COMPARING STUDY ABOUT THE METHODS TO MEASURE THE COPPER SORPTION CAPACITY OF SOILS

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Aims of the study

During these experiments, two main method types could be identified and compared:

- Batch method; gives information about the equilibrium,
- Soil column or continuous flow method; gives kinetically approaches and results.

- **The result by the different methods – where was measured the sorption amount of copper on high organic content soils should be compared with each other**

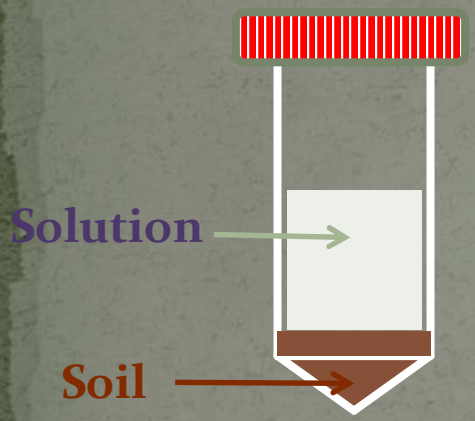
Area of samples

- The brown forest soil samples originate from Hungary, Trizs municipal (near the Bükk Mountains)
- The samples were taken from the “A” soil level (which was mixed with coal) at a control area and three charcoal burner with different leftover age:
  - 25 years ago
  - 35 years ago
  - 80 years ago
- The determination of soil abilities based on general methods

Soil abilities, used in the experiment

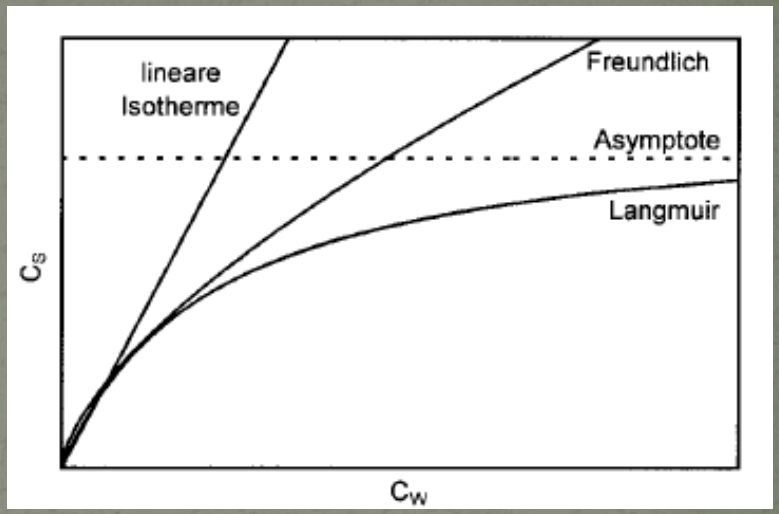
	Density	Volume mass	Porosity	Ignition loss	pH (KCl)	Organic Carbon content	Dry material content
Soil sample	(g/cm^3)	(g/cm^3)	(%)	(%)		(%)	(%)
Control	2,38	1,01	57,65	2,17	4,5	4,1	97,87
80 years	2,24	0,99	55,77	2,06	4,1	6,1	97,98
35 years	2,08	0,92	55,72	3,14	5,5	12,6	96,95
25 years	2,15	0,74	65,60	3,17	4,7	11,8	96,92

