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Description of Anthropogenic Components for Soil Mapping – A Glance to the German Guidelines for Soil Mapping, version 2023 (KA6)



Bodenkundliche
Kartieranleitung

2023

5. verbesserte und erweiterte Auflage
Hannover 2005

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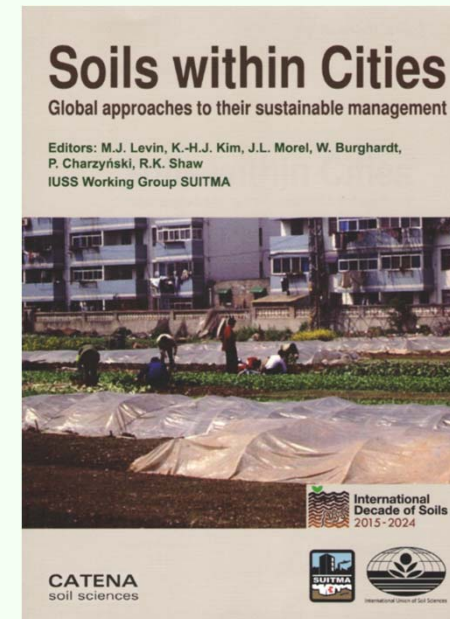
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Introduction

- SUITMAs / Technosols / **Anthropogenic Components** / “artefacts”: background
- **Anthropogenic Components**: documentation and description
- Key to **Anthropogenic Components**: systematic approach
- **Anthropogenic Components**: Link to current German Substitute Building Materials Ordinance (2023)
- **Anthropogenic Components**: Benefits / Summary



published in 2017

SUITMAs in Germany



Journal of
Plant Nutrition and Soil Science

REVIEW

Soil science within German cities

Wolfgang Burghard et al.

<https://onlinelibrary.wiley.com/doi/epdf/10.1002/jpln.202200211>

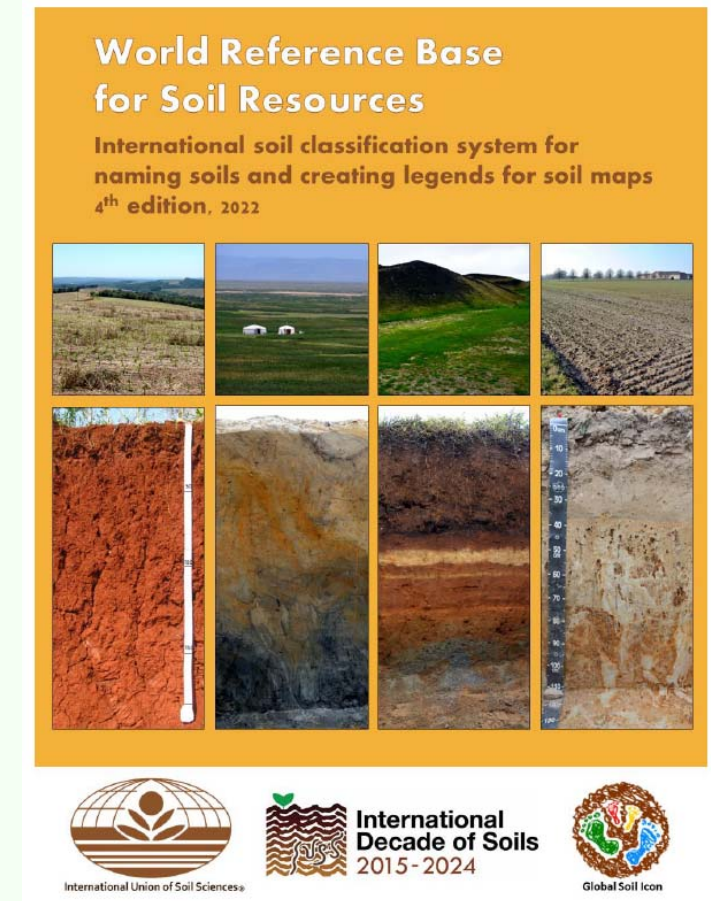
- Conclusion:
In general, SUITMAs linked
to Technosols containing
Anthropogenic Components!



