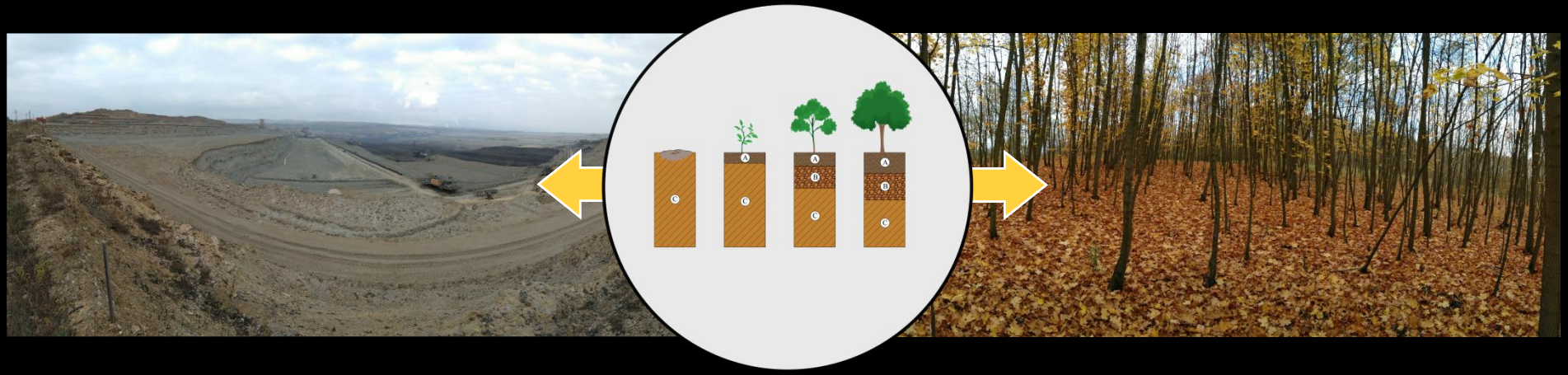
Faculty of Agrobiology,
Food and Natural Resources
Department of Soil Science and Soil Protection

The effect of various tree species and time on the process of soil formation on post-mining sites:

A common garden experiment with 22 tree species and a chronosequence from Sokolov, Czech Republic



Marko Spasić[1]*, Oldřich Vacek[1], Enkhtuya Enkhtaivan[1], Václav Tejnecký[1], Ondřej Drábek[1]

* Presenting author

HYPOTHESES:

I

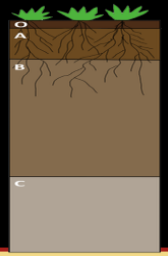
Type and rate of soil forming processes is strongly influenced by soil vegetation cover. Broadleaved species have a tendency to speed up these processes more in comparison to coniferous species (given that the soil formation time, parent material, topography and climatic conditions are the same).

II

Soil forming (pedogenetic) processes start sooner (*Huot et al., 2013*) at reclaimed sites and they follow the trends corresponding to climatic and site conditions.

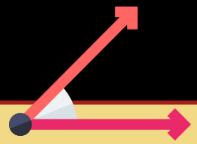
AIMS:

To compare the stage of soil development among stands different tree species;

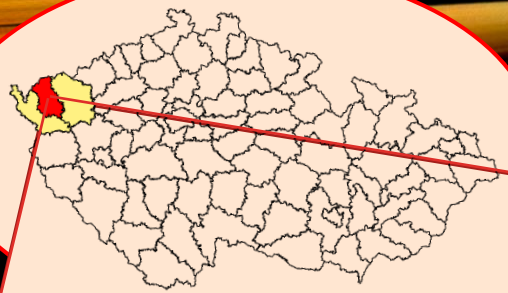


To assess the rate and type of soil forming processes in a chronosequence of reclaimed sites; To identify newly formed soil horizons;

To compare the rate of soil development between stands of various age and assess the speed of soil forming processes;

