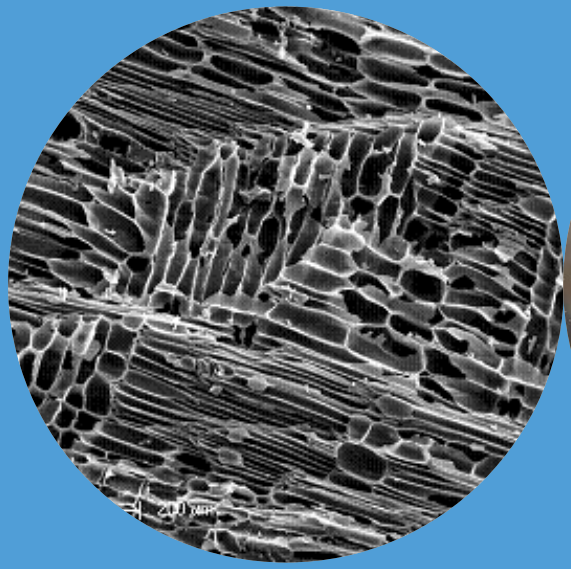
Key Functions of Biochar in Soil

Biochar: can it replace Soil Organic Matter?

Kor Zwart



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Biochar Climate saving soils Final Conference, Groningen 10-12-2013

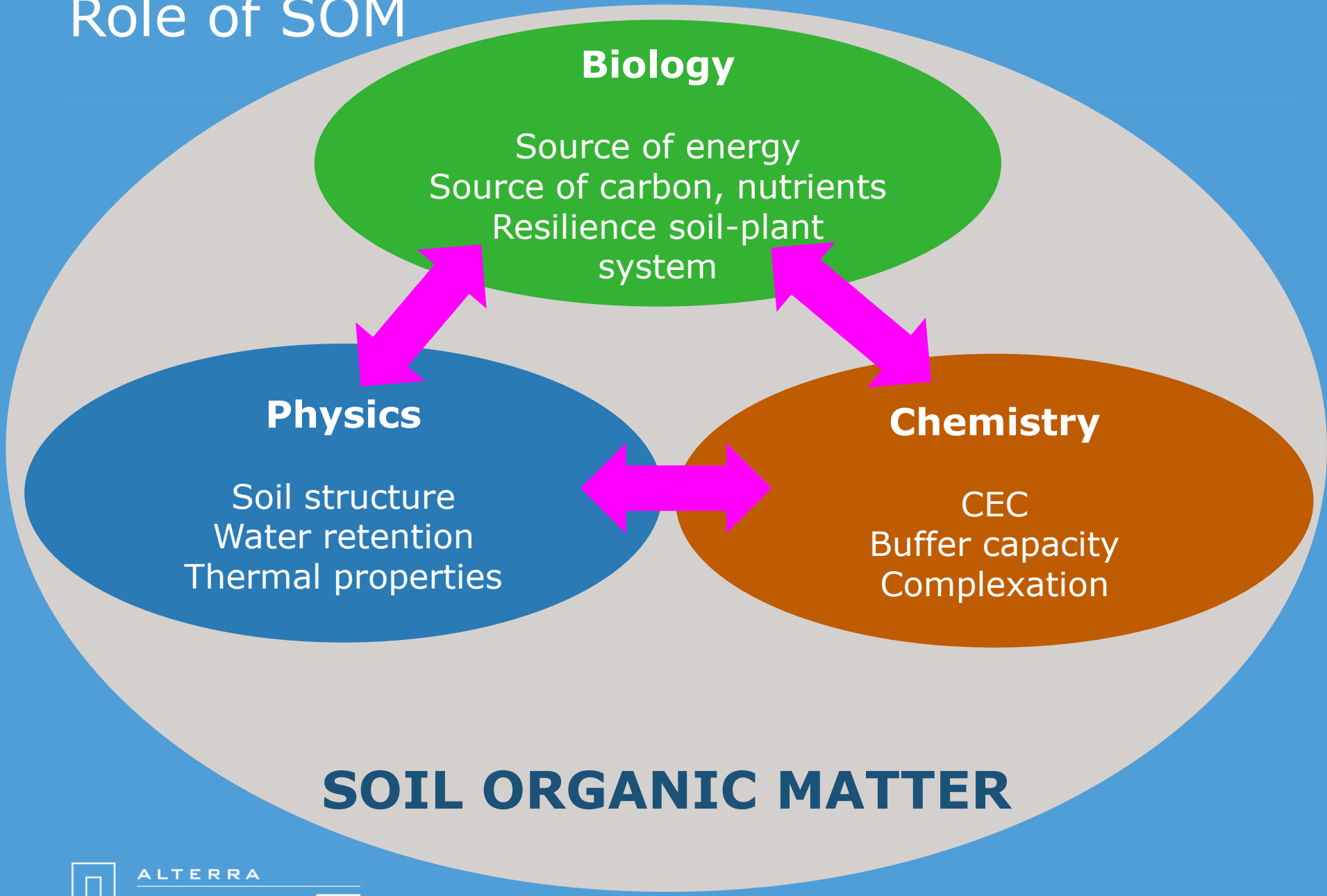
Some basic Algebra

- If $X = a$
- AND $Y = a$
- THEN $X = Y$

SOM and BIOCHAR - Algebra

- Biochar = organic carbon
- SOM = organic carbon
- Biochar = SOM ?

Role of SOM



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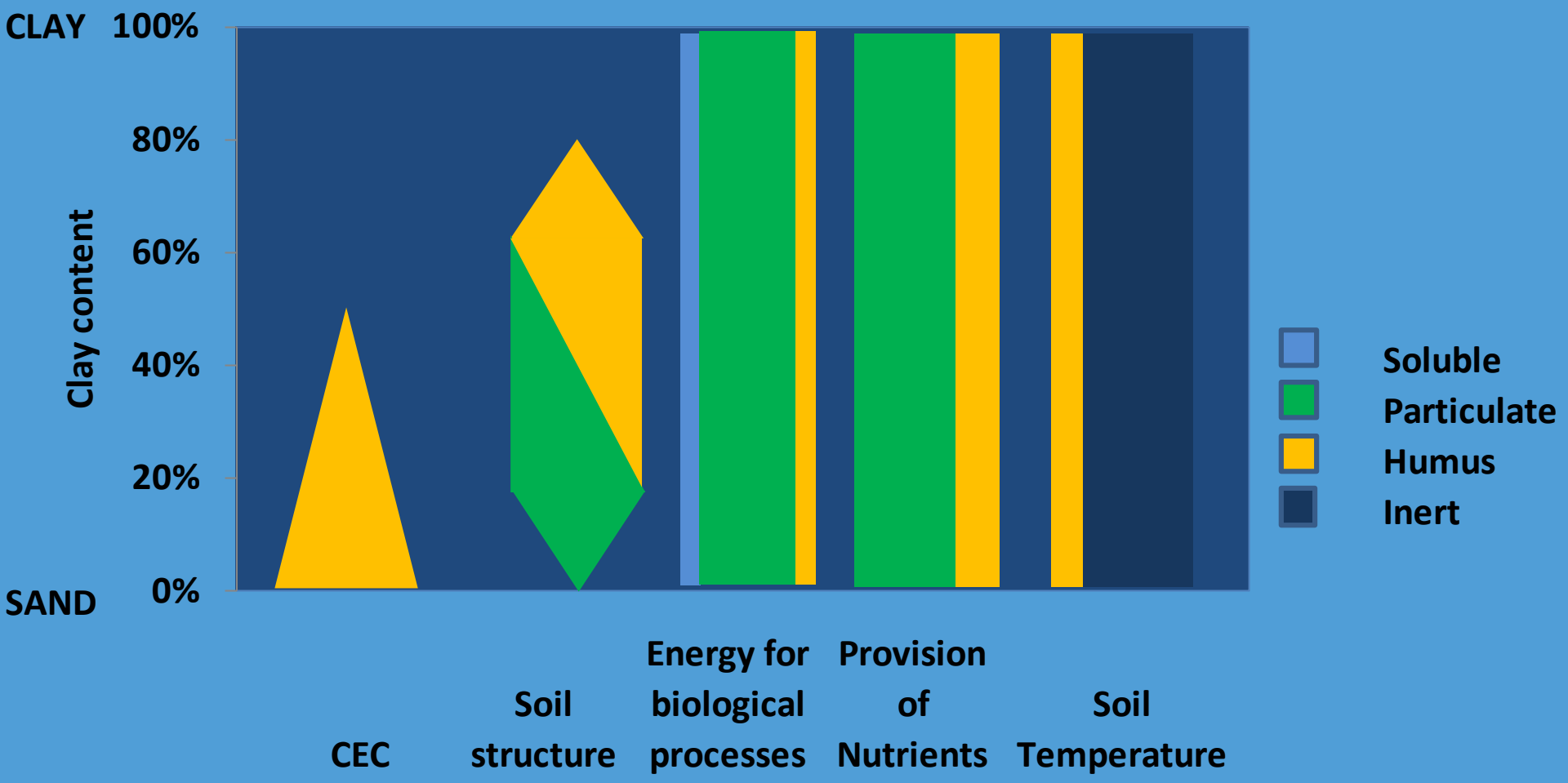
SOM types in SOIL types



