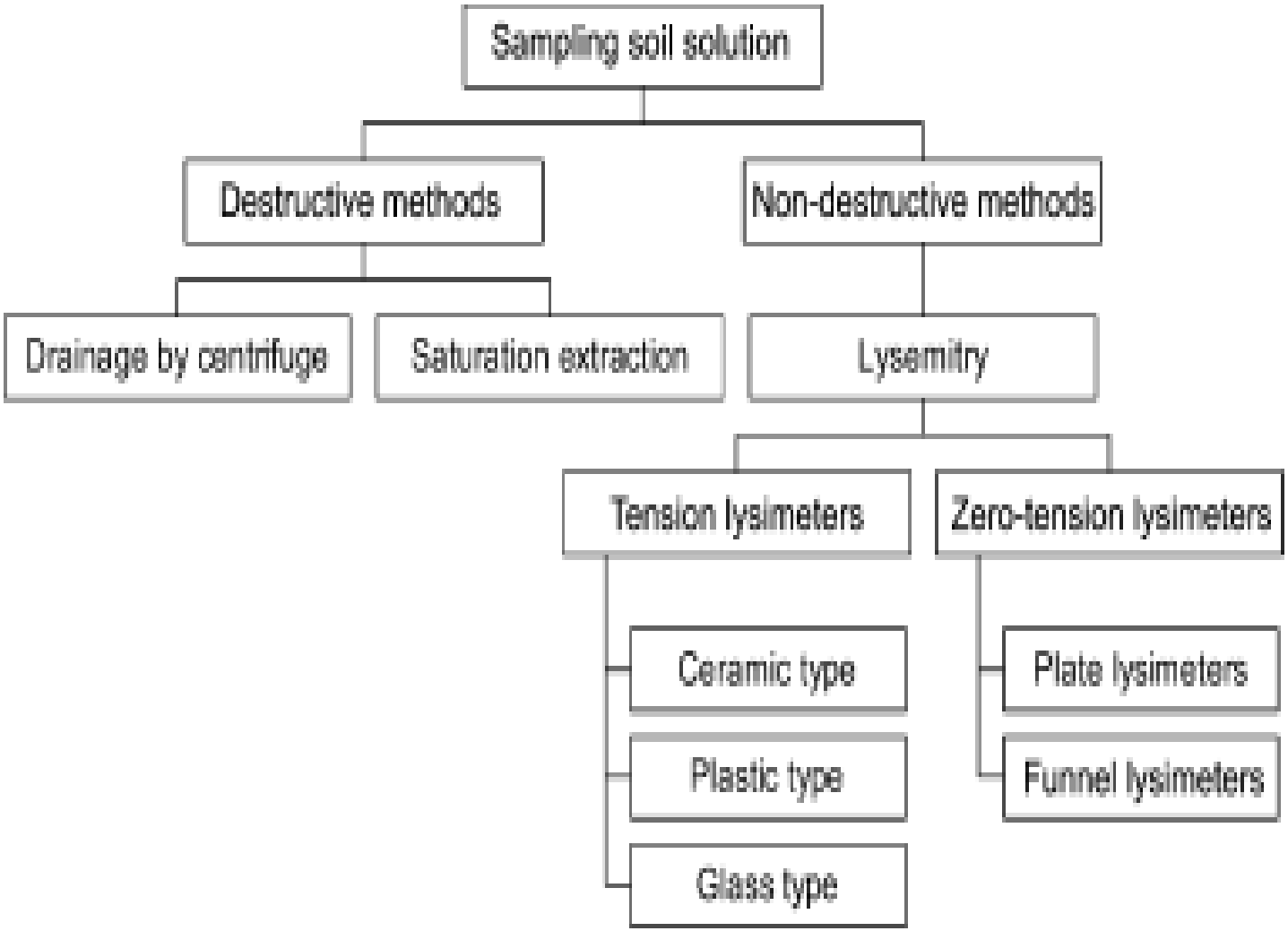
- Sample types (soil, soil water soil air)



Basit türbüşon

Kompleks örneklemeler için
delici-kazıcı-toplayıcı bir aparat

Soil water sampling



Soil water sampling tools

Fig. 10.7 Plate type lysimeter

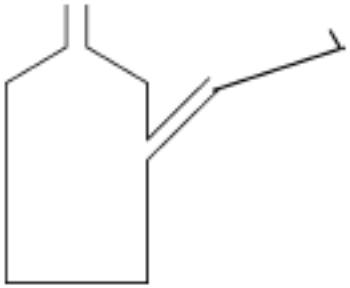


Fig. 10.8 Funnel type lysimeter

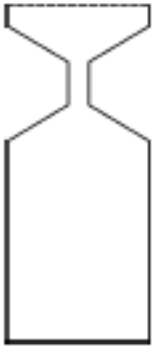


Fig. 10.9 Structure of a simple zero-tension lysimeter (after Thompson and Scharf 1994)