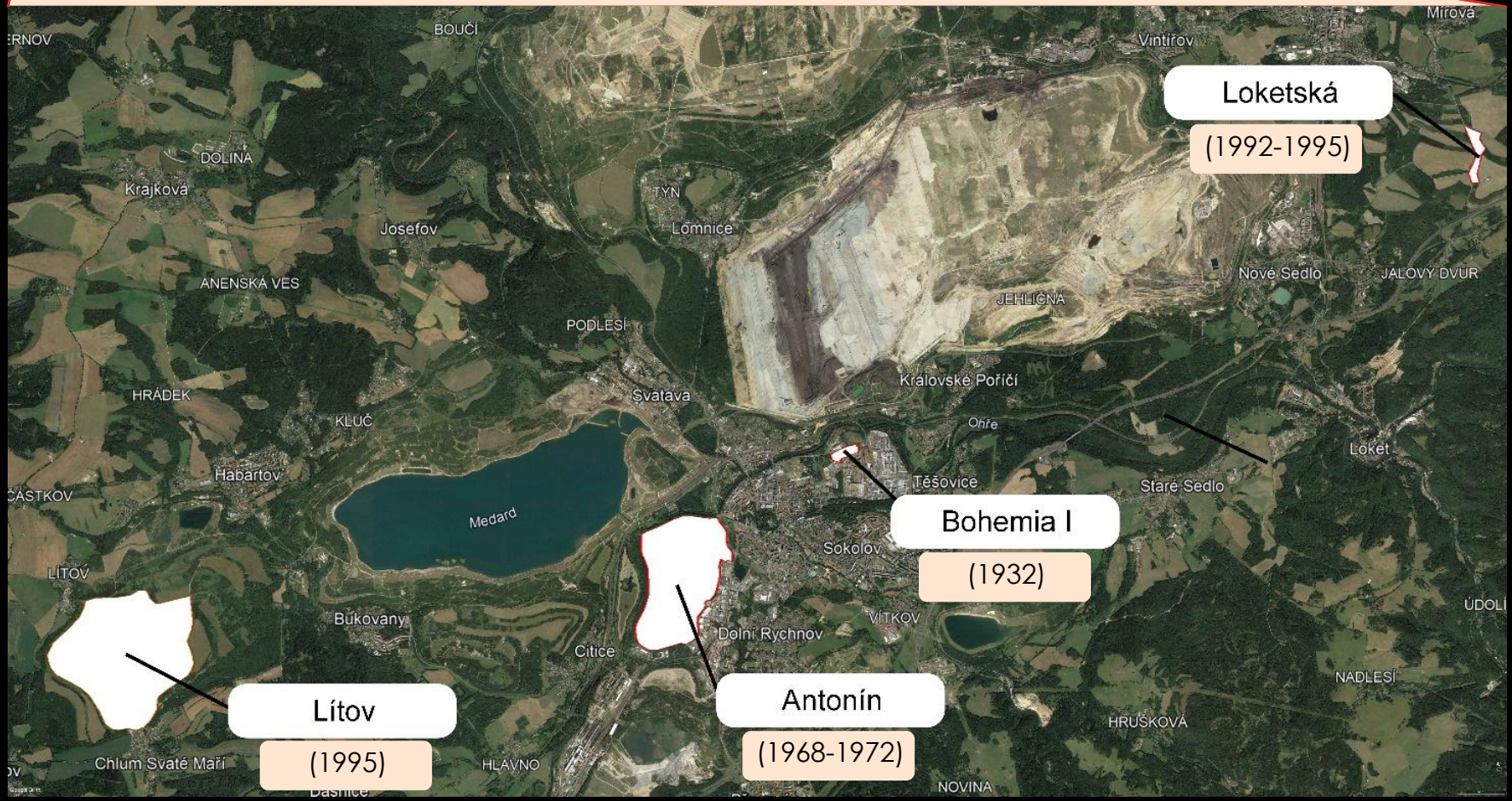


To assess the effect of relief (slope) on the process of soil formation.



MATERIALS AND METHODS:

Sokolov,
Czech Republic



*methods

5

2 research papers from Antonín forest arboretum, Sokolov

Conifers only

European Journal of Forest Research
https://doi.org/10.1007/s10342-021-01392-x

ORIGINAL PAPER

Production potential, biodiversity and soil properties of forest reclamations: Opportunities or risk of introduced coniferous tree species under climate change?

Zdeněk Vacek[1] · Jan Cukor[1,2] · Stanislav Vacek[1] · Rostislav Linda[1,2] · Anna Prokůpková[1] · Vilém Podrázský[1] · Josef Gallo[1] · Oldřich Vacek[3] · Václav Šimůnek[1] · Ondřej Drábek[3] · Vojtěch Hájek[1] · Marko Spasić[3] · Jakub Brichta[1]

Received: 2 April 2021 / Revised: 3 June 2021 / Accepted: 5 June 2021

Scan me!

Conifers + broadleaves

European Journal of Forest Research
https://doi.org/10.1007/s10342-023-01637-x

ORIGINAL PAPER

Which trees form the best soil? Reclaimed mine soil properties under 22 tree species: 50 years later—assessment of physical and chemical properties

Marko Spasić[1] · Oldřich Vacek[1,2] · Kateřina Vejvodová[1] · Václav Tejnecký[1] · Petra Vokurková[1] · Petra Křížová[1] · Filip Polák[1] · Radim Vašát[1] · Luboš Borůvka[1] · Ondřej Drábek[1]

Received: 27 April 2023 / Revised: 1 November 2023 / Accepted: 17 November 2023

Scan me!

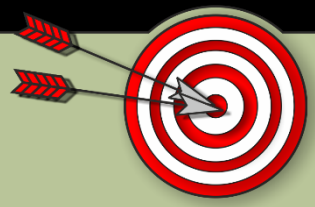
Sokolov, Czech Republic

Stands:

Broadleaved	Coniferous
12x	11x

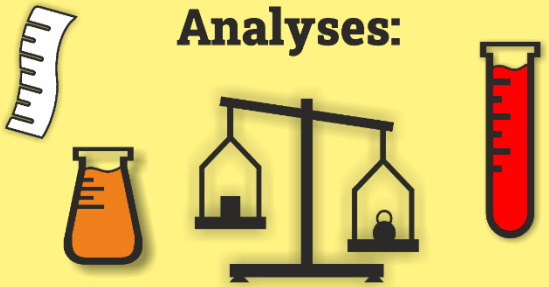
Acer platanoides	***Larix decidua***
Acer pseudoplatanus	***Picea abies***
Alnus glutinosa	*Picea mariana*
Betula pendula	*Picea omorika*
Carpinus betulus	*Picea pungens*
Fagus sylvatica	*Pinus contorta*
Pyrus communis	*Pinus nigra*
Quercus robur	*Pinus ponderosa*
***Tilia cordata* 1 (~ 3%)**	*Pinus strobus*
***Tilia cordata* 2 (~ 9.5%)**	***Pinus sylvestris***
Ulmus glabra	*Pinus rotundata*
	Pseudotsuga menziesii

Goal:



DIRECT COMPARISON
OF SOIL FORMATION PROCESS
UNDER DIFFERENT VEGETATION (TREE SPECIES)
WHERE OTHER SOIL FORMING FACTORS ARE INVARIABLE.