After: http://grdc.com.au/uploads/documents/cso000291.pdf

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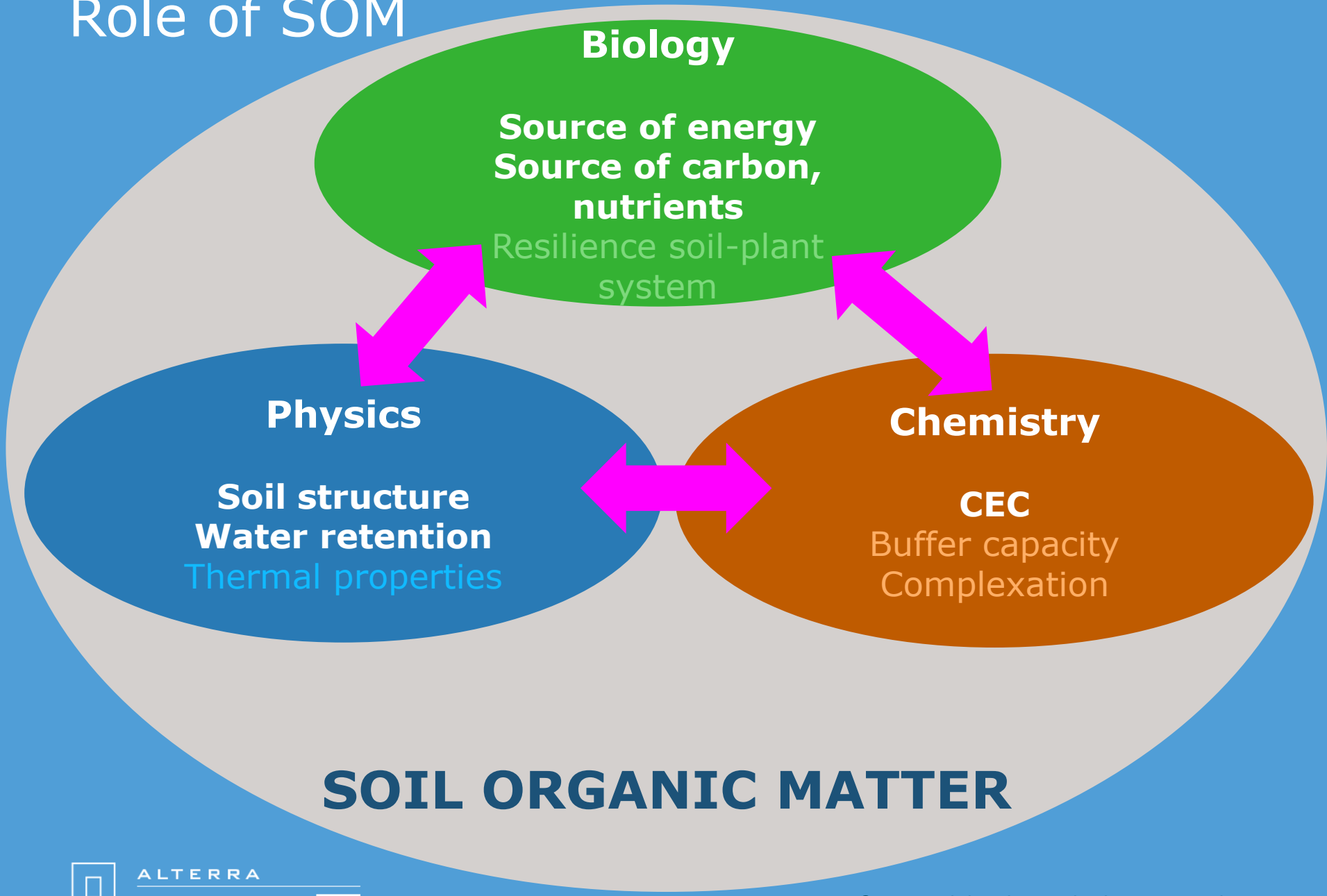
Role of SOM



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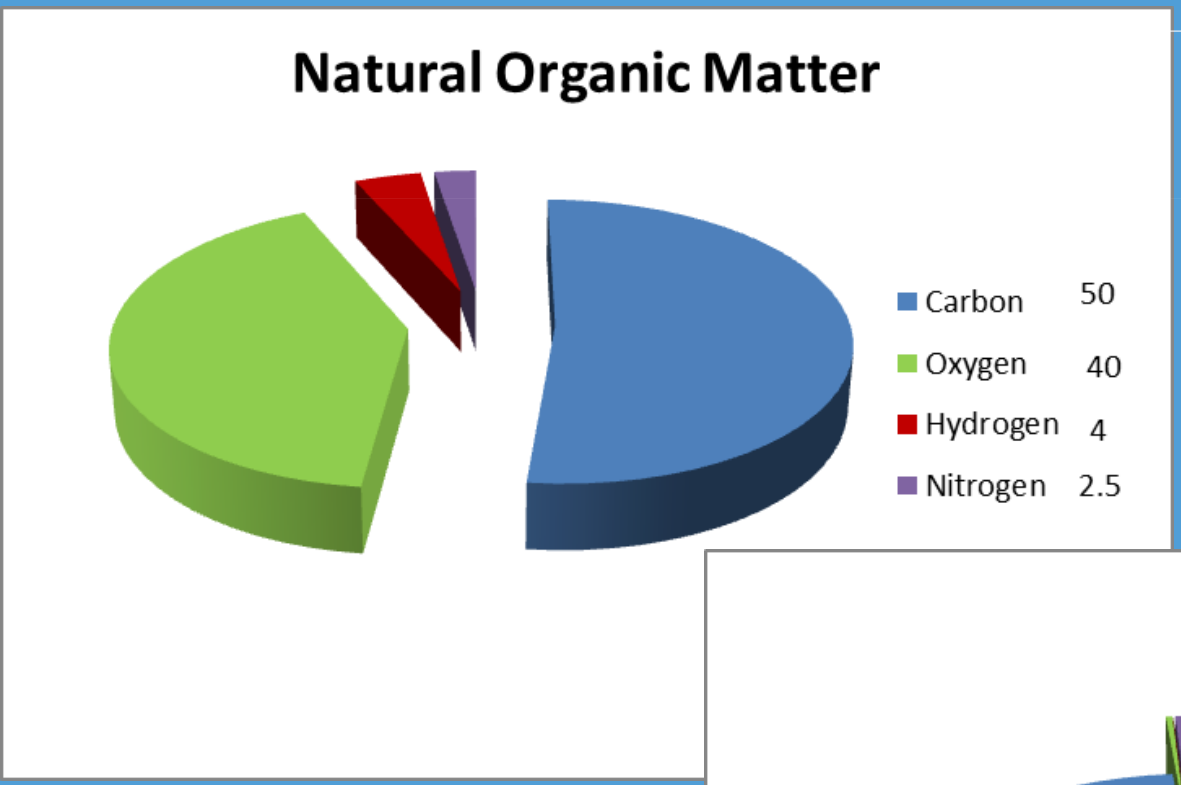
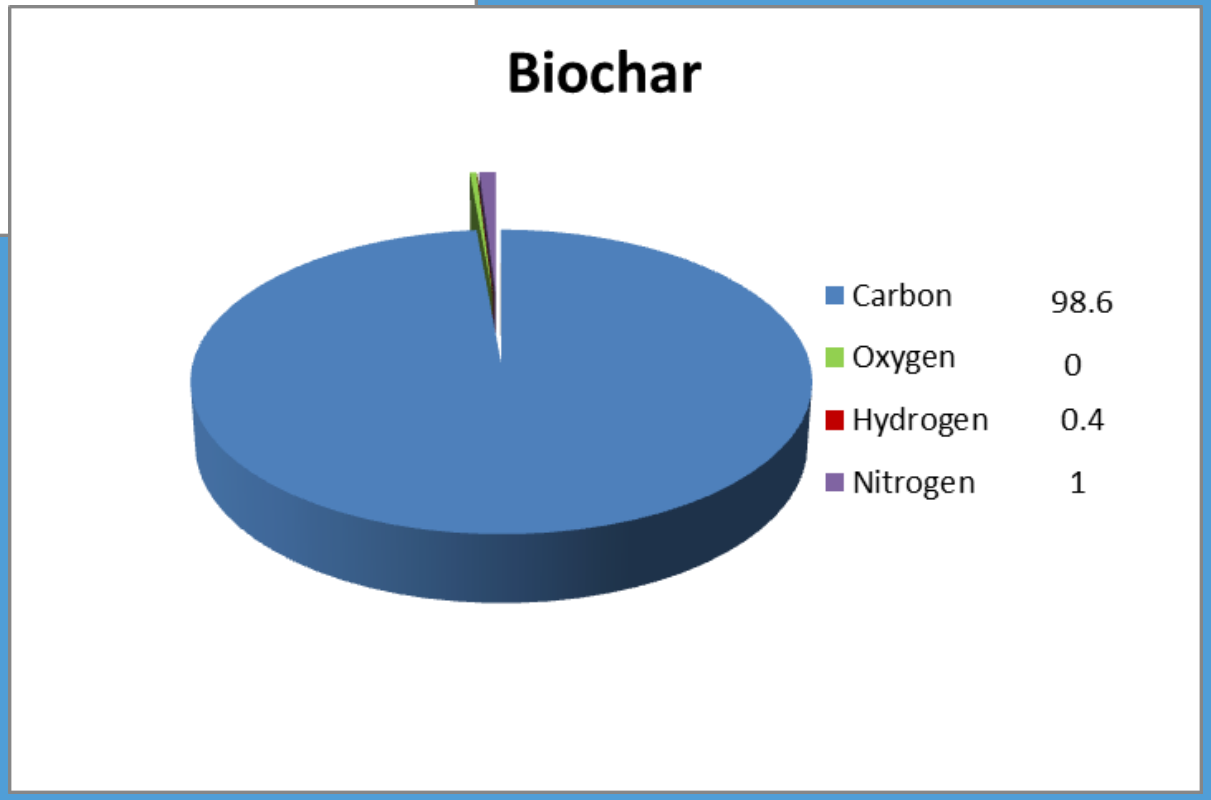
After Baldock and Skjemstad, 1999