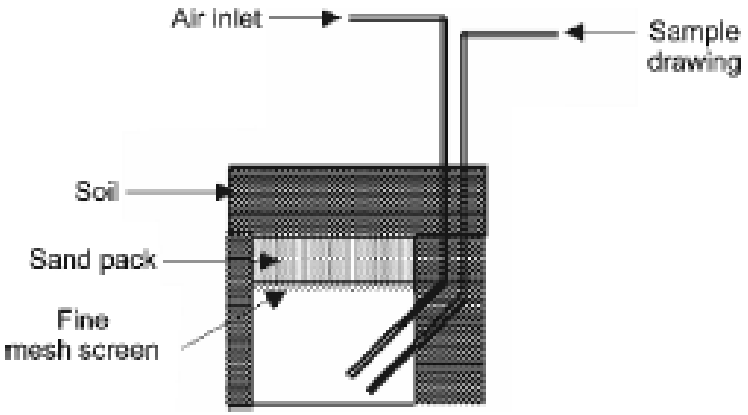
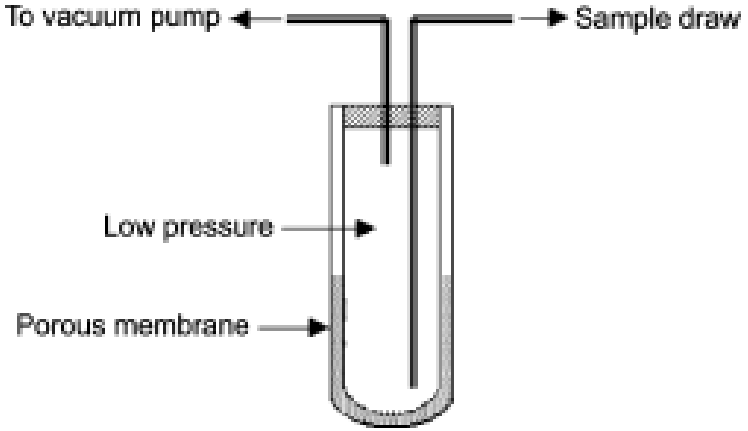
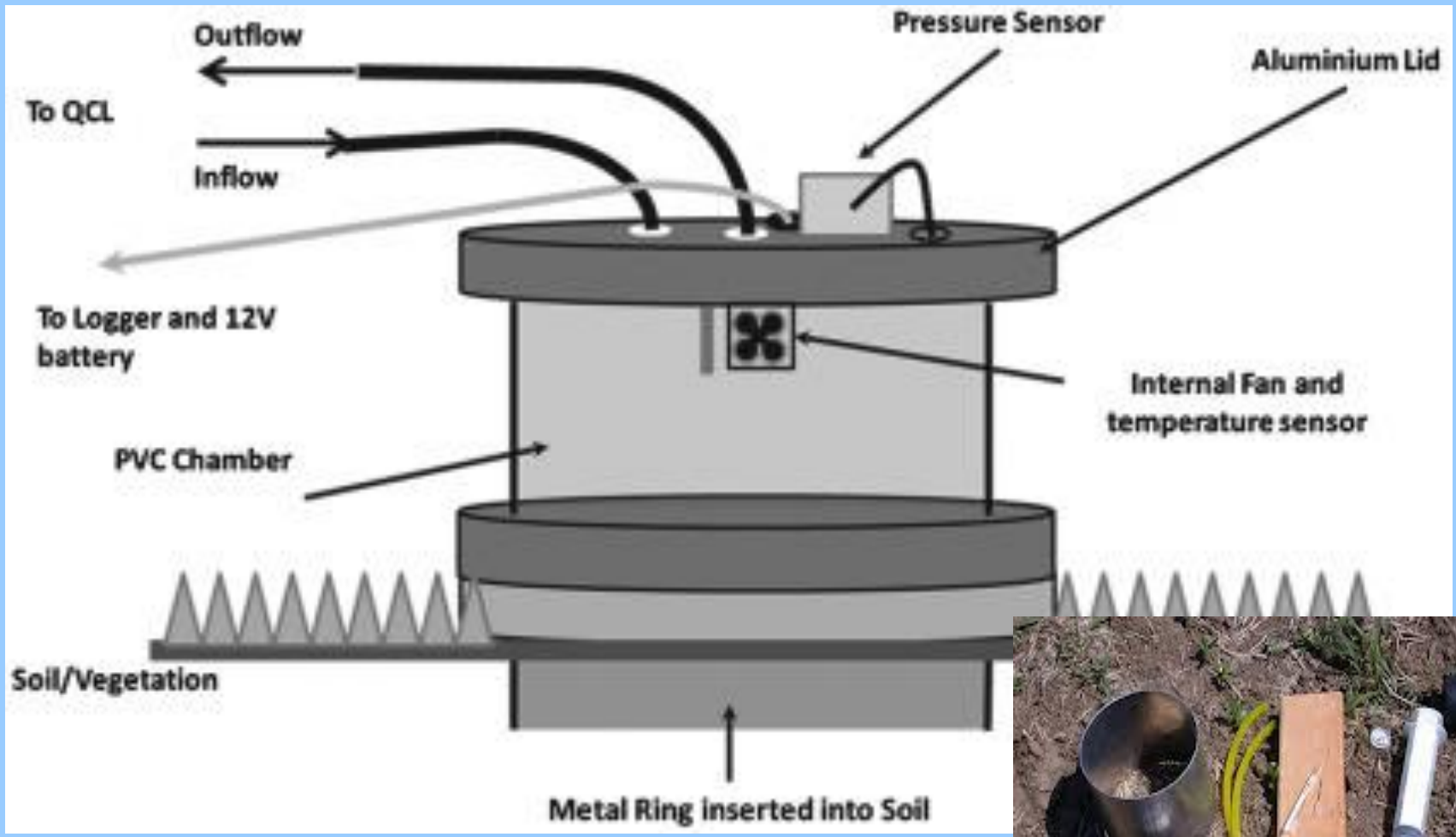