Batch method



Shake

Centrifuge, filtrate, measure



$$q = \frac{A_{max} \cdot K \cdot c}{1 + K \cdot c}$$

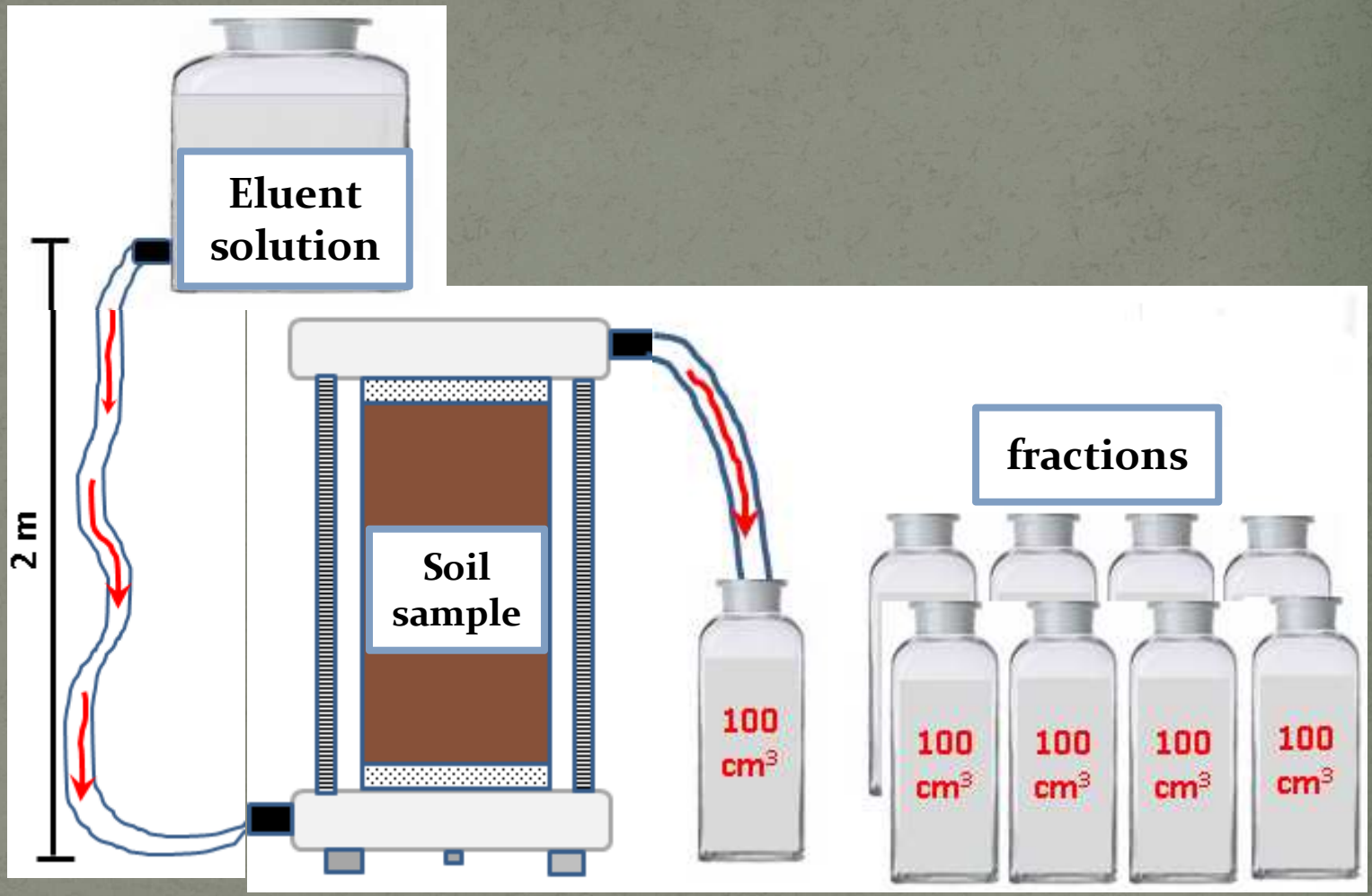
(source: Gabriella Rétháti)

q: adsorbed amount (mg/kg)
c: equivalent concentration of solution (mg/dm³)
A_{max}: maximum adsorbable amount (mg/kg)
k: Langmuir constant (dm³/mg)

Puffer capacity

$$b = \frac{dq}{dc} = \frac{A_{max} \cdot k}{1 + k \cdot c^2}$$

Soil column method



(source: Gabriella Rétháti)

Adsorption isotherms

In case of Langmuir model there is a roof for the adsorption capacity calculation which takes into account the limitation for adsorption and calculates with it (Jiang et al., 2005):