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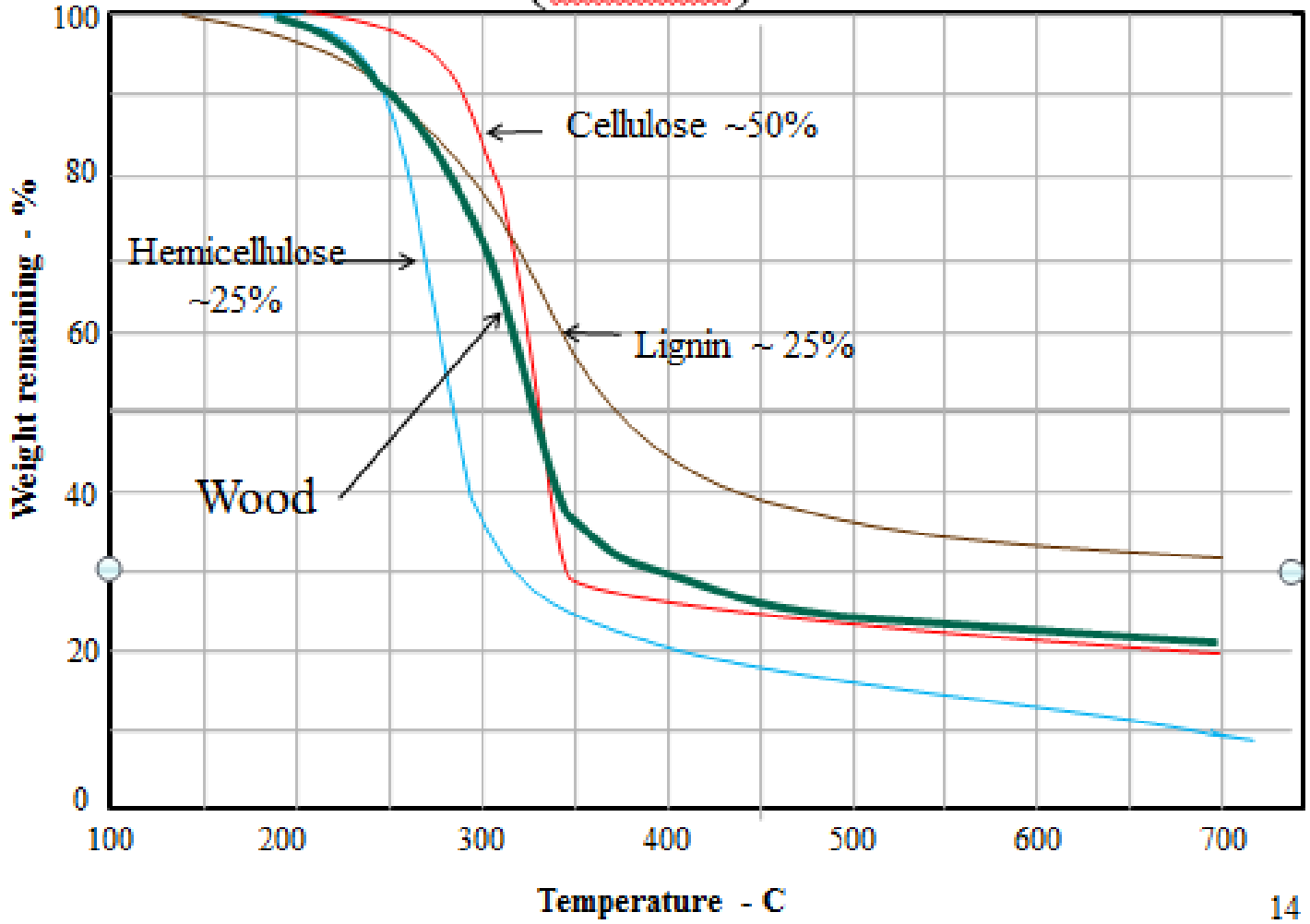
http://www.treepower.org/biochar/main.html

Pyrolysis of Biomass Components (TGA)



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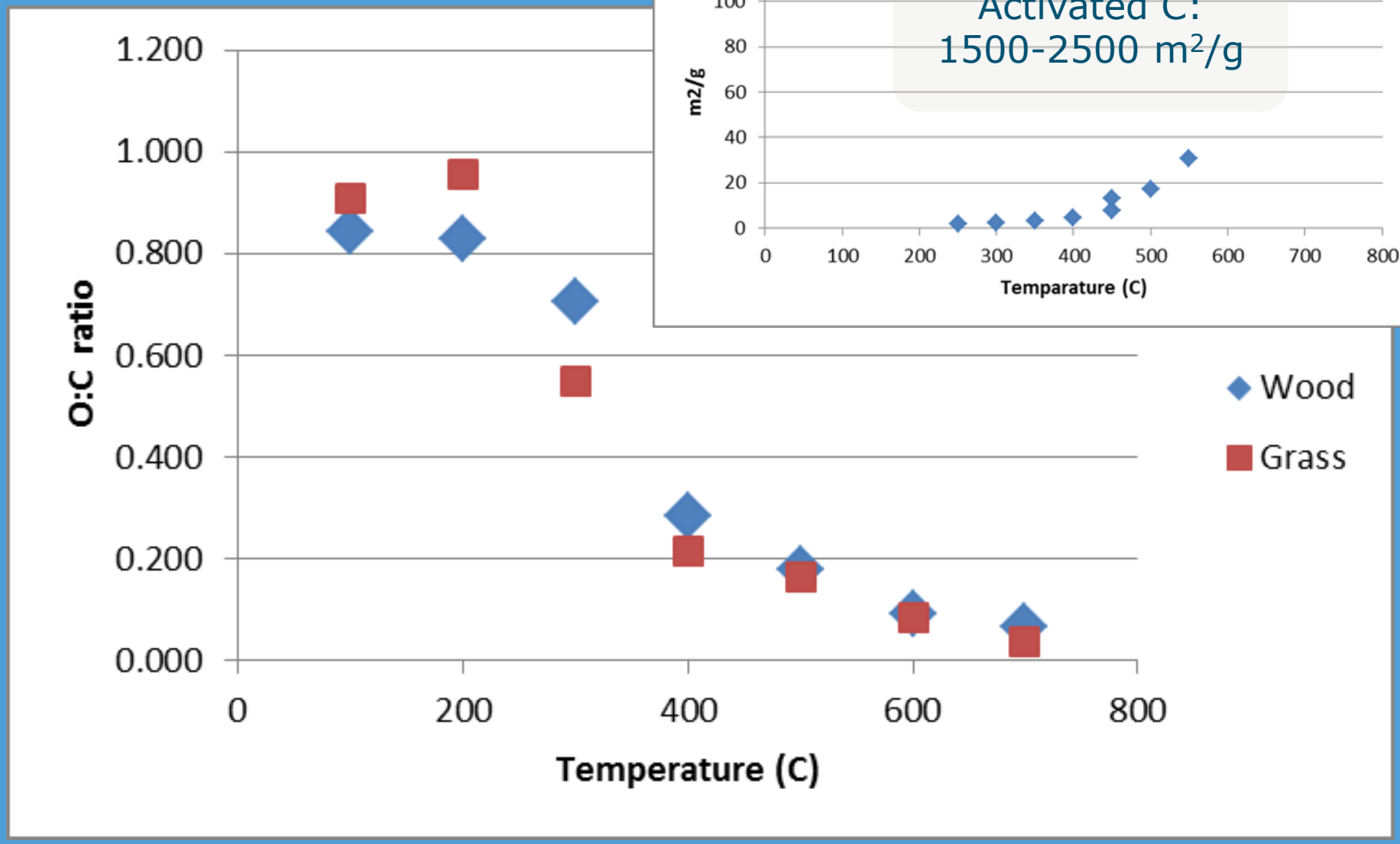
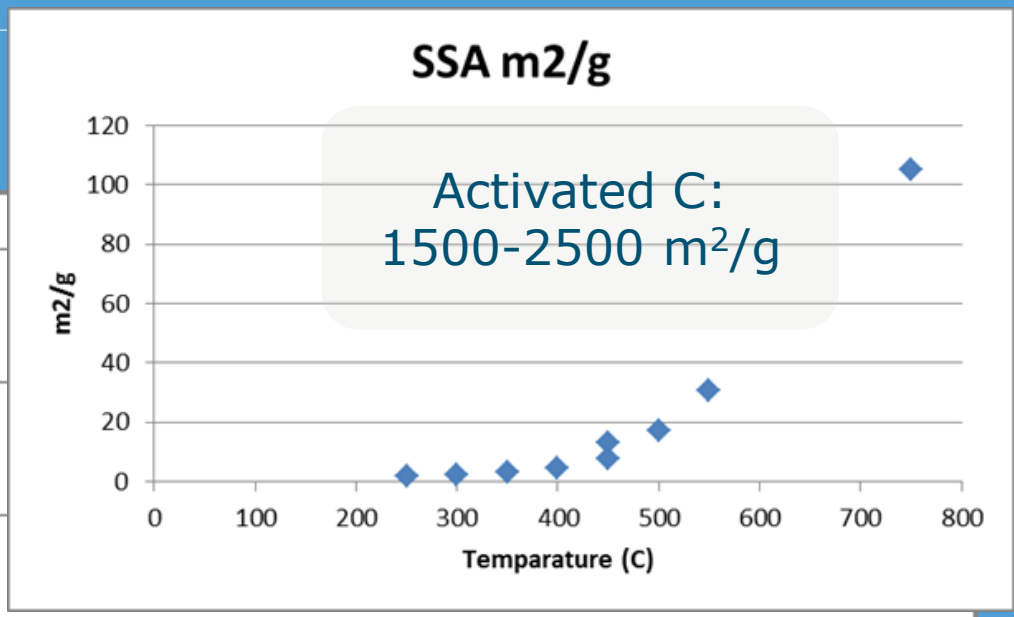
Reed and McLaughlin North American Biochar 2009