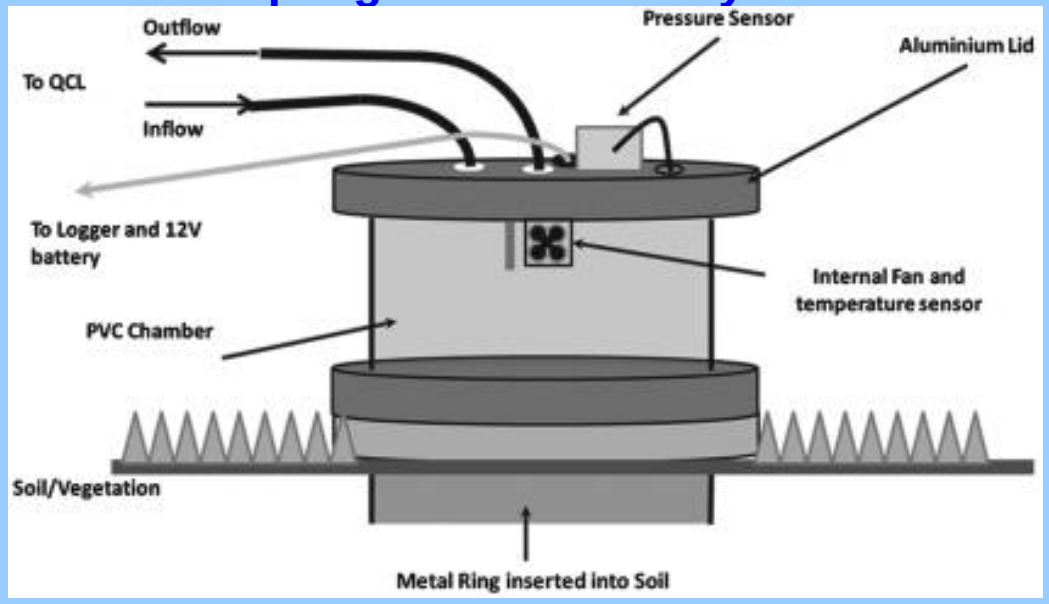
Fig. 10.10 A suction lysimeter



Soil air sampling tools and analysis



Soil air sampling tools and analysis



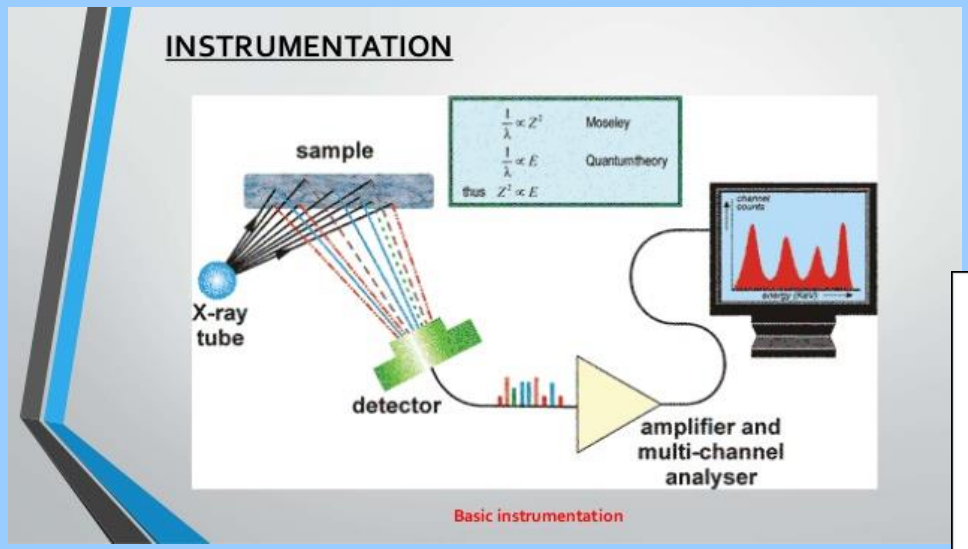
Soil air collecting syringe

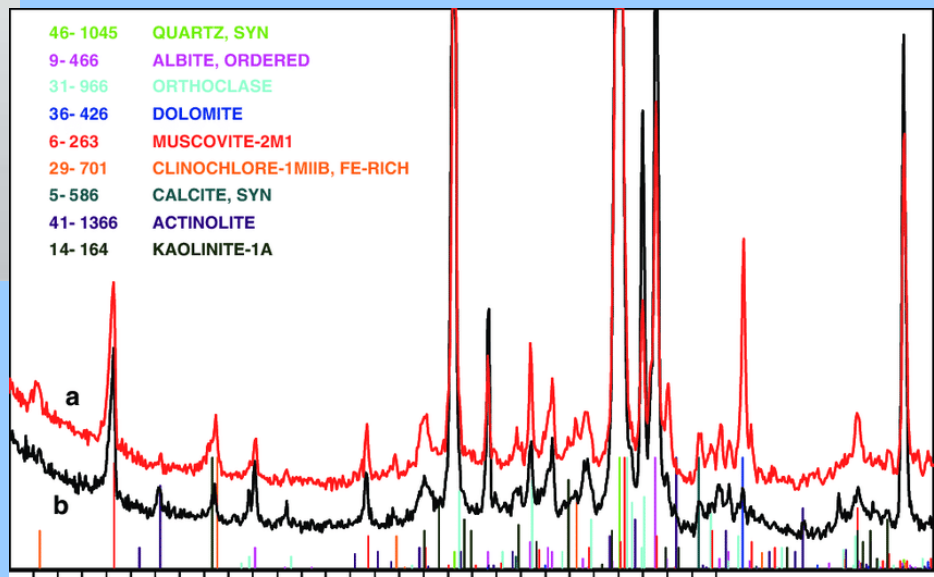
Gas chromatography

(analyzer measuring composition of gas and volatile substances