<https://www.dbges.de/de/boden-des-jahres>

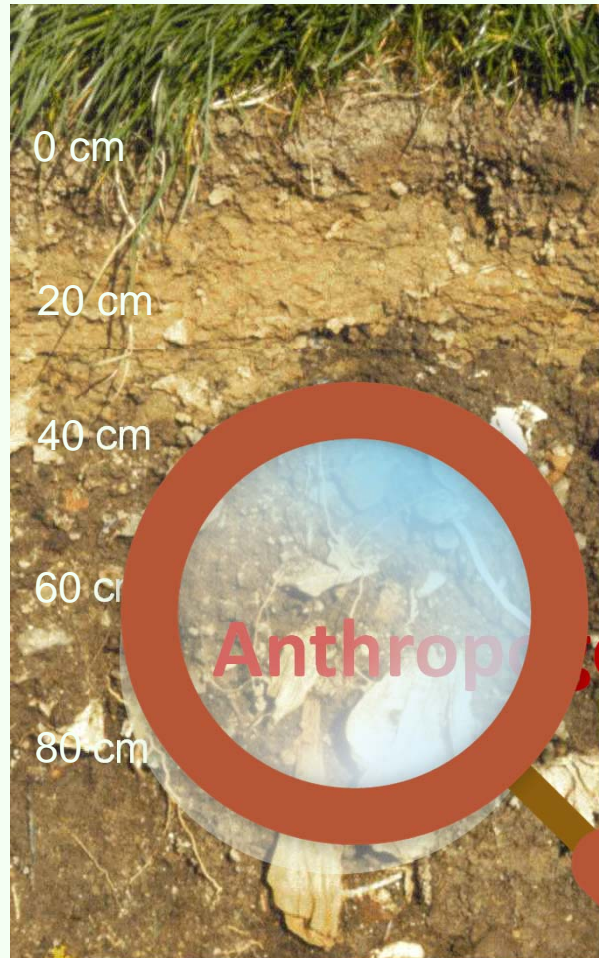
Technosols / Anthropogenic Components / „artefacts“

- Soils from wastes, pavements, with geomembrane or constructed soils
- Properties and pedogenesis dominated by their technical origin



https://www3.ls.tum.de/fileadmin/w00bds/boku/downloads/wrb/WRB_fourth_edition_2022.pdf

Pedogenesis and **Anthropogenic** **Components**: Distinct description of variety essential!