Analyses:

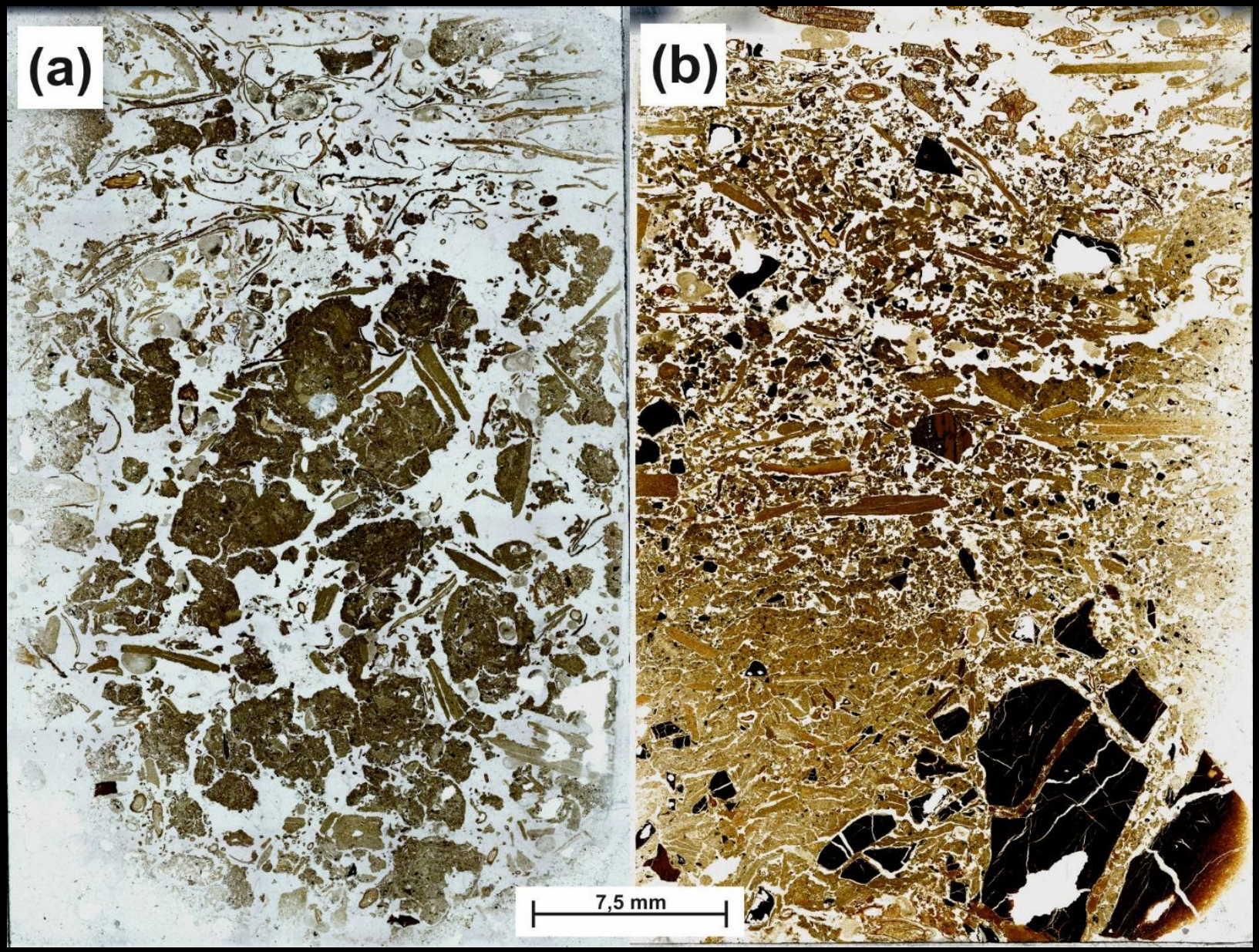


- Soil depth (formed A horiz.)
- pH
- Bulk and particle density
- Porosity
- Water retention
- Oxidizable C content
- Total C and N content
- Plant available nutrients
- Potentially toxic elements

Evaluation criteria:

- Thickness of the formed A horizon (greater → better)
- Bulk density/porosity (looser → better)
- MCC (greater → better)
- pH (higher → better)
- Total C, N, S (greater → better)
- C/N ratio (lower → better)
- Available nutrients (more → better)
- Available PTEs (less → better)