Common tools and analysing systems used in soil analysis

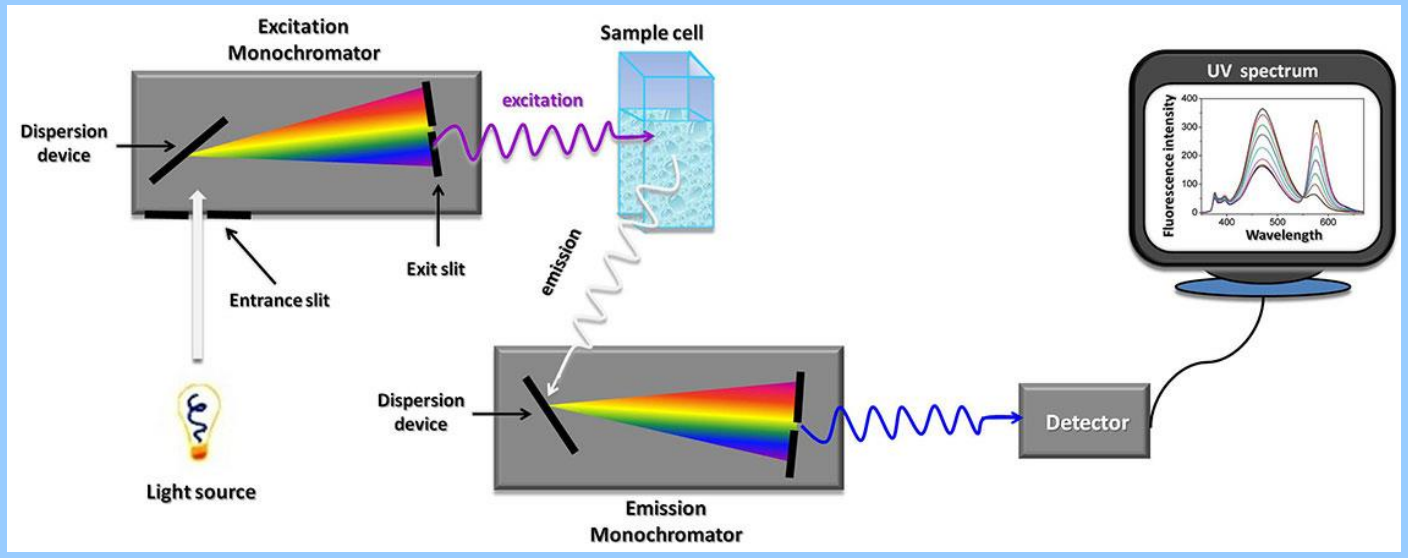
- XRD (X-ray diffraction device is based on the principle of breaking the X-rays in a characteristic pattern depending on the atomic structure of each crystalline phase. The X-ray diffraction-absorption levels of the rocks, minerals and also the pollutants are different.)