Pyrolysis conditions





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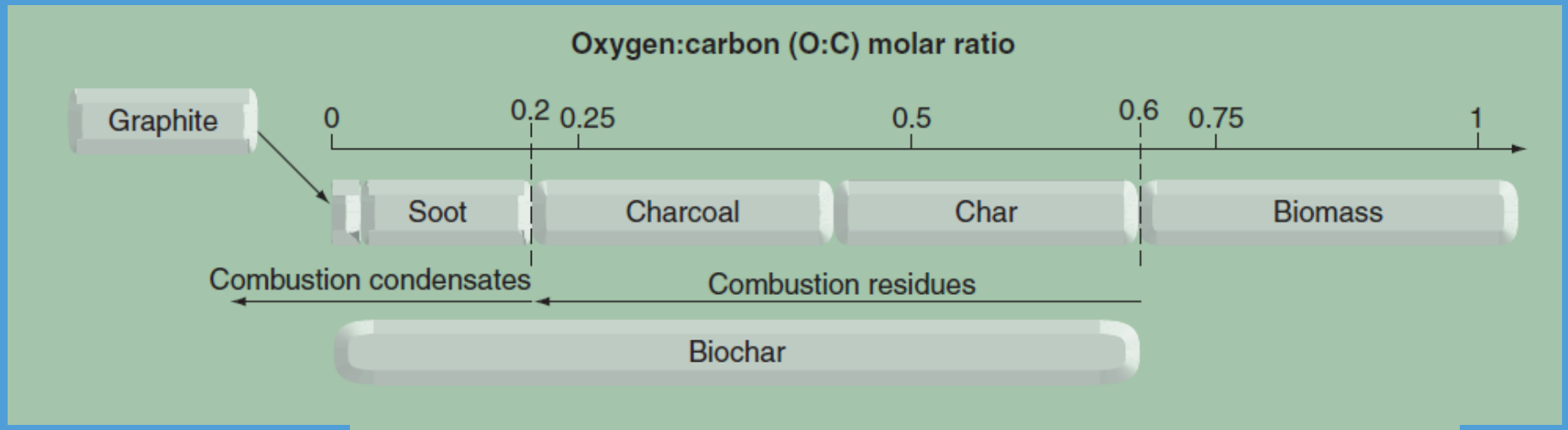
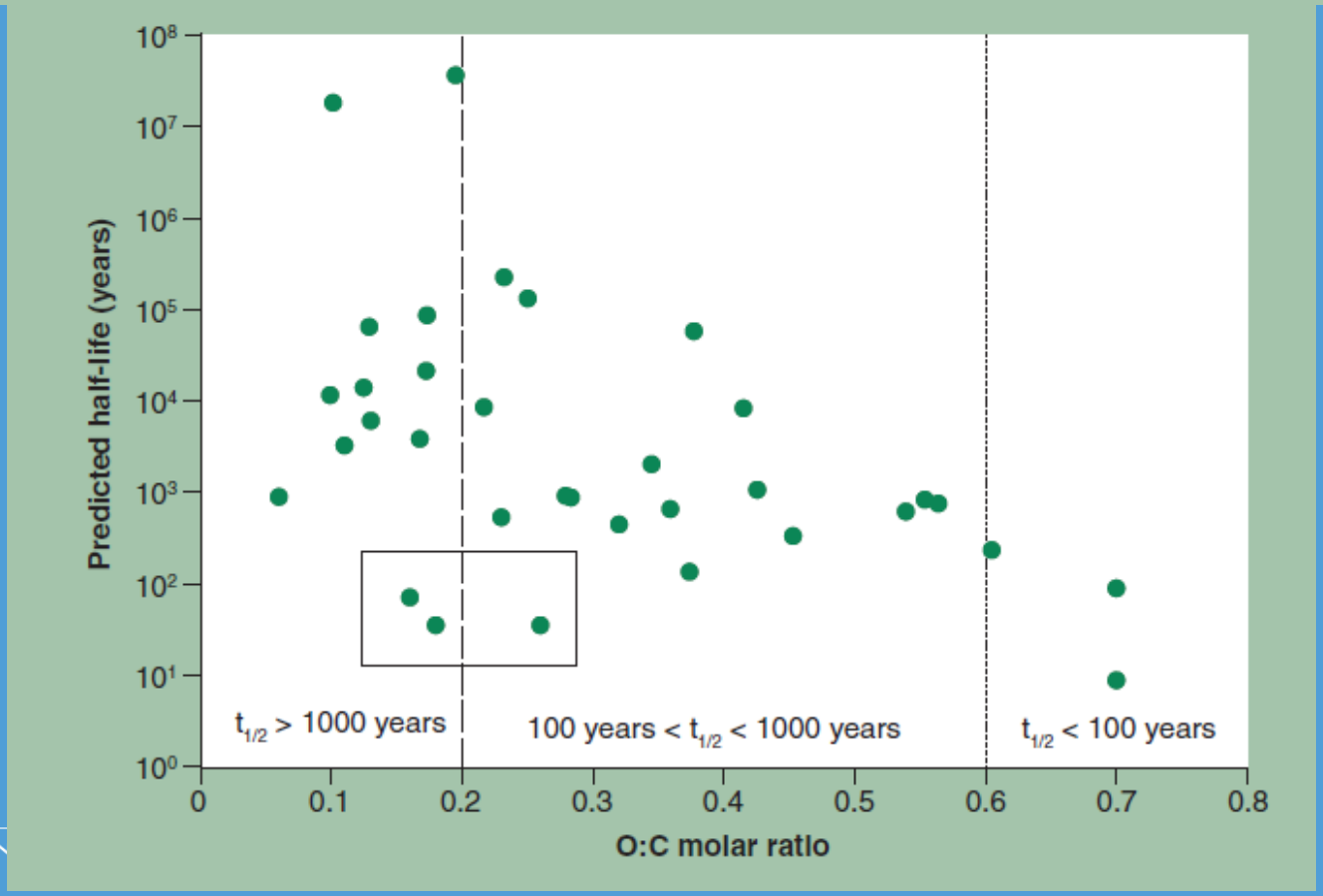
Keiluweit et al, (2010) Environ. Sci. Technol.





Spokas (2010) Carbon Management (2010) 1(2)

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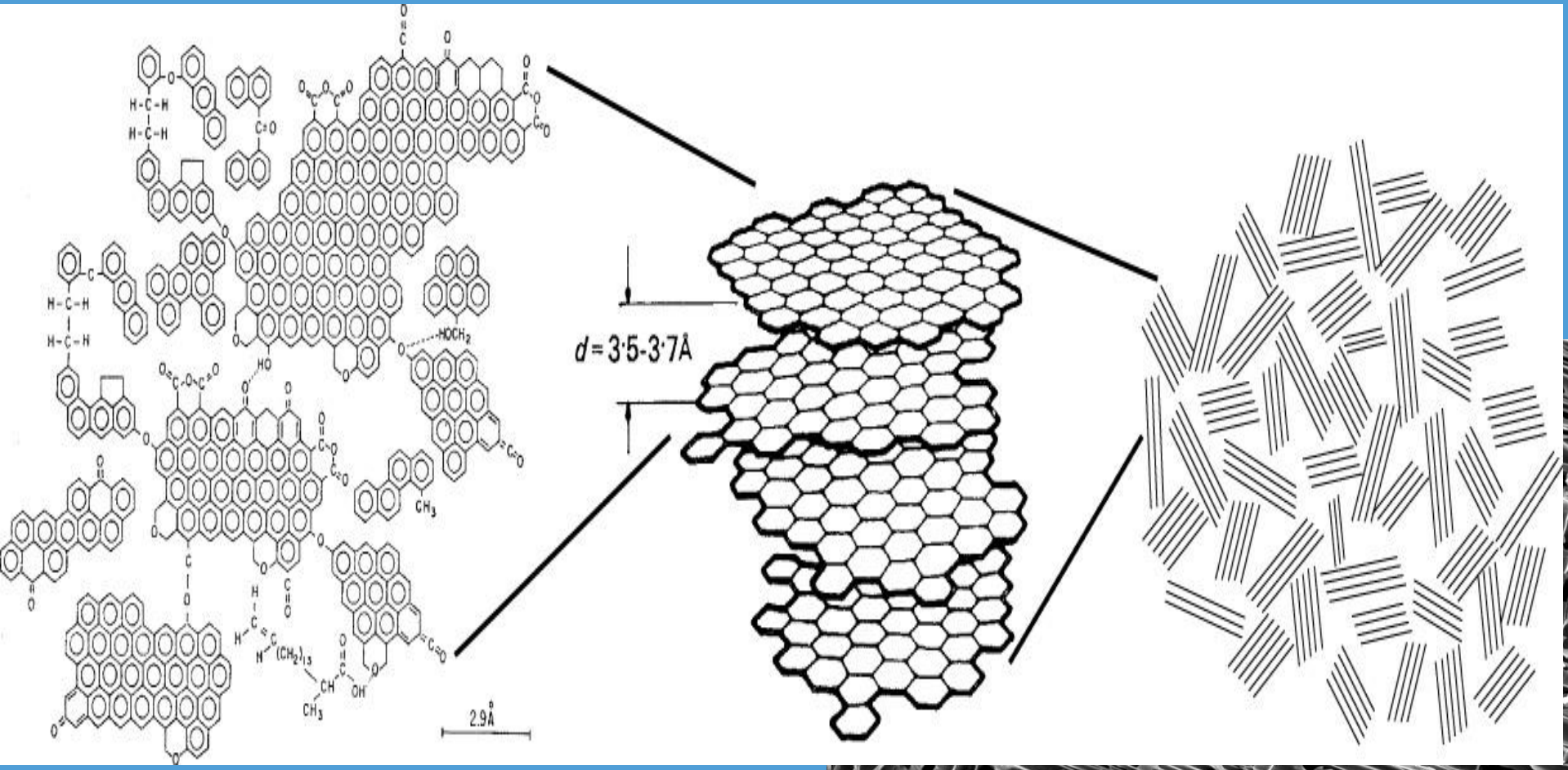
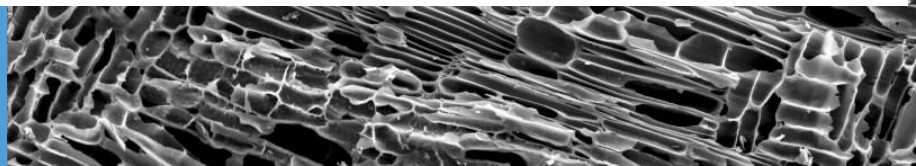
Biochar Carbon & Energy for micro-organisms ?