$$q = \frac{KcM}{(1 + Kc)}$$

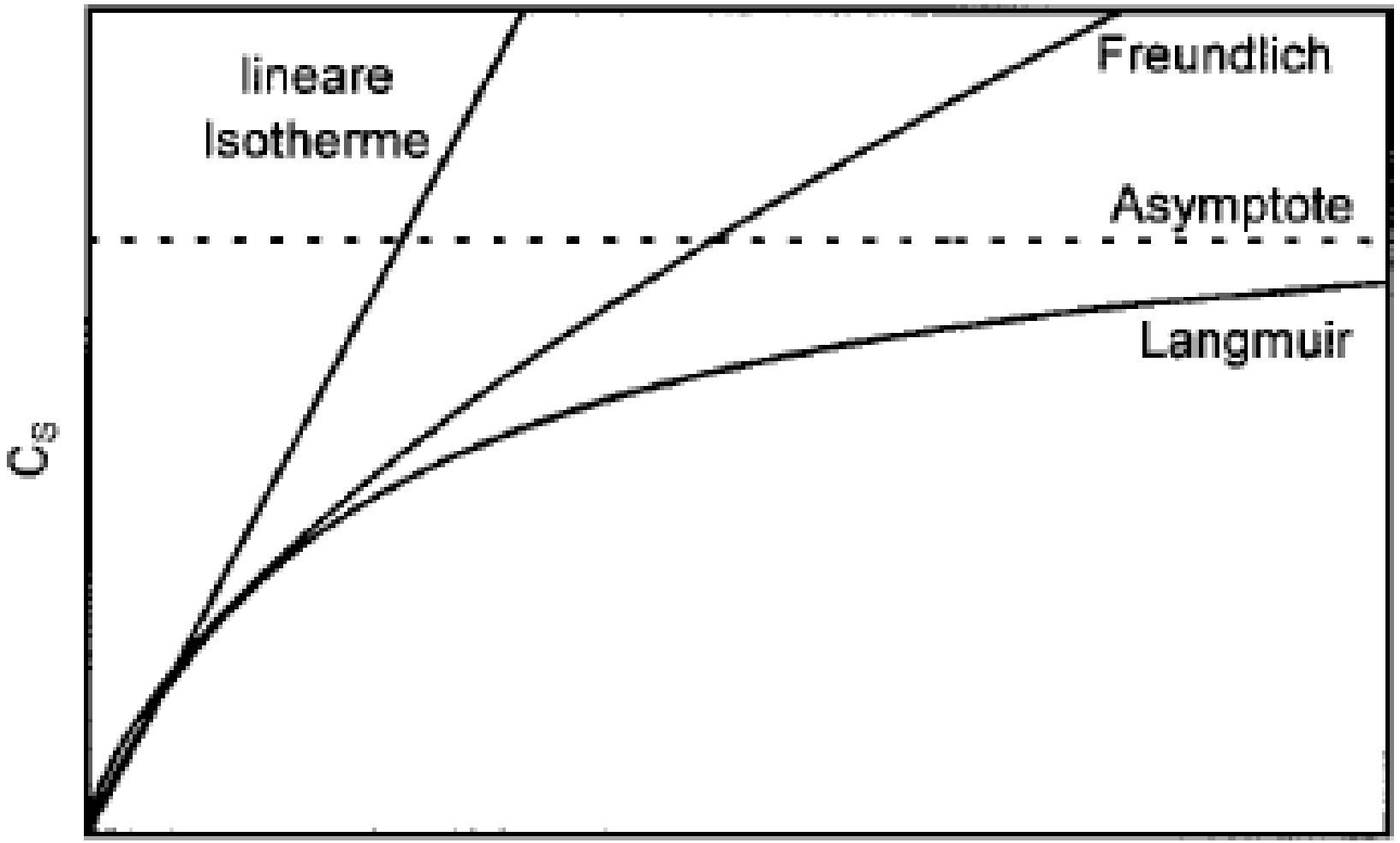
Opposite this the Freundlich isotherm does not take account the loading of the surface (Sparks, 2003). The general form for it:

$$q_e = k_f c_e^n$$

W. Jiang - S. Zhang - X. Shan - M. Feng -Y. G. Zu - R. G. McLaren: 2005. Adsorption of arsenate on soils. Part 1: Laboratory batch experiments using 16 Chinese soils with different physicochemical properties. Environmental Pollution, 138: 278-284 pp.