Thin section microscopy *(source: Tejnecký, V., unpublished)*

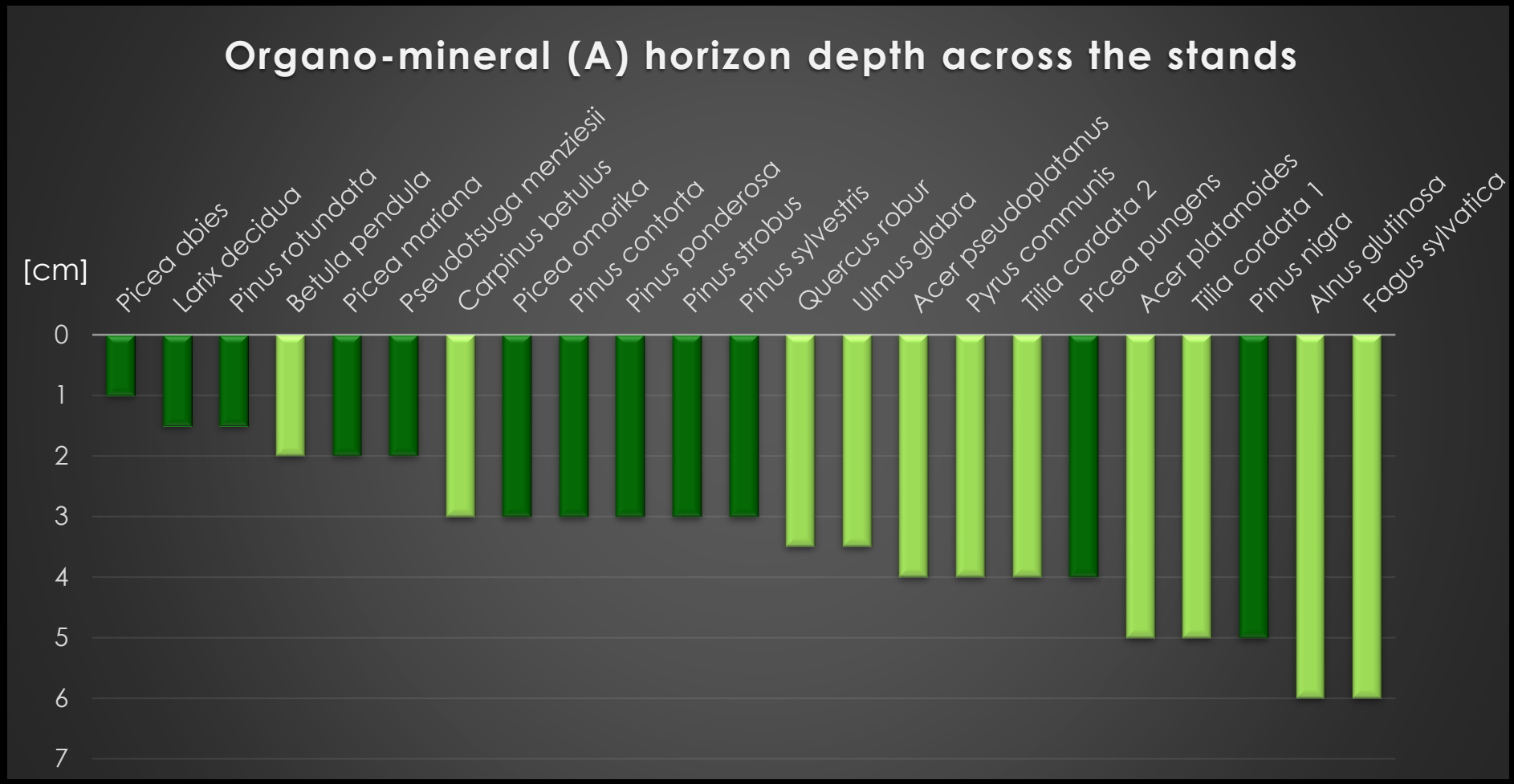


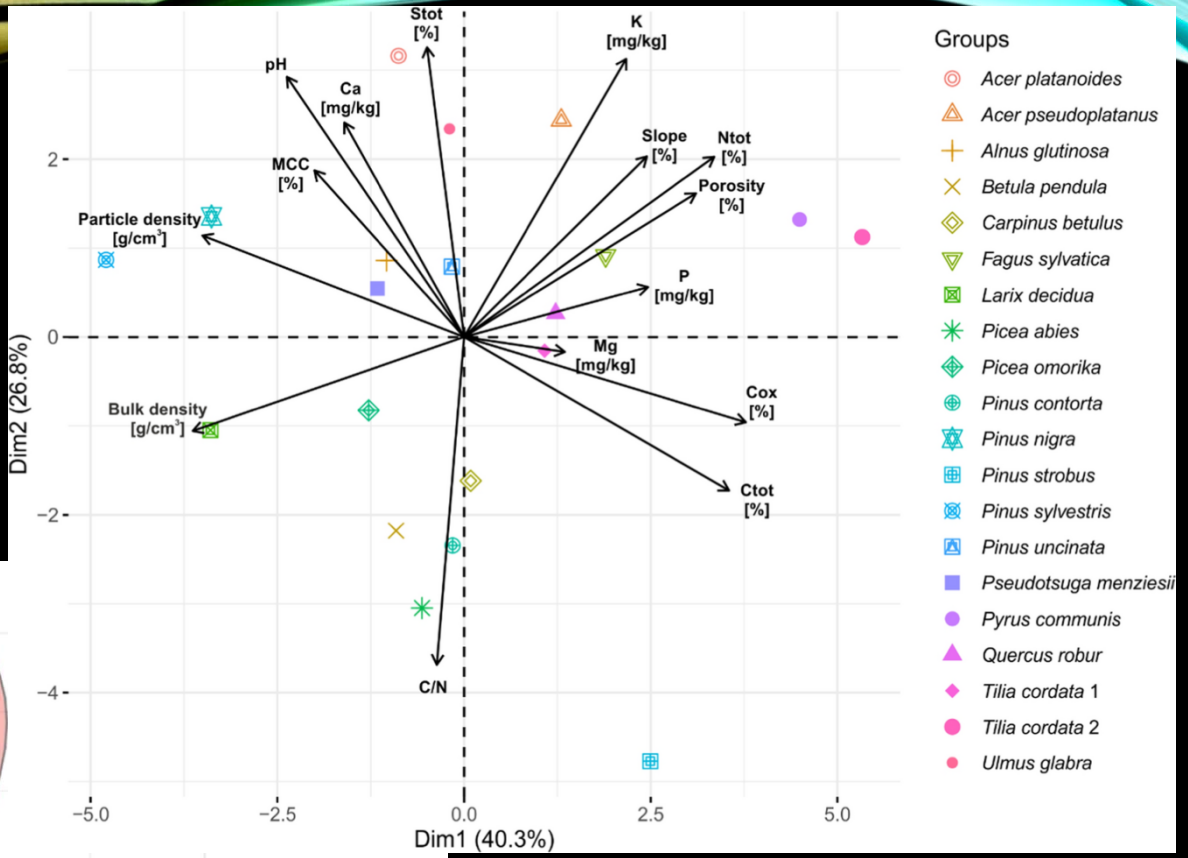
European beech (*F. sylvatica*)