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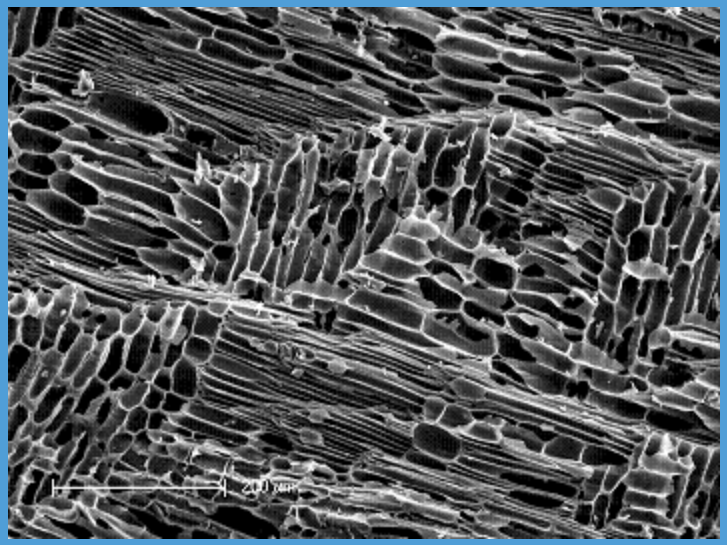
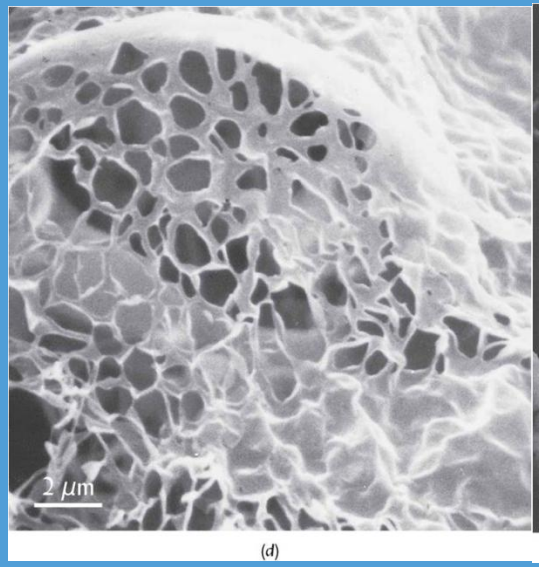
Biochar Refuge for micro-organisms ?

Biochar

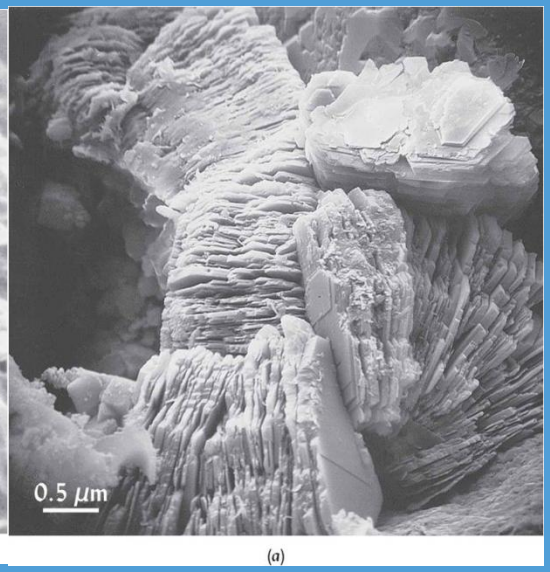


Sohi et al (2009)

Humic acid



Clay



faculty.yc.edu/ycfaculty/ags105/week08/soil_colloids/soil_colloids_print.html

Hydrophobic interaction bacteria and sand in a Fluidized bed reactor

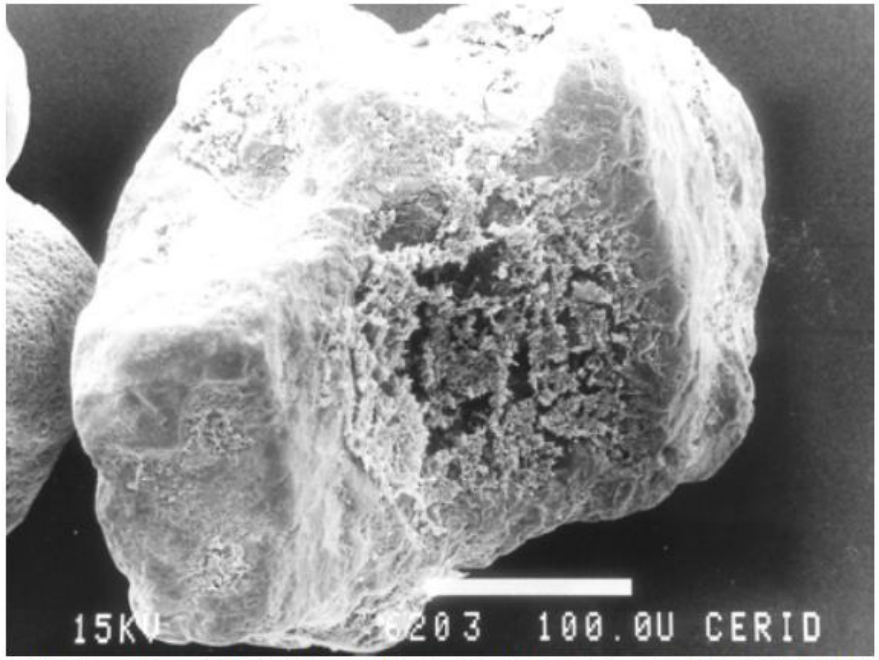


Figure 4. Representative sand particle partially covered with an anaerobic biofilm of thin thickness.

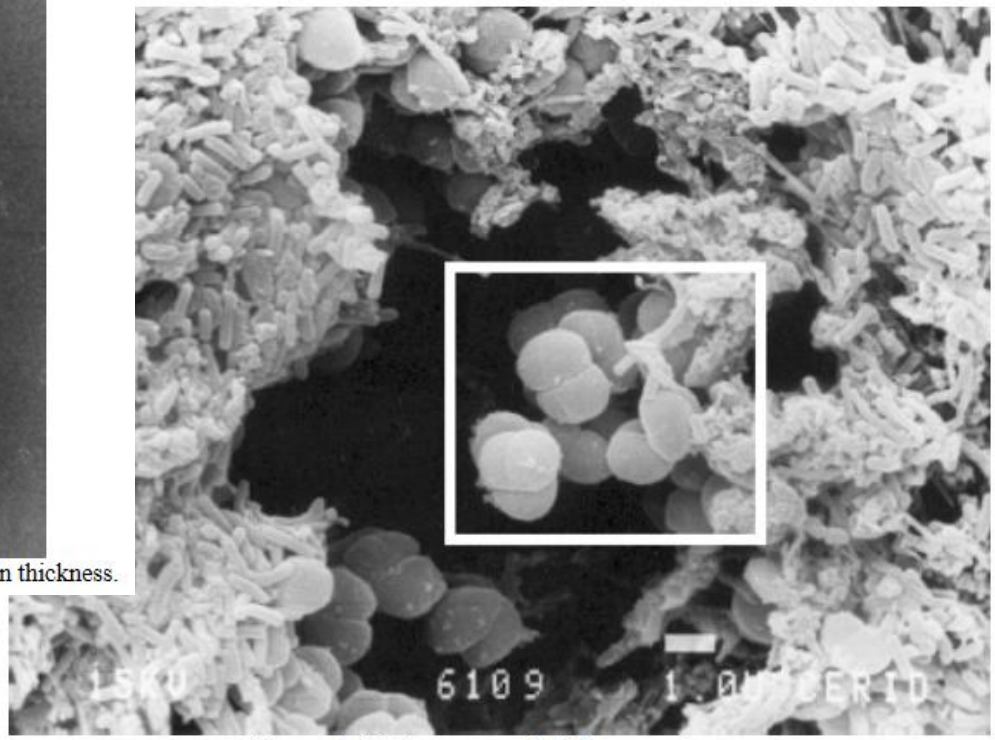


Figure 3. Methanogens: *Methanosarcina sp*

Mussati et al, 2005

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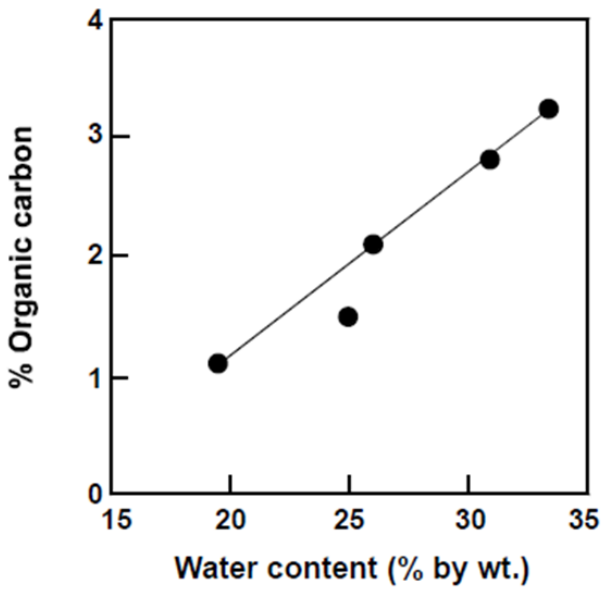
Relation SOM-plant available water (pF 2-4.2)