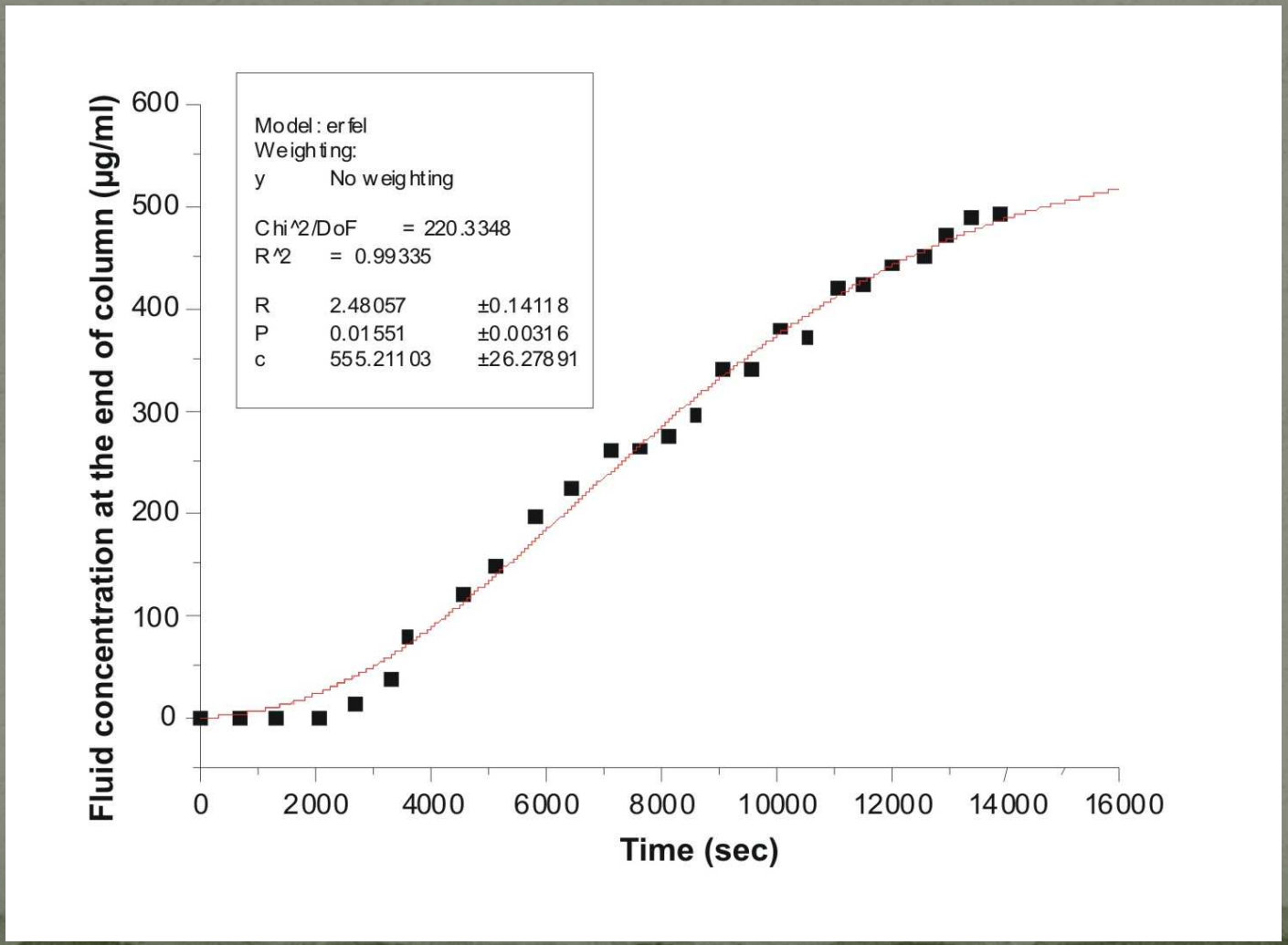
D. L. Sparks: 2003. Environmental Soil Chemistry. Academic Press, The United States, 352 pp.

Adsorption isotherms



(Spring: http://www.delta-h.de/SPRING/download/SPRING4_Webhilfe_E/Stofftransport7.htm)