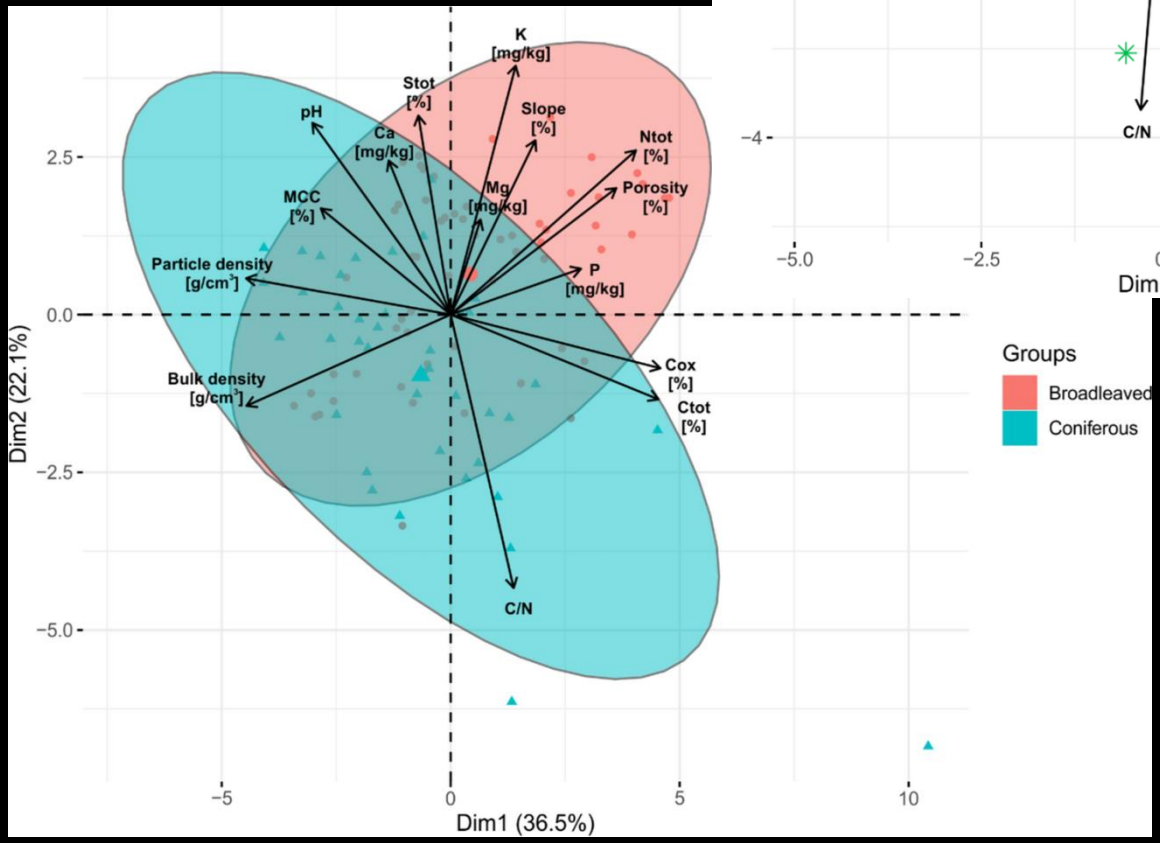
Norway spruce (*P. abies*)

ALDER, BEECH, LINDEN, PEAR, BLUE SPRUCE, PONDEROSA PINE

BIRCH, LARCH, NORWAY SPRUCE, MOUNTAIN, WEYMOUTH & SCOTS PINE




Stot [%]
K [mg/kg]
pH
Ca [mg/kg]
Slope [%]
Ntot [%]
MCC [%]
Porosity [%]
Particle density [g/cm³]
P [mg/kg]
Mg [mg/kg]
Bulk density [g/cm³]
Cox [%]
Ctot [%]
C/N
Dim2 (26.8%)
Dim1 (40.3%)
Groups
Acer platanoides
Acer pseudoplatanus
Alnus glutinosa
Betula pendula
Carpinus betulus
Fagus sylvatica
Larix decidua
Picea abies
Picea omorika
Pinus contorta
Pinus nigra
Pinus strobus
Pinus sylvestris
Pinus uncinata
Pseudotsuga menziesii
Pyrus communis
Quercus robur
Tilia cordata 1
Tilia cordata 2
Ulmus glabra


K [mg/kg]
Stot [%]
pH
Slope [%]
Ca [mg/kg]
Ntot [%]
MCC [%]
Mg [mg/kg]
Porosity [%]
Particle density [g/cm³]
P [mg/kg]
Cox [%]
Bulk density [g/cm³]
Ctot [%]
C/N
Dim2 (22.1%)
Dim1 (36.5%)
Groups
Broadleaved
Coniferous

Extreme examples and why both publications matter:

Pinus sylvestris

Picea pungens

Soil development and properties?

Comprehensive approach?