Garbic Urbic Technosol



glas



brick



metal



organic waste



ceramic



textile

Anthropogenic components

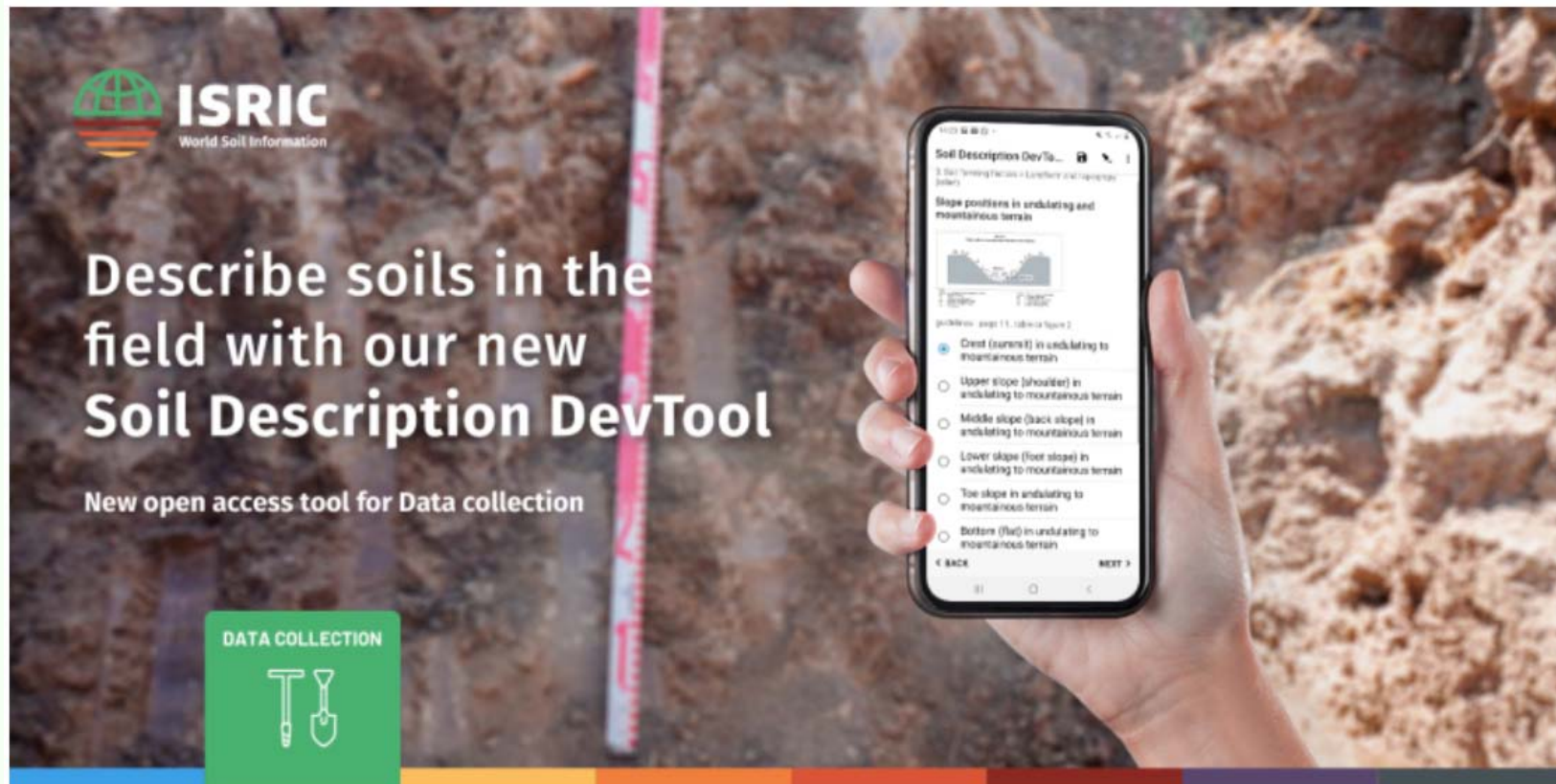


grate ash

photos: Makowsky & Steinweg

Anthropogenic Components / „artefacts“: documentation form or app

- basic information: kind, size and amount in each horizon



<https://www.isric.org/news/soil-description-devtool>

Anthropogenic Components / „artefacts“: key for description (extract WRB, Meuser 1996)



- | | | |
|---|---|----------------------|
| 1 | Observation at the profile | |
| | a) stratified (spoiled materials) | go to step 2 |
| | b) not stratified but clods of different colour, texture and/or artefacts (dumped substrate) | go to step 3 |
| 2 | Test for colour and texture | |
| | a) light to dark grey, fine sand to silt, coarser grains have vesicular pores | fly and bottom ash |
| | b) dark grey to black, visible particles of coal | coke mud |
| | c) light to dark brown, fine sand to silt, small Fe/Mn concretions | dredge mud of rivers |
| | d) dark grey to black, H ₂ S smell | dredge mud of lakes |
| | e) dark grey to black, NH ₃ smell, artefacts | sewage sludge |
| | f) dark grey to black, faecal smell, artefacts | faecal sludge |
| 3 | Test for texture, consistence and colour | |
| | h) > 30 percent pieces of grey to reddish-brown slag | slag |
| | i) > 30 percent pieces of bricks and mortar and concrete | construction rubble |
| | j) grey to black, H ₂ S smell, > 30 percent artefacts (glass, ceramic, leather, wood, plastic, metals) | waste |

Anthropogenic Components / „artefacts“: key in KA5

- 9 headtitles (level 1):
construction rubble, ash, slag,
mining waste, „anthroorganic“
material, anthropogenic solid
rock, natural soil material, waste
and sludge
- 37 subtitles (level 2 resp. 3, no
systematic structure and
incomplete/examples)

Bodenkundliche
Kartieranleitung

2005
(KA5)