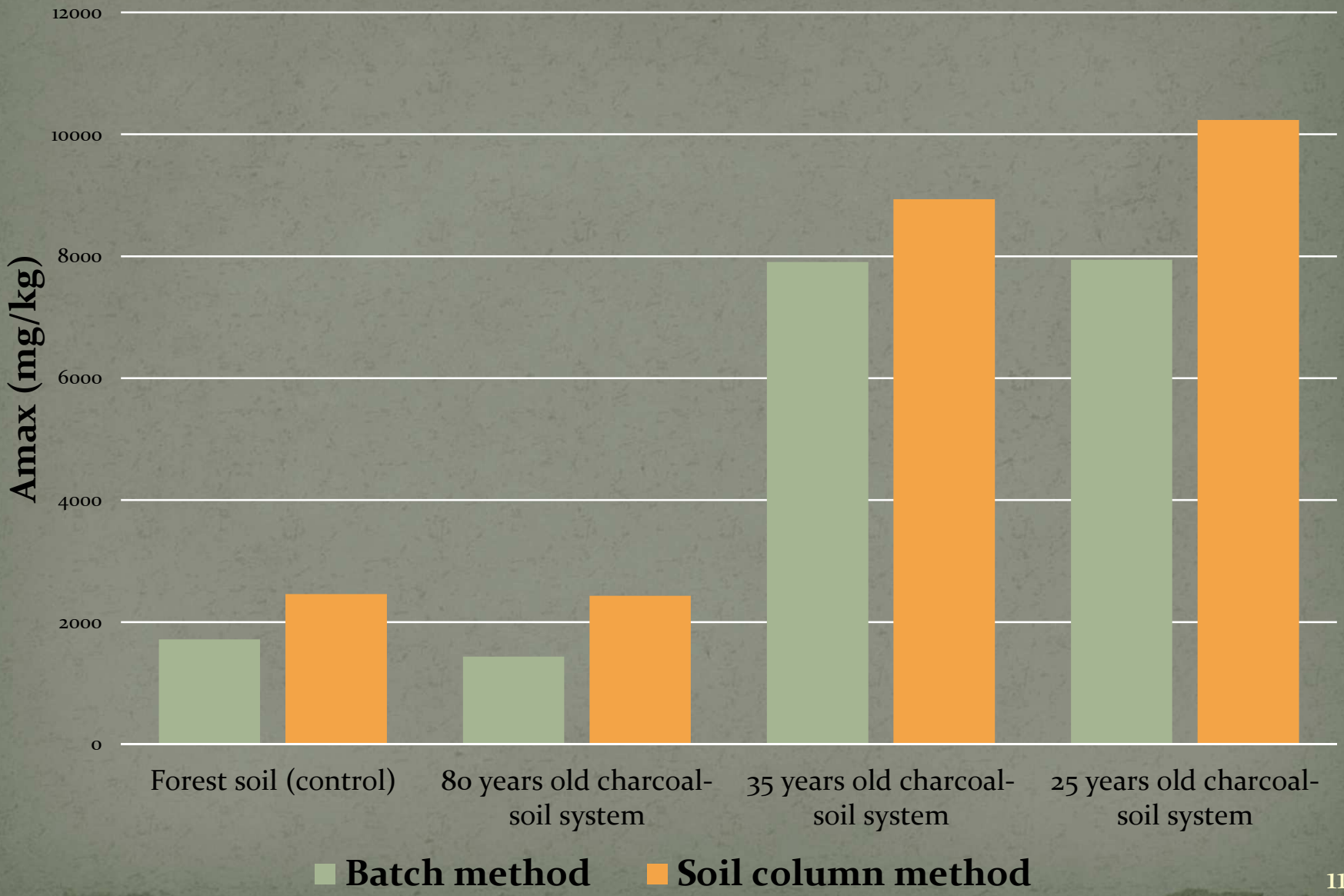
Copper adsorption for 80 years old charcoal-soil system sample (Applied: 500 mg Cu eluent concentration)



Calculated maximum adsorbable copper amount for the two different methods

Soil Sample	Retardation factor	Buffer capacity (dm^3/kg)	Eluent concentration (mg Cu/dm^3)	Batch method (Langmuir) A_{max}(mg/kg)	Soil column method A_{max}(mg/kg)
Forest soil (control)	1,96	14,49	500	1716	2459
80 years old charcoal-soil system	2,48	25,35	500	1435	2432
35 years old charcoal-soil system	3,01	41,72	1000	7904	8937
25 years old charcoal-soil system	1,83	20,31	2000	7943	10235

Adsorption of soil samples



Conclusion

- As summary can declare: the soil column technique can used for the measurement of metal adsorption in case of different origin soils.
- The concentration of eluent has big influence on the breakthrough point also on the exhaustive point.
  (However these different concentrations have no effect to the maximum adsorbable amount)
- The maximum adsorption values from the batch technique could be compared with the calculated results from the soil column method.
  - The results from the soil column method were bigger than the batch technique. It was caused by the different circumstances for the two methods.
  - The difference increased between adsorption maximum of batch and soil methods as the difference raised in the organic carbon content.

Thank you for your attention!