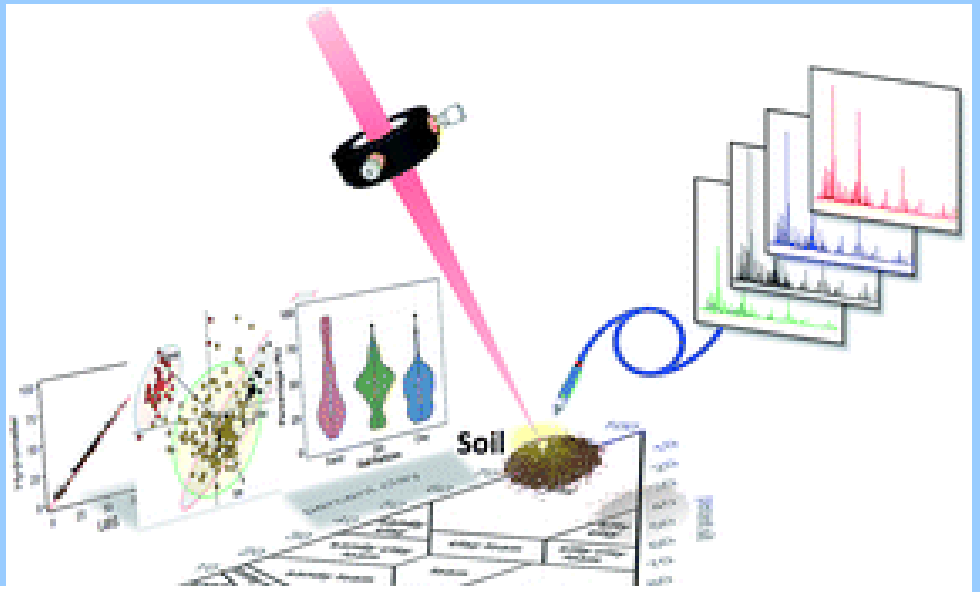
Common tools and analysing systems used in soil analysis

- UV-Fluorescence Spectroscopy (measurement of the absorbed / emitted levels of UV light excitated from a UV source to the analyzed sample)



Common tools and analysing systems used in soil analysis

- Infrared (IR) Spectroscopy is the measurement of the interaction of infrared radiation with matter by absorption, emission, or reflection. It is used to study and identify chemical substances or functional groups in solid, liquid, or gaseous forms (*Wikipedia*)



Direct determination of soil texture using laser-induced breakdown spectroscopy and multivariate linear regressions†

Journal of Analytical Atomic Spectrometry (IF 3.498) **Pub Date : 2019-05-29 00:00:00** , *DOI: 10.1039/c9ja00090a*

Christian L. Goueguel, Adja Soumare, Charles Nault, Jacques Nault

Common tools and analysing systems used in soil analysis

- Atomic absorption spectroscopy (AAS) and atomic emission spectroscopy (AES) is a spectroanalytical procedure for the quantitative determination of chemical elements using the absorption of optical radiation (light) by free atoms in the gaseous state. Atoms of different substances exhibit different UV behaviors in gas phase.
- AAS can be used to determine over 70 different elements in solution, or directly in solid samples such as soil