5. verbesserte und erweiterte Auflage
Hannover 2005

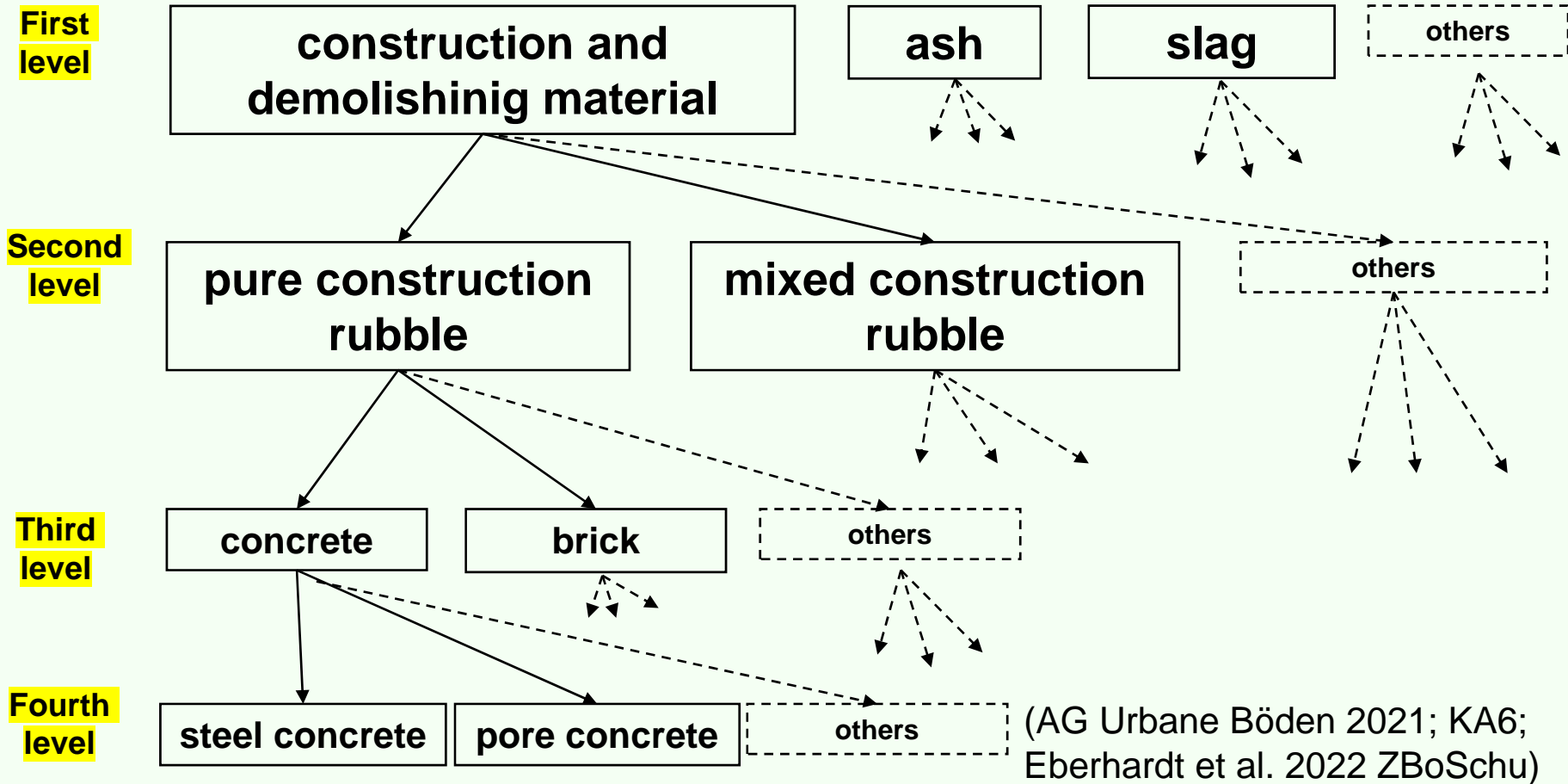
Anthropogenic Components (AC) / „artefacts“: systematic key in **KA6 (2023)**

- 7 headtitles (level 1):
 - construction and demolishing material (10 ACs)
 - ash (5 ACs)
 - slag (10 ACs)
 - residues from smelting and foundry works (4 ACs)
 - residues from mining resources and by-products (5 ACs)
 - waste (11 ACs)
 - sludge (15 ACs)
- 20 subtitles (level 2) and 60 Anthropogenic Components (level 3) + 18 additional ACs (level 4)



https://www.infogeo.de/Infogeo/DE/Downloads/bodenkundl_KA_bodenausgangsgesteine_geol_KA_petrogenet_gesteinszeichnung.html

Key to **Anthropogenic Components:** example „construction and demolishing material“



Key to **Anthropogenic Components**: construction and demolishing material - origin





