Soil quality – Guideline for the screening of soil polluted with toxic elements using soil magnetometry

ISO 21226:2019

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The world's first standardized method using soil magnetometry in environmental pollution research analyzes.

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- Technical Committee ISO/TC 190/SC 3
- Soil quality - Chemical and physical characterization

ICS : 13.080.10 Chemical characteristics of soils

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The subject of standardization is a detailed measurement procedure, measurement protocols and guidelines for the use of soil magnetometry as a site pre-screening method in a two-stage procedure of integrated geophysical and geochemical methodology for an effective characterization of soil pollutions. Its purpose is to precisely determine the range of contaminated areas and to precisely locate appropriate sampling points for geochemical analyses. It is an introduction to the second step of the methodology, based on detailed geochemical measurements aimed at quantitative identification of potentially toxic elements.

Basic description of study area

- 1. Name of the screened site.
- 2. Category of the screened site

a) forest b) arable land c) grassland, d) post-industrial area e) urban area f) other

- 3. Site description (obligatory information)

a) forest – type of forest, predominant forest stand, age of trees, undergrowth, slope of the site (flat, slope < 5 %, slope > 5 %), other important available information;

b) arable land – arable land - state of the field (e.g. stubble field, ploughed field, sowed field - type of crop), slope of the site (flat, slope < 5 %, slope > 5 %) other important available information;

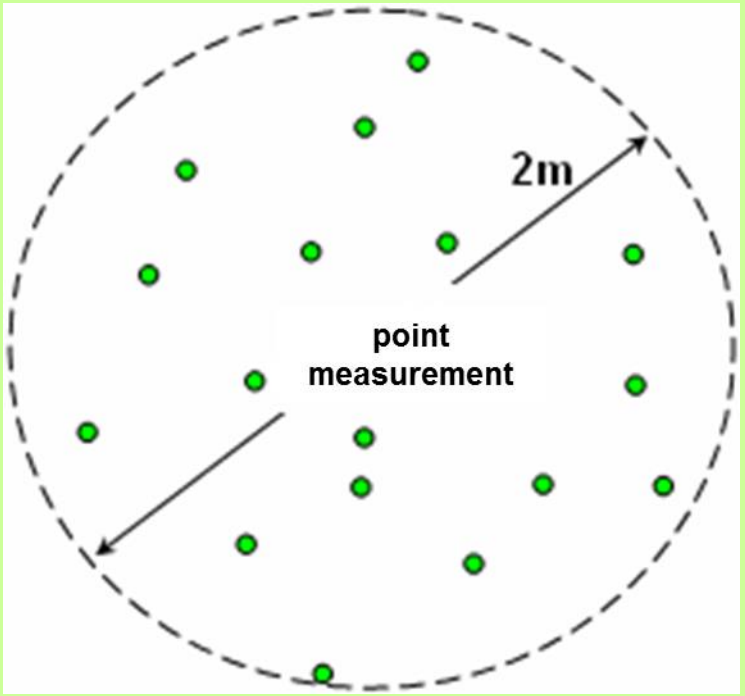
c) grassland – height of the grass, slope of the site (flat, slope < 5 %, slope > 5 %), other important available information;

d) post-industrial area – type of former industry, type of waste landfill/dumping site, kinds of artefacts present in topsoil, other important available information;

e) urban area – type of site (park, lawn, roadside), kinds of artefacts present in topsoil, other important available information;

f) other – type of site (park, lawn, roadside), kinds of artefacts present in topsoil, other important available information.