Soil sample	Zn [mg/kg]	Pb [mg/kg]	Fe [mg/kg]	Cd [mg/kg]	Mn [mg/kg]	Ni [mg/kg]	Cu [mg/kg]	Cr [mg/kg]	Mg [mg/kg]
Uncontaminated sand red in colour	64,9	11,8	4548,9	b.d.l.	95,1	b.d.l.	37,1	9,0	453,6
Uncontaminated sand	11,3	b.d.l.	346,4	b.d.l.	55,9	b.d.l.	11,4	b.d.l.	466,8

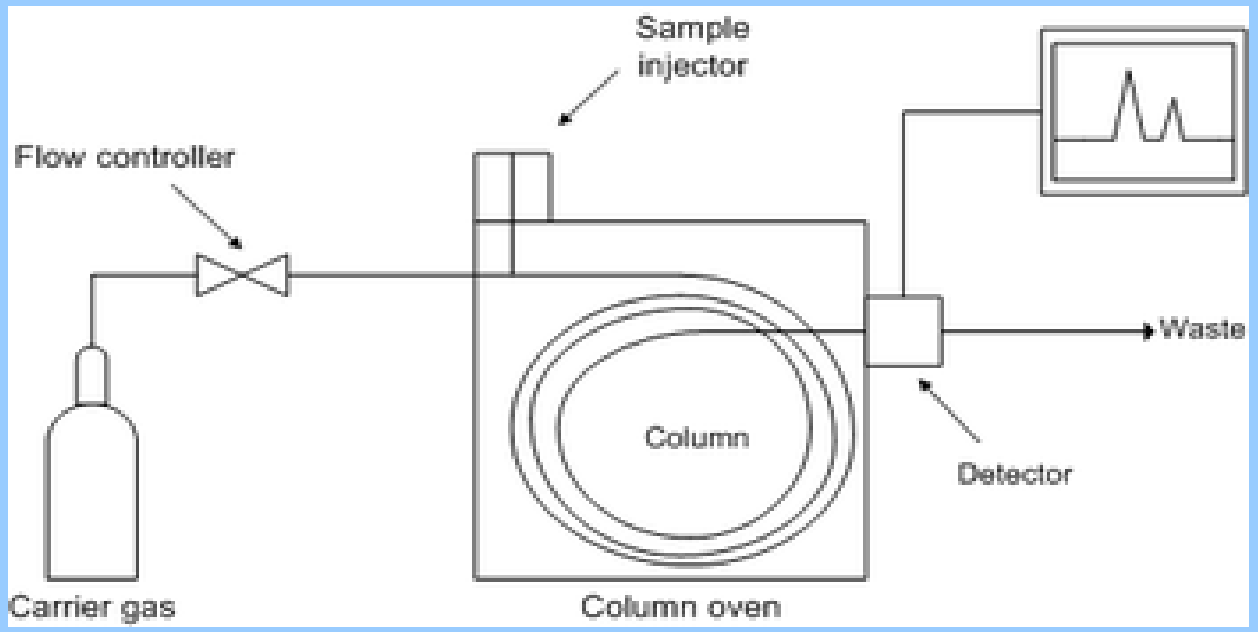
b.d.l. – below detection level

Common tools and analysing systems used in soil analysis

- Chromatography is an analytical system including separation, identification and purification of substances in a mixture of two-phase system, one of which is stationary (a column, a capillary tube, a plate, or a sheet) and the other is mobile phase (gas, solvent or water).