photo: Makowsky

Baustoffrecycling, Standort Tongrube Dechbetten, Regensburg

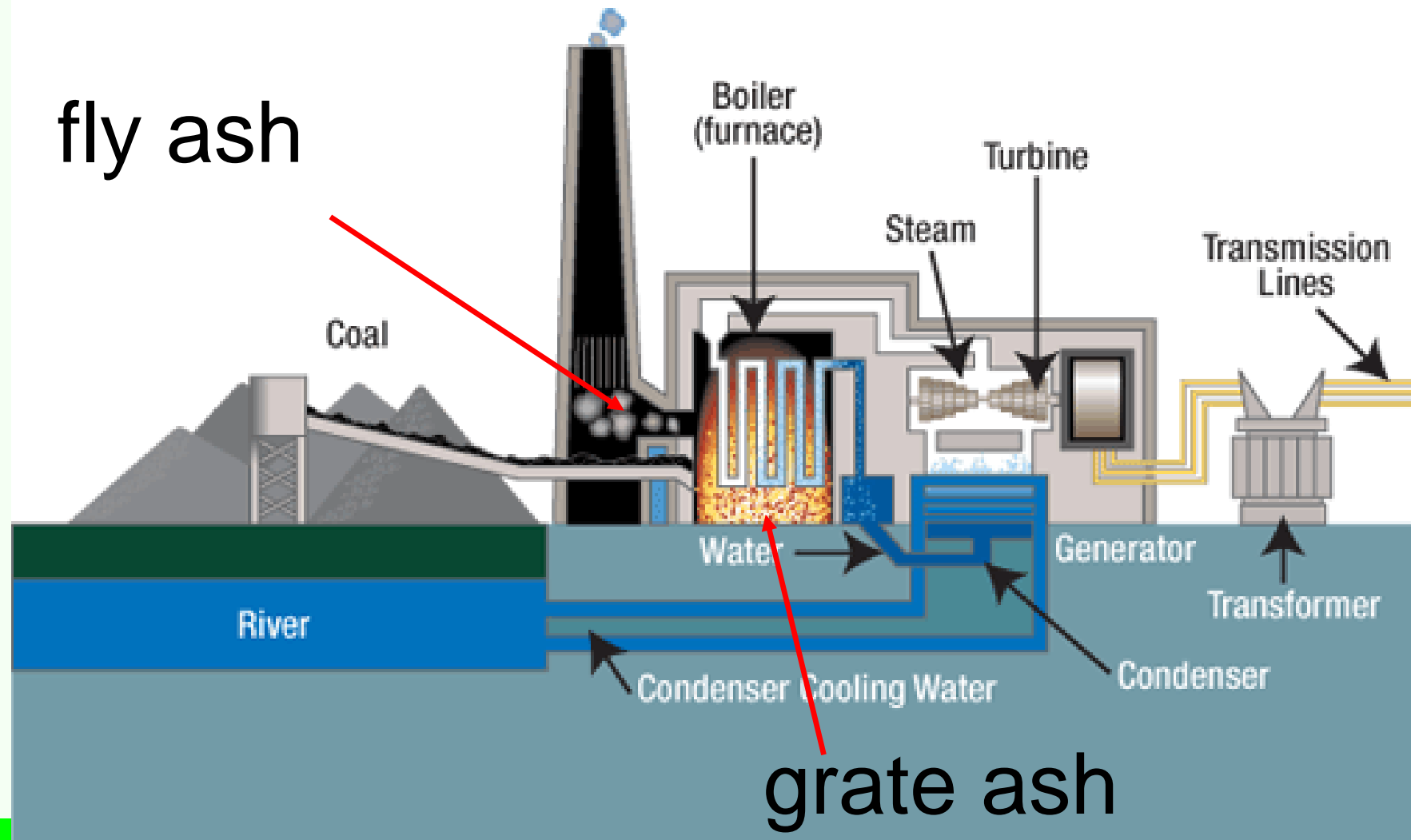
Key to **Anthropogenic Components**:

construction and demolishing material – brick vs. tar asphalt

feature	brick 	tar asphalt 
colour	reddish to brown	grey to black
pores	small pores	not visible
shape/surface of grains	angular	dull, coarse surface, angular-rounded off, conglomeratic
texture	indifferent	indifferent
contaminants	no typical contaminants	PAH
smell	no typical smell	Naphthaline, melting when strongly heated