- Effect of time?

forests

MDPI

Article

Profile Development and Soil Properties of Three Forest Reclamations of Different Ages in Sokolov Mining Basin, Czech Republic

Marko Spasić [1], Oldřich Vacek [2], Kateřina Vejvodová [1], Luboš Borůvka [1], Václav Tejnecký [1] and Ondřej Drábek [1,*]

Soil and Water Research, 19, 2024 (3): 133–143 *Original Paper*

https://doi.org/10.17221/17/2024-SWR

Temporal changes of soil characteristics on Lítov spoil heap, Czech Republic

*Enkhtuya Enkhtaivan[1], Oldřich Vacek[2], Petra Vokurková[1], Marko Spasić[1], Radim Vašát[1], Ondřej Drábek[1]**

Scan me!

Scan me (and check out the poster session)!

Stand 2:
~50 years
Maple
(*Acer pseudoplatanus*)

Stand 1:
~90 years
(1932)
Cherry and Maple
(*Prunus avium, Acer pseudoplatanus*)

Stand 3:
~30 years
(1992-1995)
Alder
(*Alnus glutinosa*)

All profiles have exhibited similar horizon formation (A-Bv-C)

Parent material: Cypress clays

A

Bv

C

Level

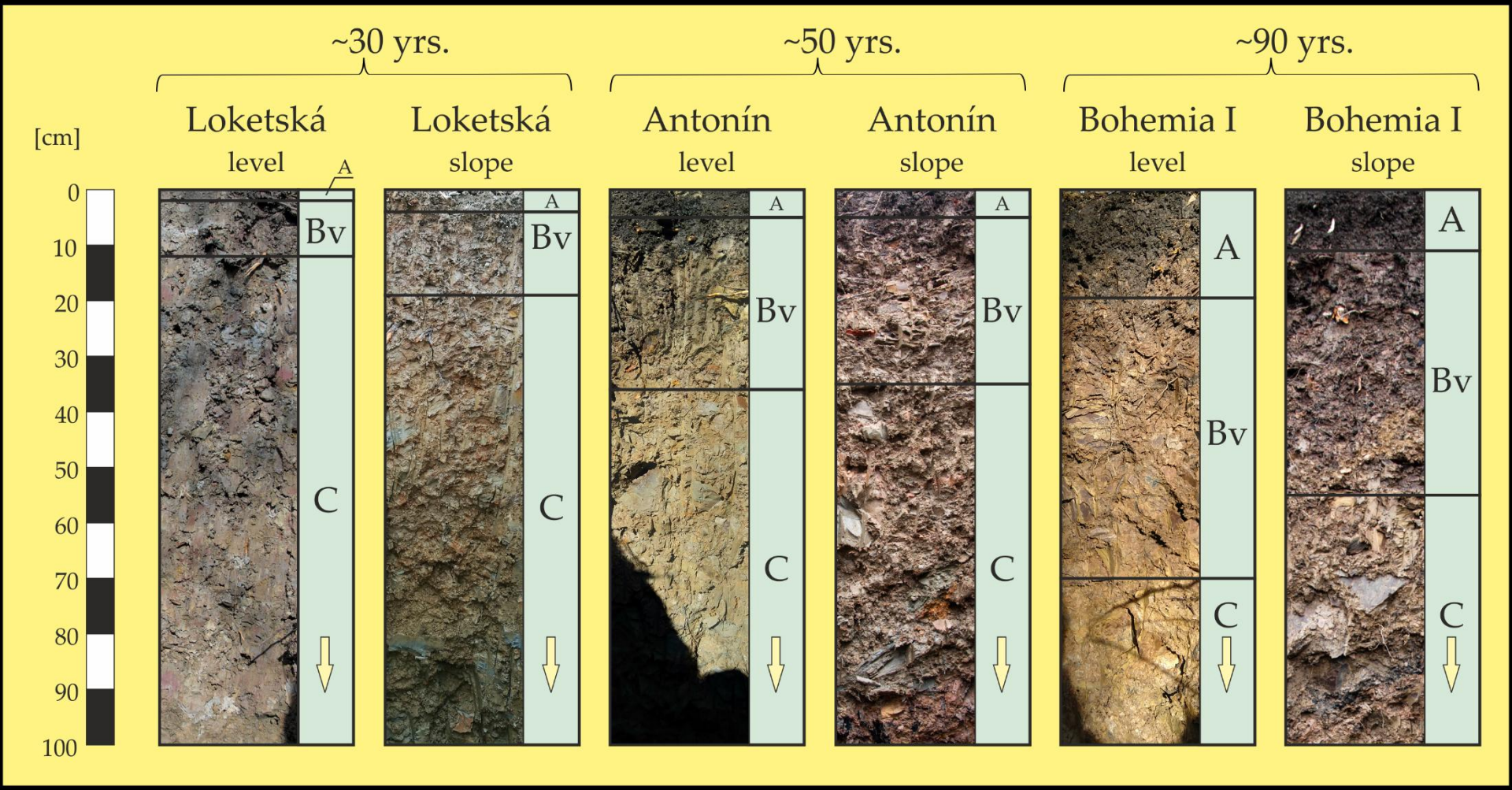
A

Bv

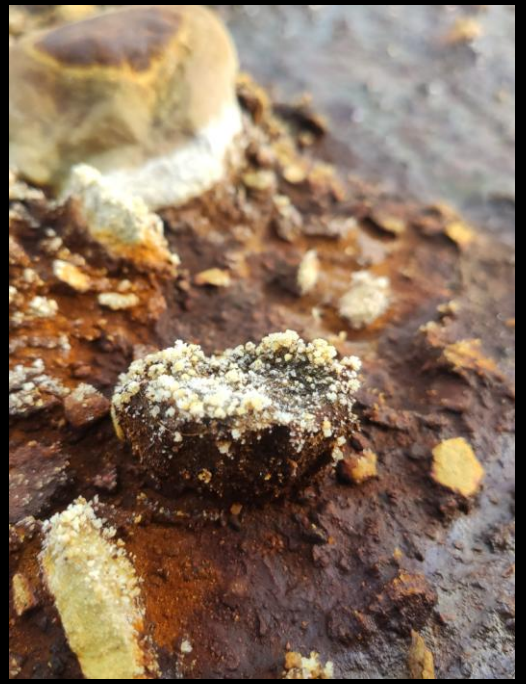
C

Slope

Bohemia I



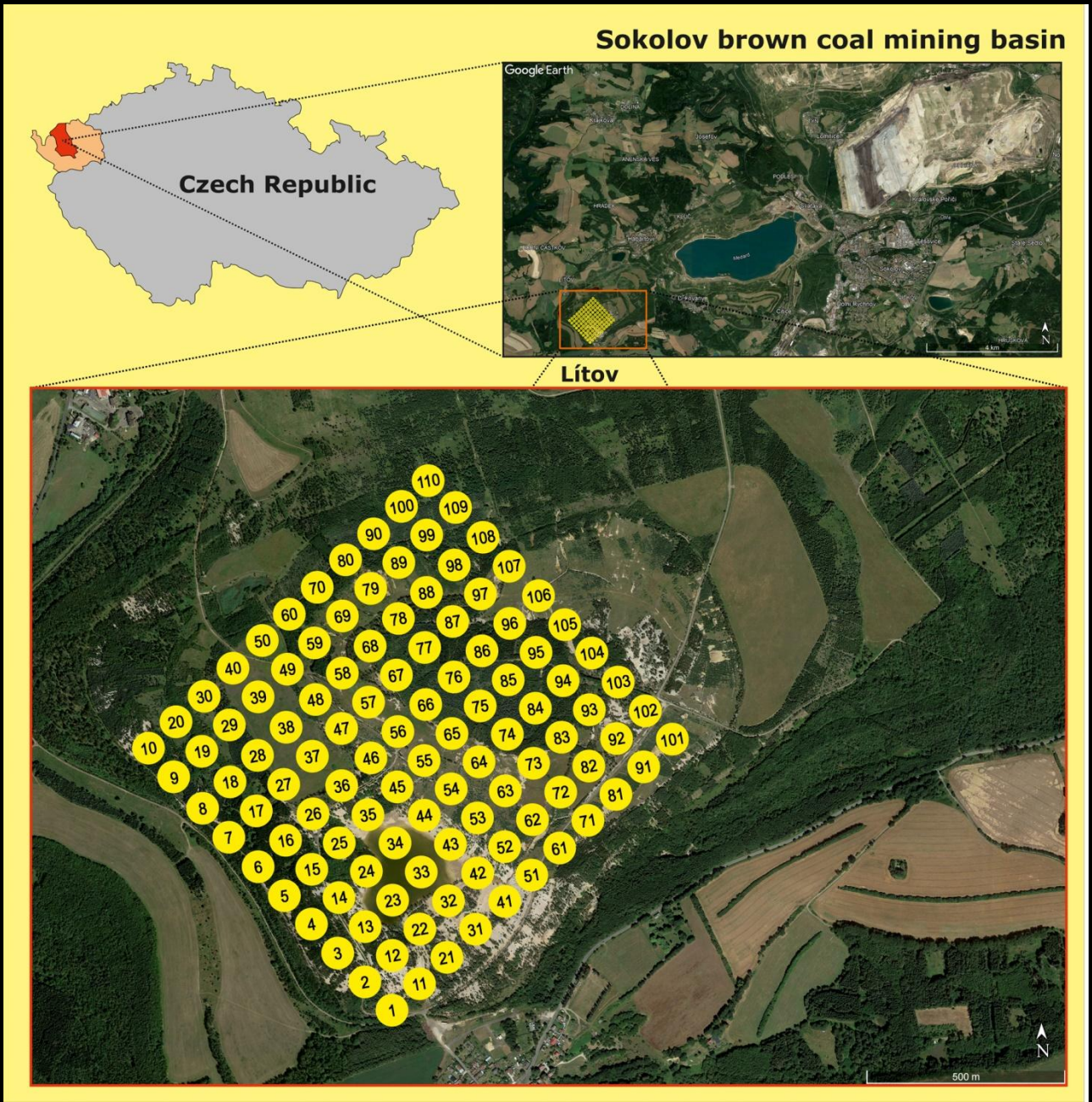
- Effect of time?
  - Clearer horizon boundaries
  - Wider physical and chemical ranges with time
- Effect of SOM accumulation and mineralization on soil quality
- Effect of slope?



Lítov spoil heap

20 years later

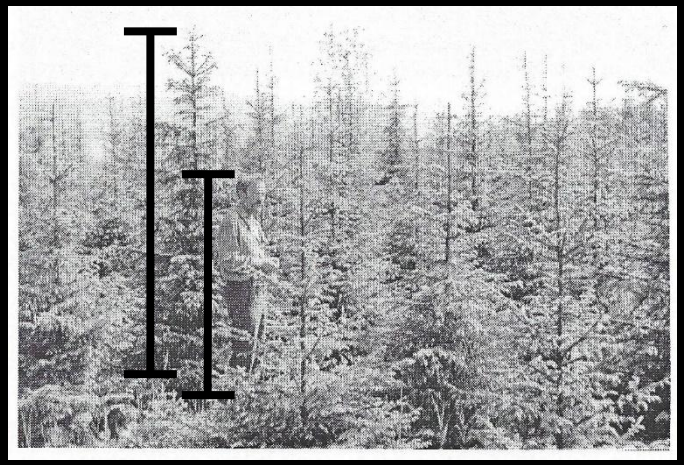
- Increase of pH_{KCl}, C_{ox} and a slight improvement in humus quality in 2018, compared to the results from 1998.
- Afforestation (mainly by decideous trees) supported the improvement of soil properties.
- High pyrite content