Measurement of surface magnetic susceptibility (κ) in individual measuring point



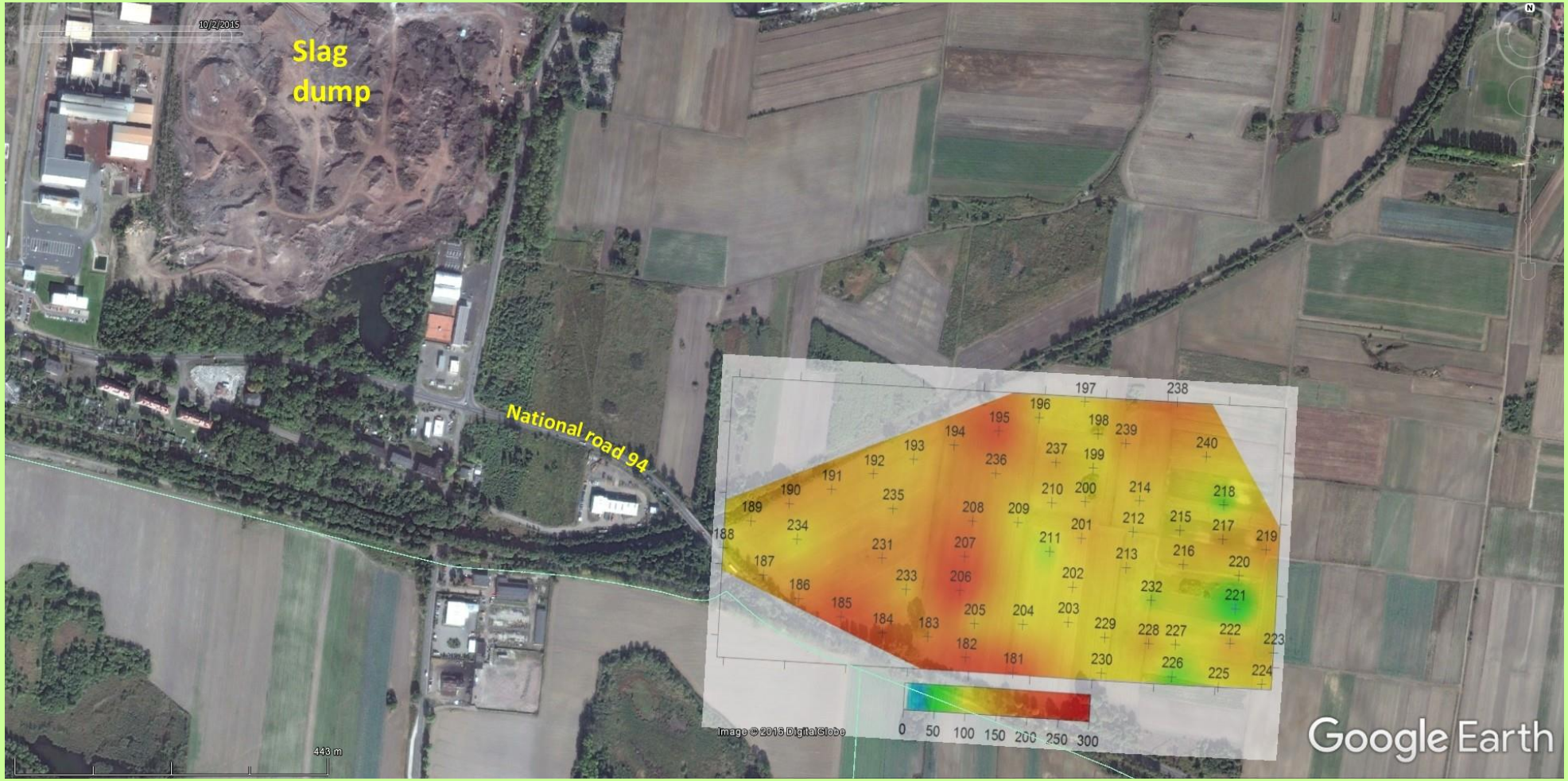
One measurement point consists of at least 11 individual measurements taken within a circle 2 m in diameter from the recorded GPS position

The soil surface must be available for the sensor, therefore dense vegetation or branches at the measuring point should be removed.

Protocol on surface measurements of κ values.

Point no.	κ $\times 10^{-5}$ SI				geographical position		
	Measured κ values $\times 10^{-5}$ SI	mean/ median	±sd	outliers (rejected values)	latitude	longitude	altitude
.../1							
.../2							
.../3							
.../4							
.../5							
.../6							
.../7							
.../8							
.../9							
.../...							
.../n							

Graphic presentation of a computed contour 2D map of surface magnetic susceptibility distribution.



Measurements of vertical distribution of κ values in a soil profile.