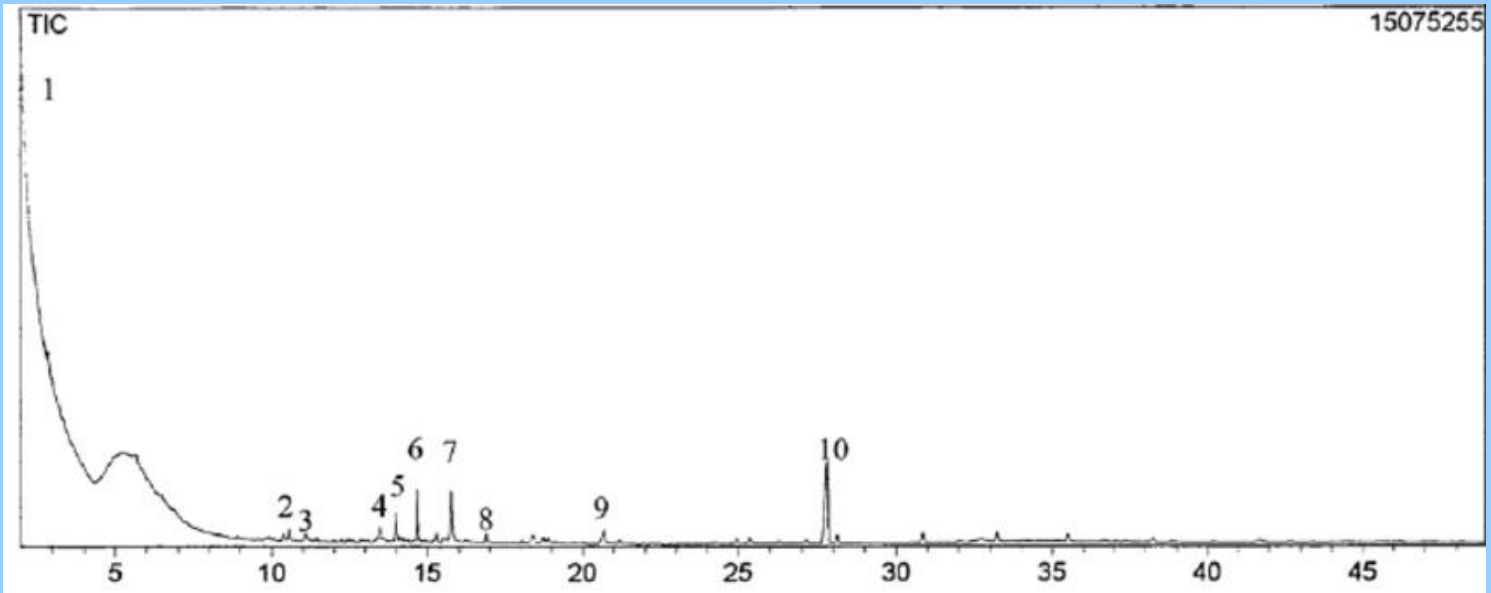
Common tools and analysing systems used in soil analysis

- Gas Chromatography (GC) is used to separate components that are gaseous or can be easily evaporated in a mixture. In this method, separation occurs according to the different adsorption properties of the components on different solid surfaces. The components in the sample are brought into spectrum with a device and each peak in this spectrum shows a separate component.



Common tools and analysing systems used in soil analysis

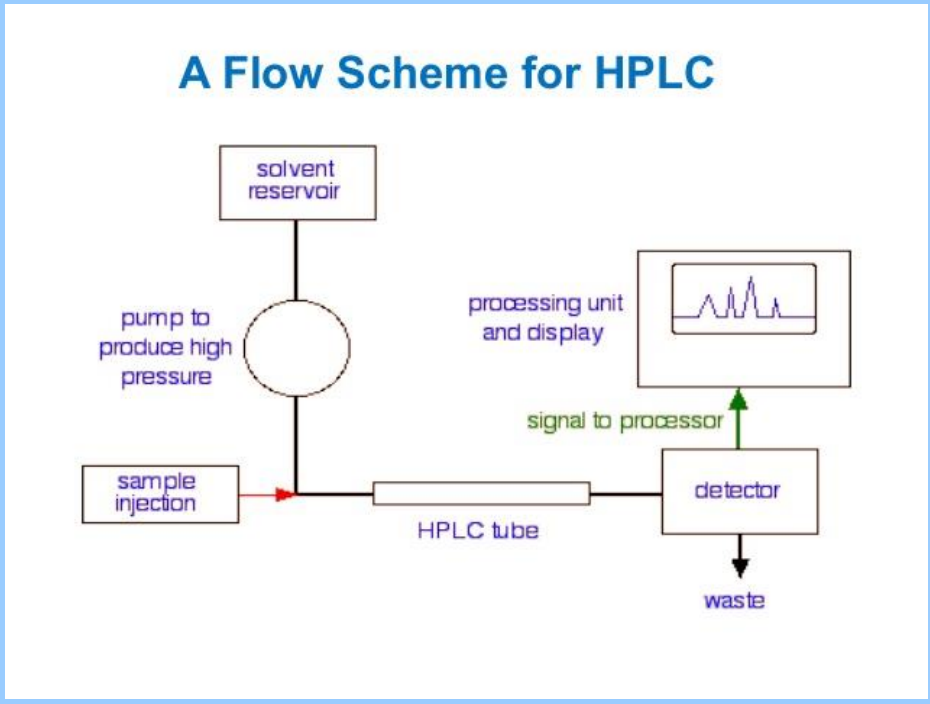
- Gas Chromatography (GC)