SOM %	Plant available water mm
2	50
4	66
5	70
6	75
8	81
10	86

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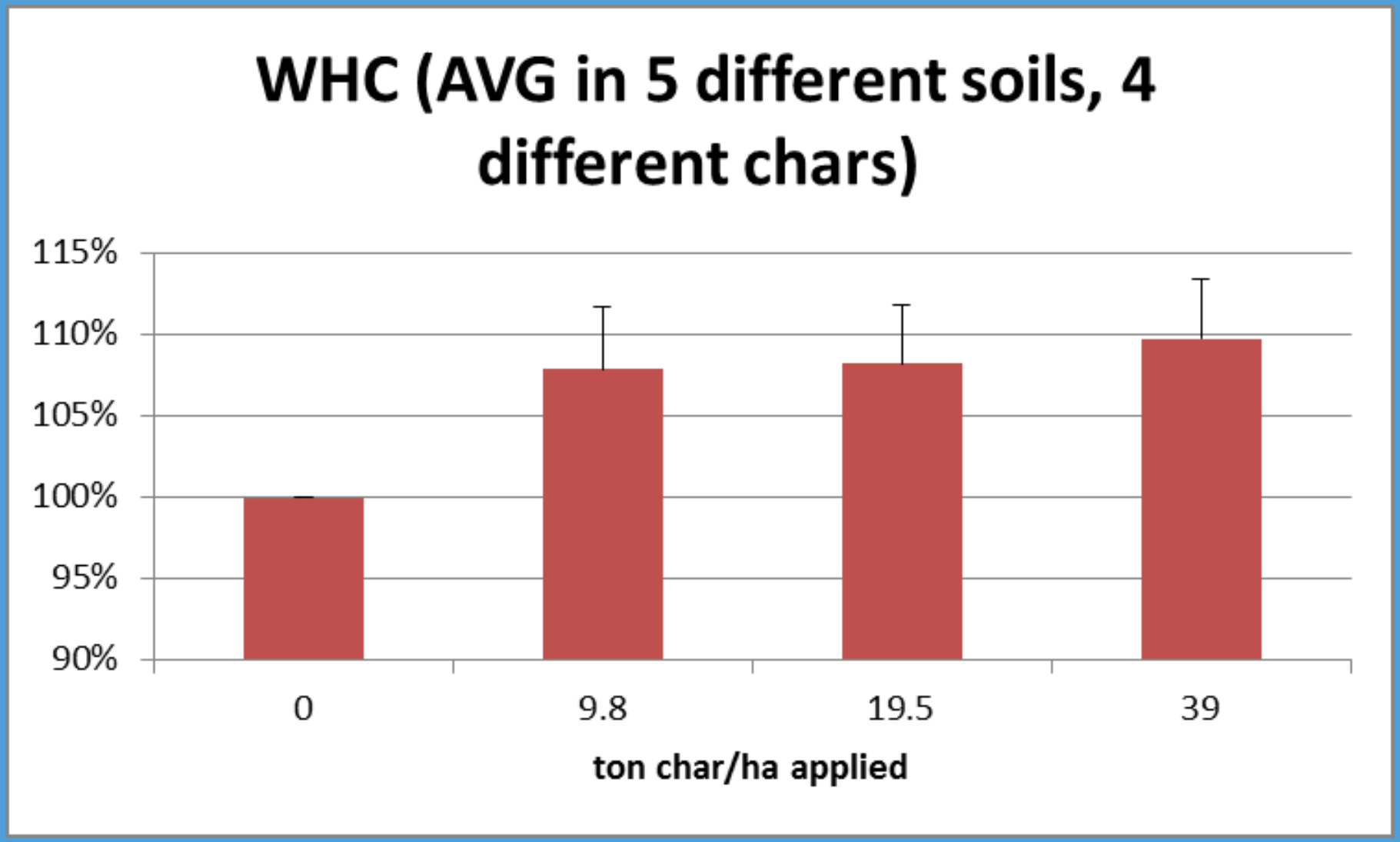
Biochar and WHC ?



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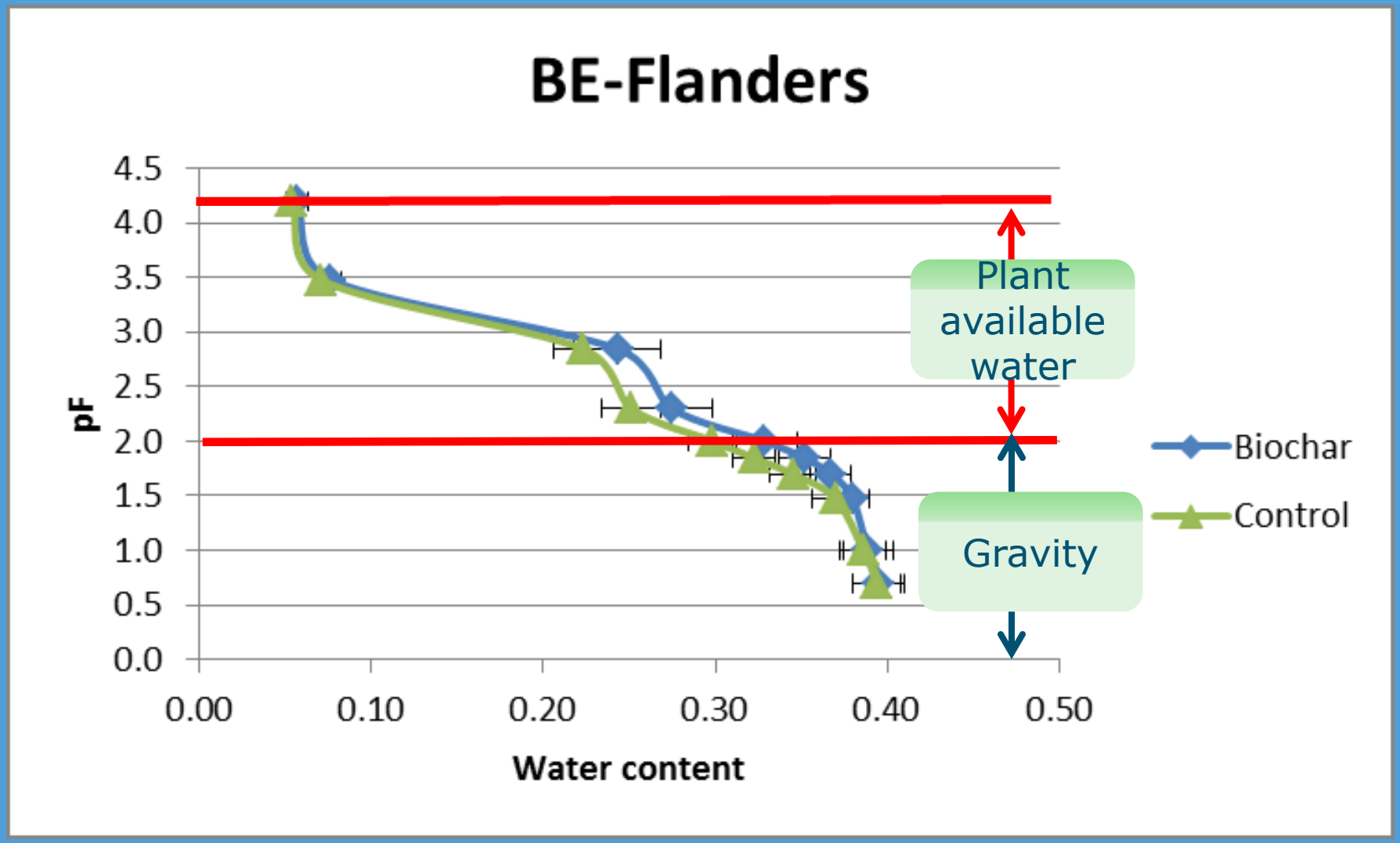
Streubel et al, 2011, JSSSA, 75:1402-1413

Biochar and Water retention ?