CONCLUSIONS:

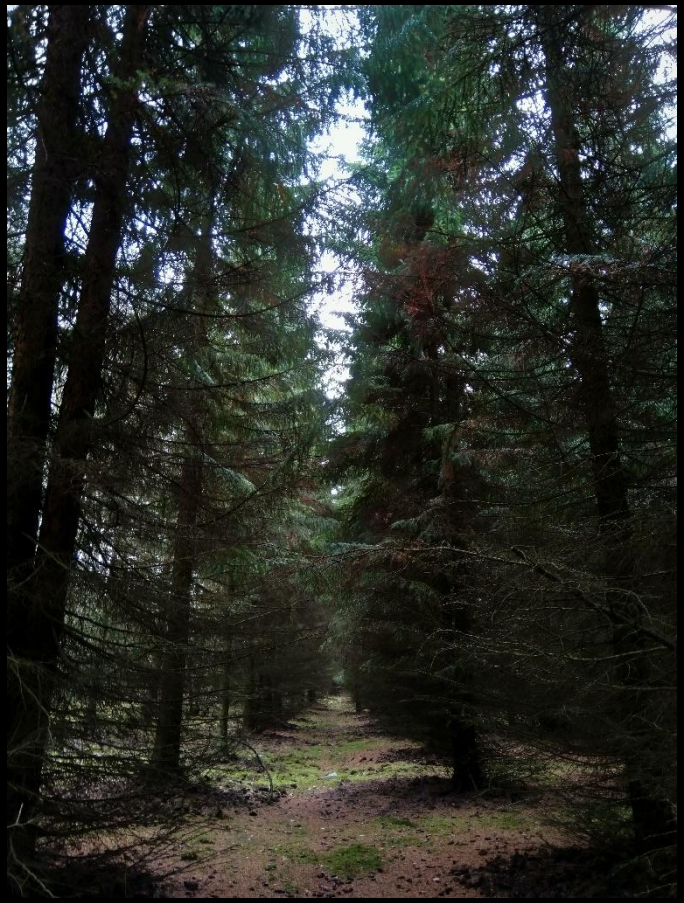
- The effect of time was clearly visible, accummulation of SOM has a very important role
- From the standpoint of soil formation and soil quality, black alder (*A. glutinosa*) and long-lasting broadleaves (beech, maples, linden, pear) are recommended
- Suitable native coniferous species are Scots pine (*P. sylvestris*) and European larch (*L. decidua*)
- Suitable introduced species were black pine (*P. nigra*), Serbian spruce (*P. omorika*) and Douglas-fir (*P. menziesii*)
- The effect of relief on soil formation on reclaimed mine sites was noticed and addressed, but further research is recommended.



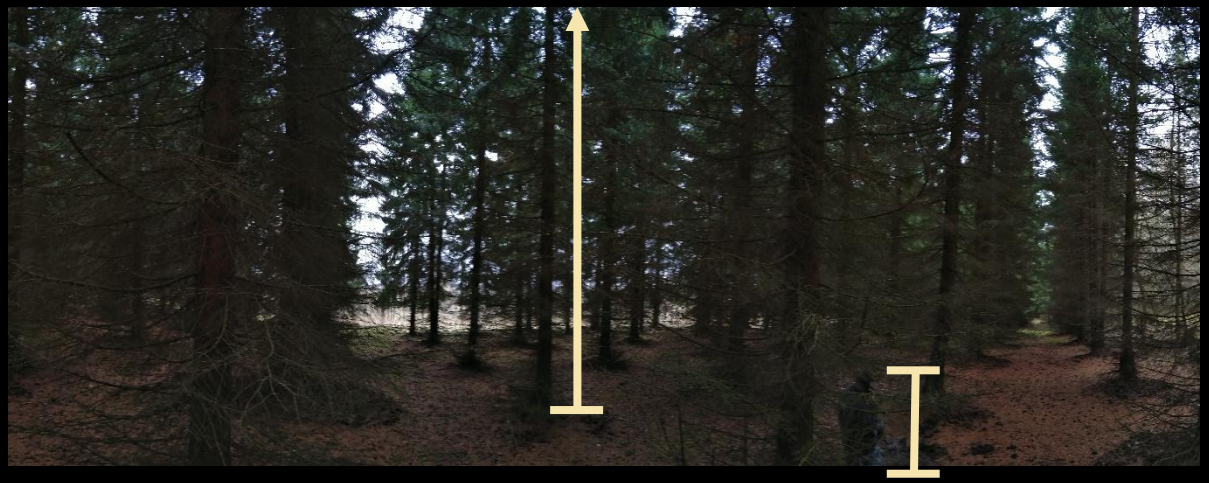



Dožić, S. (1981)
Forestry reclamation with Serbian spruce in Sokolov, ČSSR

(Dožić & Lujić, 2005)



Spasić, M. (2019)



for your attention!

Pedologické dny 2025
Antropogenně ovlivněné půdy
Most
17.–19. 9. 2025

Belchatow, Poland

Góra Kamieńska,
Belchatow, Poland


PLAN ZAGOSPODAROWANIA ZAKŁADU GÓRNICZEGO KWB „BEŁCHATÓW"
Pole Szczerców
Pole Bełchatów
PRZEKRÓJ GEOLOGICZNY PRZEZ ZŁOŻE WĘGLA BRUNATNEGO „BEŁCHATÓW"
ZIMA
LATO