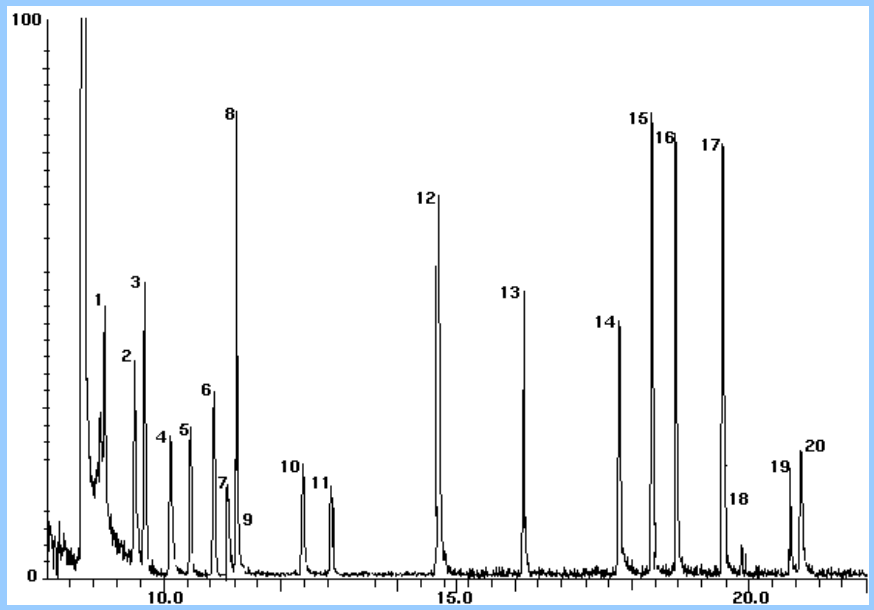


1 – acetone
2 - pyruvic acid
3 - octanoic acid, 7-oxo
4 - n-octadecanoic acid
5 - phosphorothioic acid, o,o-diethyl o-[6-methyl-2-(1-methylethyl)-4-pyrimidinyl] ester
6 - di-isobutyl phthalate
7 - di-n-buthyl phthalate
8 - 1-tetradecanol
9 - 9-octadecenoic acid (Z)
10-DEHP

Common tools and analysing systems used in soil analysis

- High Performance Liquid Chromatography (HPLC) is a type of chromatography that pumps a sample mixture in a solvent (not a gas carrier) (known as the mobile phase) at high pressure through a column with chromatographic packing material (stationary phase).





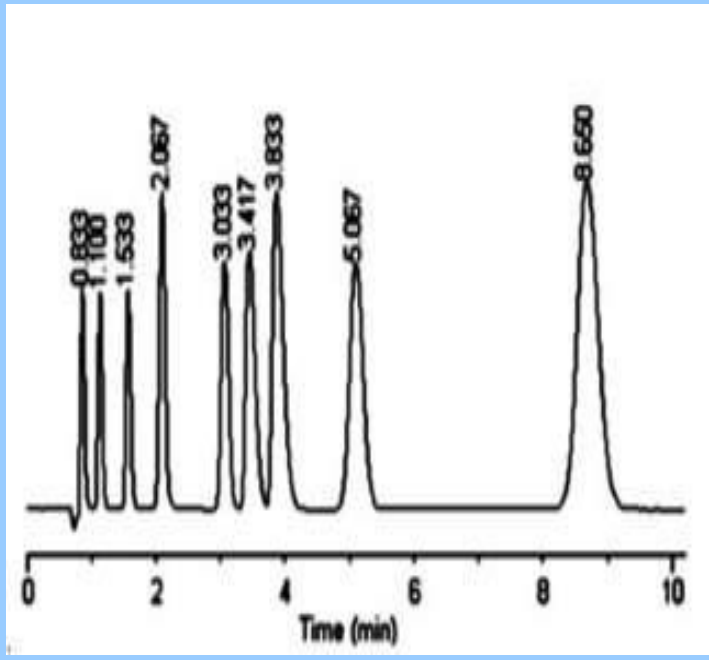
Analysis of volatile organics in soil

- Gas chromatographic system (components of the high-temperature gasified sample are passed through the column with the aid of a carrier gas.

- Chemical compounds separated leave the column and reach to the detector at different times.

- The detector generates different peaks for each component.

- by comparing the multiple peak pattern (chromatogram) with that of a standard substance, the components of the sample are identified.



- In the high pressure liquid chromatography (HPLC) system, carrier is a liquid.
- The sample passes through the column in the liquid carrier and reaches to the detector
- In the gas chromatographic system, the sample is destroyed during analysis
- In HPLC, the same sample can be analyzed over and over again.
- HPLC requires less user skill and analysis time is shorter than GC.