The main purpose of κ measurement in vertical soil profile is:

- determination of the vertical distribution of pollution in the topsoil that may be caused by:

  different degree of accumulation of TMP in uppermost horizons and sub-horizons or

  vertical downward migration of TMP in soil profile;
- assessment of the possible influence of the geological bedrock on the magnetic properties measured in topsoil;
- assessment of the possible influence of pedogenic background on the magnetic properties measured in topsoil.

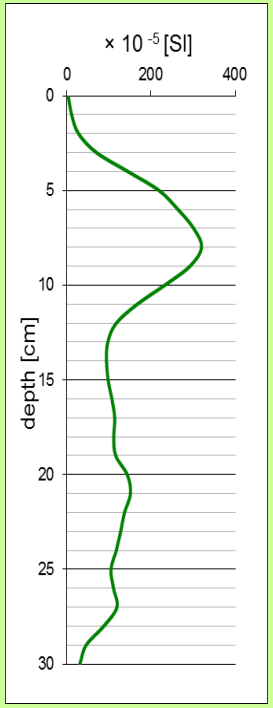
Soil sampling in the form of topsoil cores

2 twin cores in distance < 1 m

Measurement of vertical distribution of κ value

For in situ measurements, the diameter of the core probe must correspond to the diameter of the magnetic susceptibility meter. The walls of the meter must fit snugly against the walls of the hole in the soil.

Measurement of vertical distribution of κ value



Laboratory measurement of κ value in the cores should be performed immediately, not later than 7 days from collection, during this time cores should be stored in a refrigerator.

Technical parameters of soil cores used (length and diameter)

core no.	surface magnetic susceptibility κ ×10^{-5} SI	geographical position			remarks
		latitude	longitude	altitude	
.../A					
.../B					

Core sampling protocol

core no. .../A	κ ×10^{-5} SI	core no. .../B	κ ×10^{-5} SI
depth		depth	
0 cm		0 cm	
1 cm		1 cm	
2 cm		2 cm	
3 cm		3 cm	
4 cm		4 cm	
5 cm		5 cm	

Protocol on calculation of the most important parameters related to vertical distribution of κ values in a soil profile

core no.	maximum κ value in core ($\times 10^{-5}$ SI)	depth of maximum κ value (cm)	boundary depth (cm)	mean κ value of topsoil[1] ($\times 10^{-5}$ SI)	±sd	mean κ value of subsoil[2] ($\times 10^{-5}$ SI)	±sd
…/A							

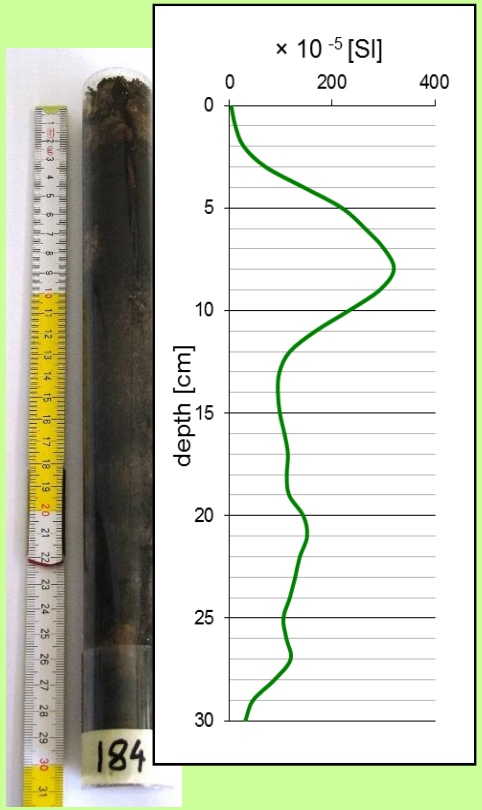
[1] Calculated as mean κ value above boundary depth
[2] Calculated as mean κ value beneath boundary depth