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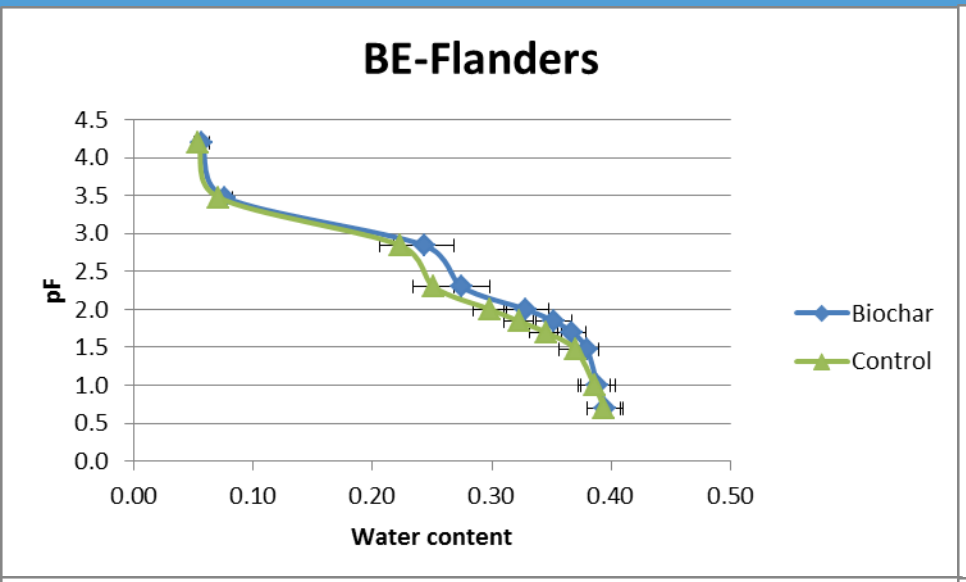
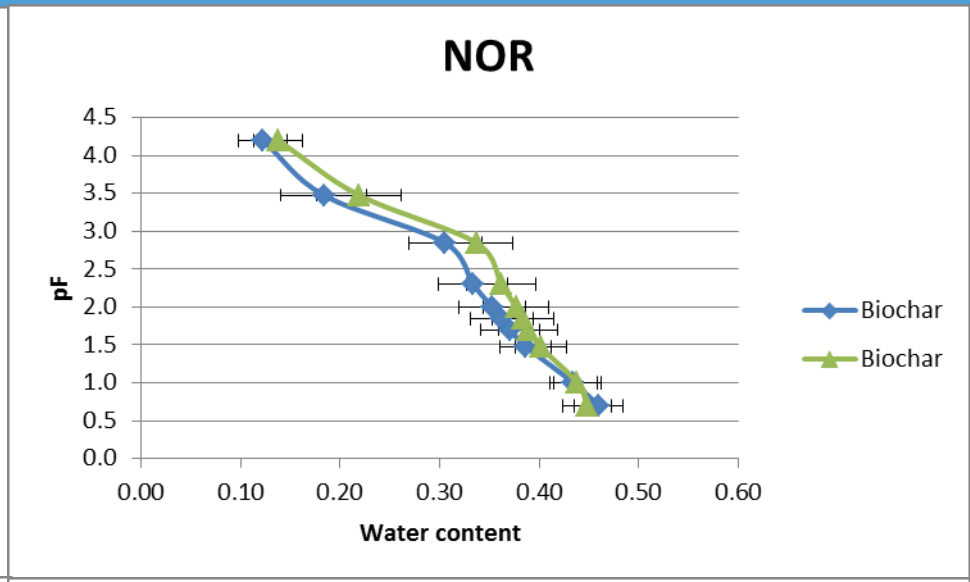
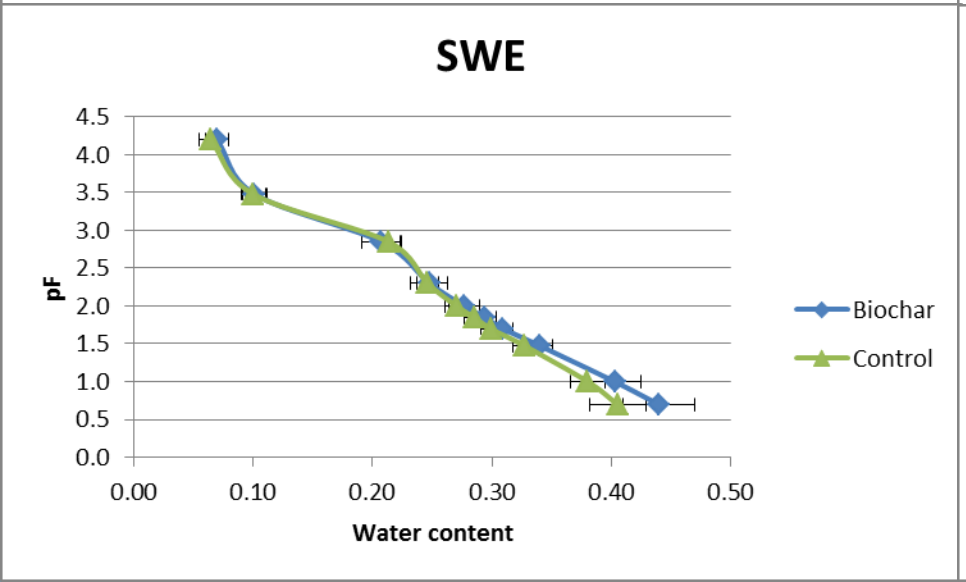
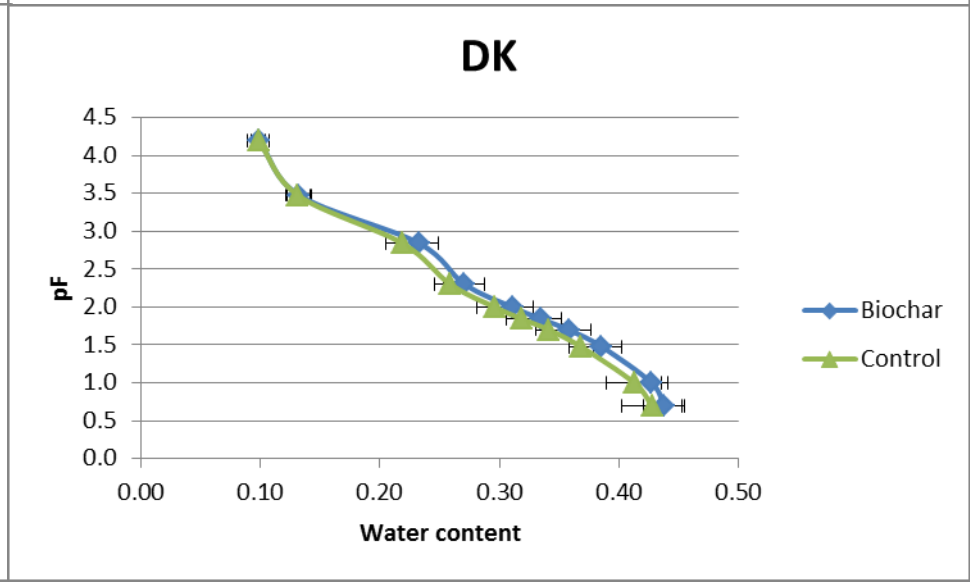
Water retention Interreg Biochar Project