Key to **Anthropogenic Components:**

ash – origin: combustion of fossil resources or waste

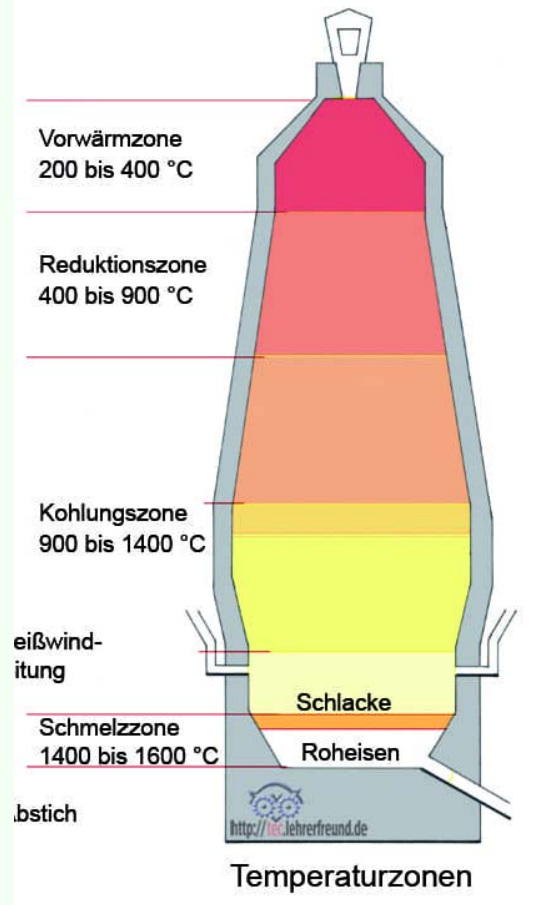


Key to **Anthropogenic Components**:

ash – grate ash vs. municipal solid waste incinerator ash

feature	grate ash 	municipal solid waste incinerator ash 
colour	reddish, brown, grey, black	grey to dark brown; different colours from metals / glas
pores	many open pores of different size	many small pores
shape/surface of grains	vesicular, hooky, cemented, fragile	dull, coarse to glassy /rounded off surface
texture	< 35 mm (typical)	< 63 µm to > 2 mm
contaminants	PAH	PAH, metals
smell	H2S when adding HCl	H2S when adding HCl

Key to **Anthropogenic Components:** slag – origin: melting of ores and pig iron / scrab metal



<https://www.lehrerfreund.de/technik/1s/Vom-Roheisen-zum-Stahl-Hochofen-1/4093>



https://www.juergen-reichmann.de/europa/d/ruhrgebiet_duisburg2/47688/

Key to **Anthropogenic Components:** slag – blast furnace slag vs. steel work slag

feature	blast furnace slag 	steel work slag 
colour	grey	grey to (blue-)black
pores	many pores of different size	many pores of different size
shape/surface of grains	dull, dense, solid, angular	dull to shiny, coarse to smooth surface, dense, heavy, solid, angular
texture	indifferent; > 2 mm (typical)	indifferent; > 2 mm (typical)
contaminants	no typical contaminants	metals, e.g. Chrome
smell	H ₂ S when adding HCl	H ₂ S when adding HCl

Key to **Anthropogenic Components**: residues of smelting and foundry works – origin



photo: Makowsky

Key to **Anthropogenic Components**: residues of mining for resources and by-products - origin



photo: Makowsky

Heap with residues from hard coal mining,
Huainan (Anhui Province, China)



Winding tower
„Ewald“,
Ruhr area

Key to **Anthropogenic Components:** (municipal solid) waste - origin



photo: Niemuth

Key to **Anthropogenic Components**: sludge - origin



photo: Makowsky

sludge polder charged with fly ash
from hard coal combustion (China)

German Substitute Building Materials Ordinance (new from August 2023)

- Regulates the use of quality-controlled mineral substitute building materials (MSBM), i.e. recycling construction material, slags, ashes etc., which are used on or in „soil-like technical buildings“ (e.g. surface layers, backfilling of excavation pits and trenches)



Reconstruction of underground water supply lines in Bielefeld (Germany)
(photo: Makowsky)

German Substitute Building Materials Ordinance (new from August 2023)

- MSBM represent the parent material of technical buildings in which soil formation processes / pedogenesis start (at least) after utilization function terminates
-> Technosol / Constructed Soil



Forest path built from quality-controlled steelwork slags

German Substitute Building Materials Ordinance (new from August 2023)

- Can (and should) carry natural soil functions (e.g. water storage, root penetration zone -> „sponge city“)



<https://www.sieker.de/fachinformationen/rege-nwasserbewirtschaftung/versickerung/article/versickerungsmulden-156.html>

- Steinweg, Makowsky & Dohlen (in preparation, Nov 2022) provide an overview of the 13 ACs which are regulated in the new ordinance

Anthropogenic Components: benefits / summary

- description of Anthropogenic Components on-site should be performed as detailed as possible to
 - understand pedogenesis
 - define reference soil group (WRB) resp. soil form (KA)
 - make contamination assumption
- “level 1” terms (e.g. waste, ash, slag) should be used as qualifiers (WRB) resp. soil form (KA), only
- systematic and completed key for (common) Anthropogenic Components available which represents state of the art



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Take your chance to upgrade urban soil description! Thank you!

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