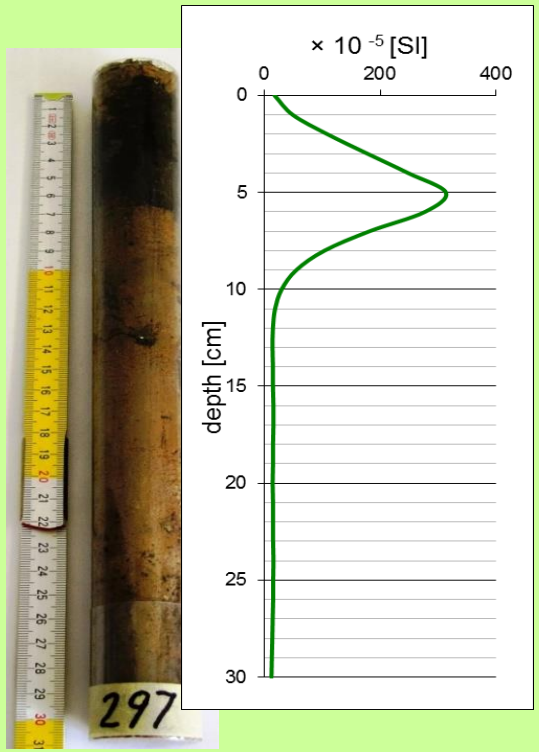
Soil cores should be collected in places showing the highest κ value (positive magnetic anomalies). Additionally, as reference samples, the cores must be taken:
at least one core from the area with the lowest κ value;
at least one core from the area with the average κ value.
The number of core sampling points should be assessed individually in terms of their representativeness.

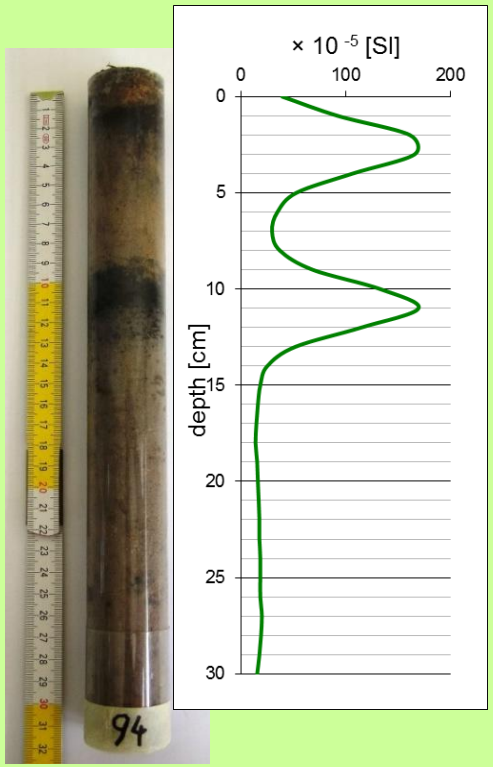
Cores should be collected in the field into plastic tubes using a core sampler pushed in or hammered into soil.

After checking the condition of the core, plastic tubes must be secured against the sample moving within the tube, marked and tightly wrapped in a thin plastic film to protect against moisture loss.

Examples of vertical distributions of κ values in cores

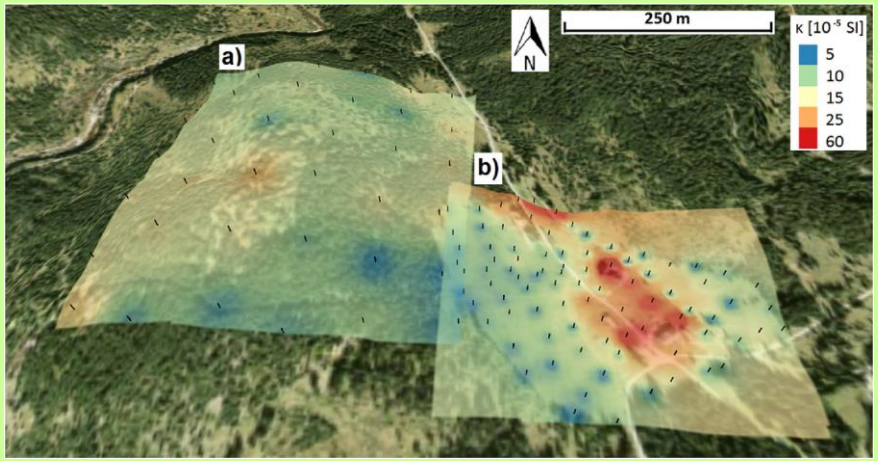






Geochemical verification

Magnetic pre-screening



Portable XRF

AAS

ICP MS

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https://www.iso.org/standard/70136.html

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