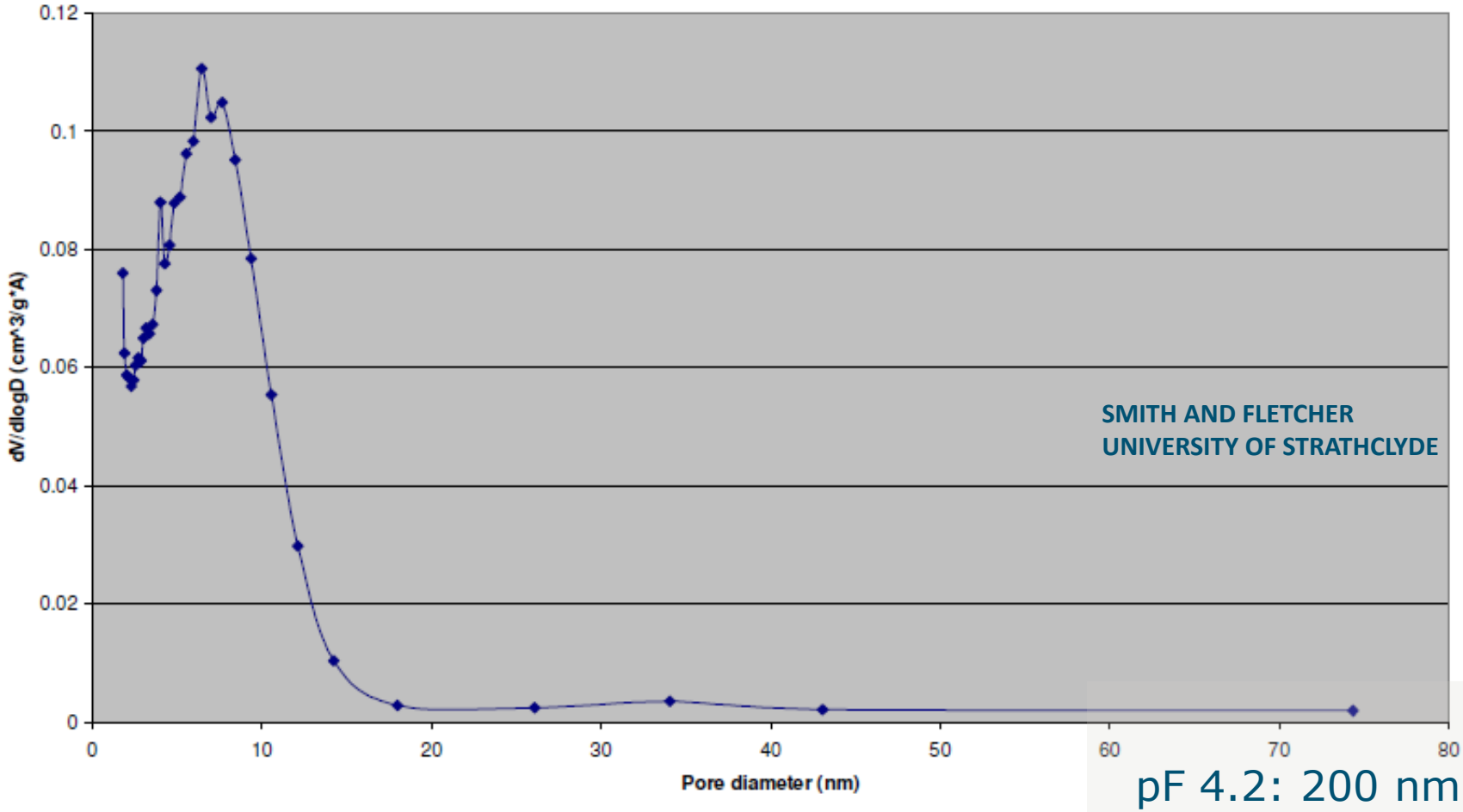








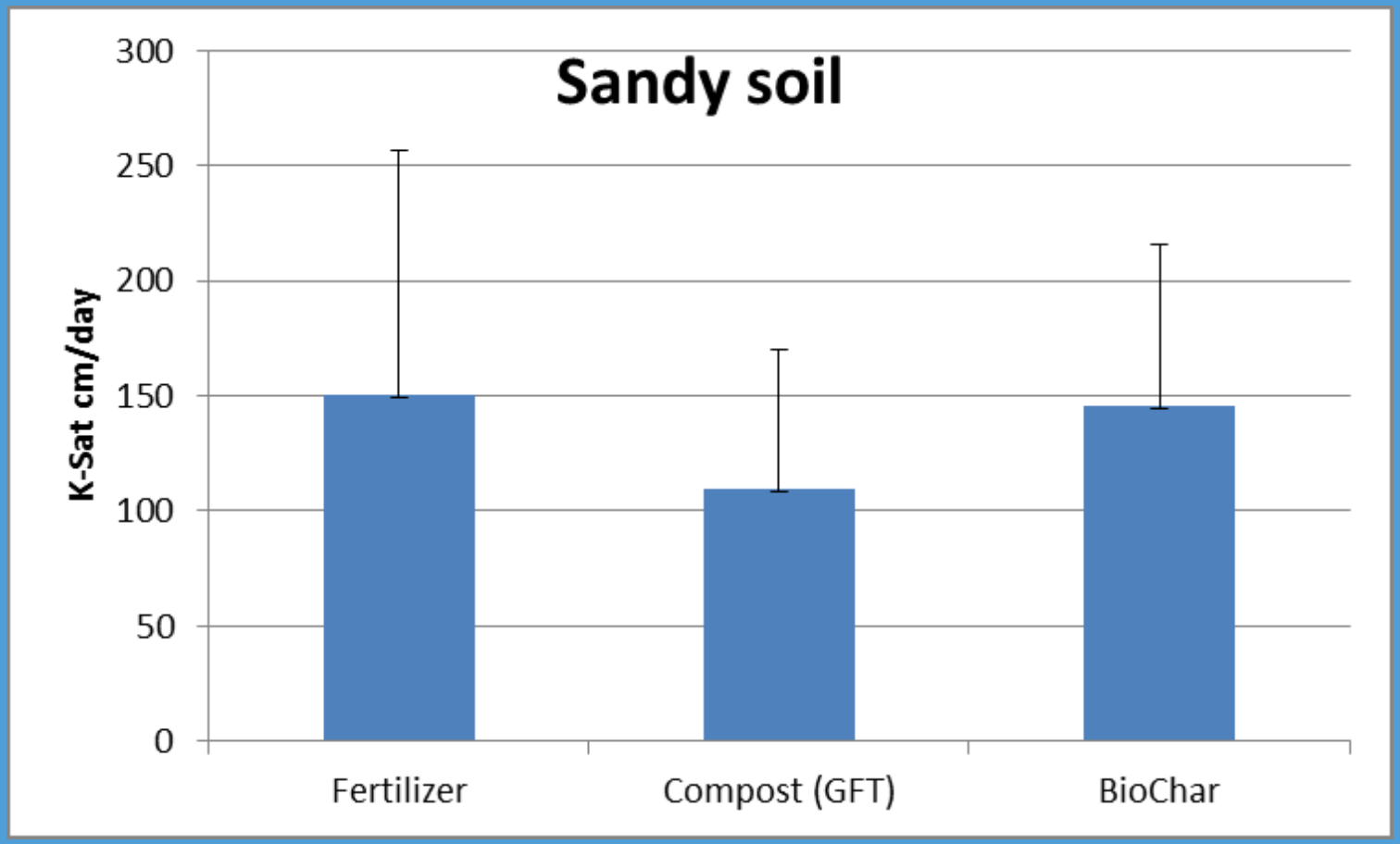
Pore size distribution



pF 4.2: 200 nm

FIGURE 2.4: PORE SIZE DISTRIBUTION FOR COARSE CHAR

Water infiltration Interreg Biochar Project



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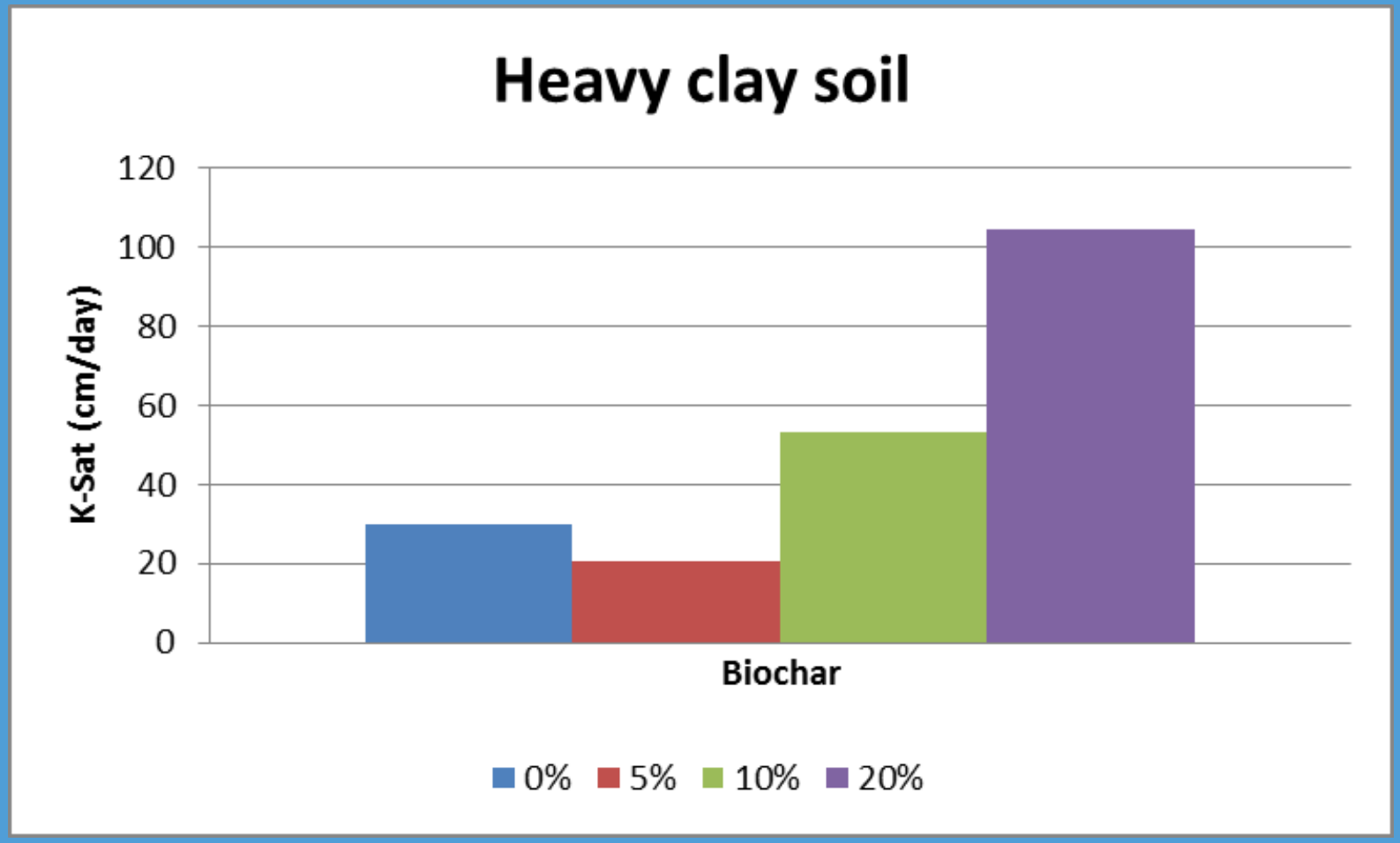
Water infiltration Interreg Biochar Project



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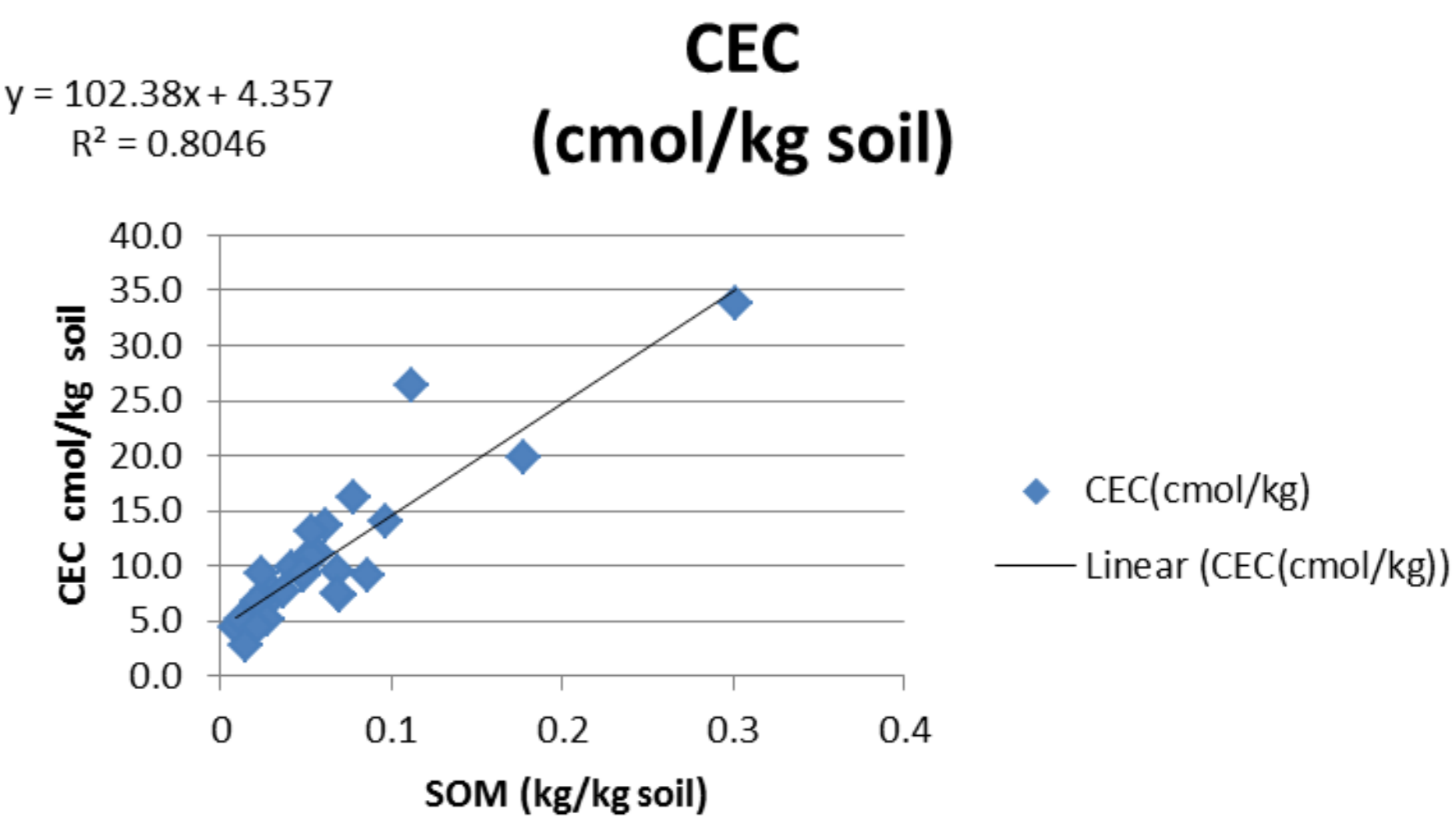
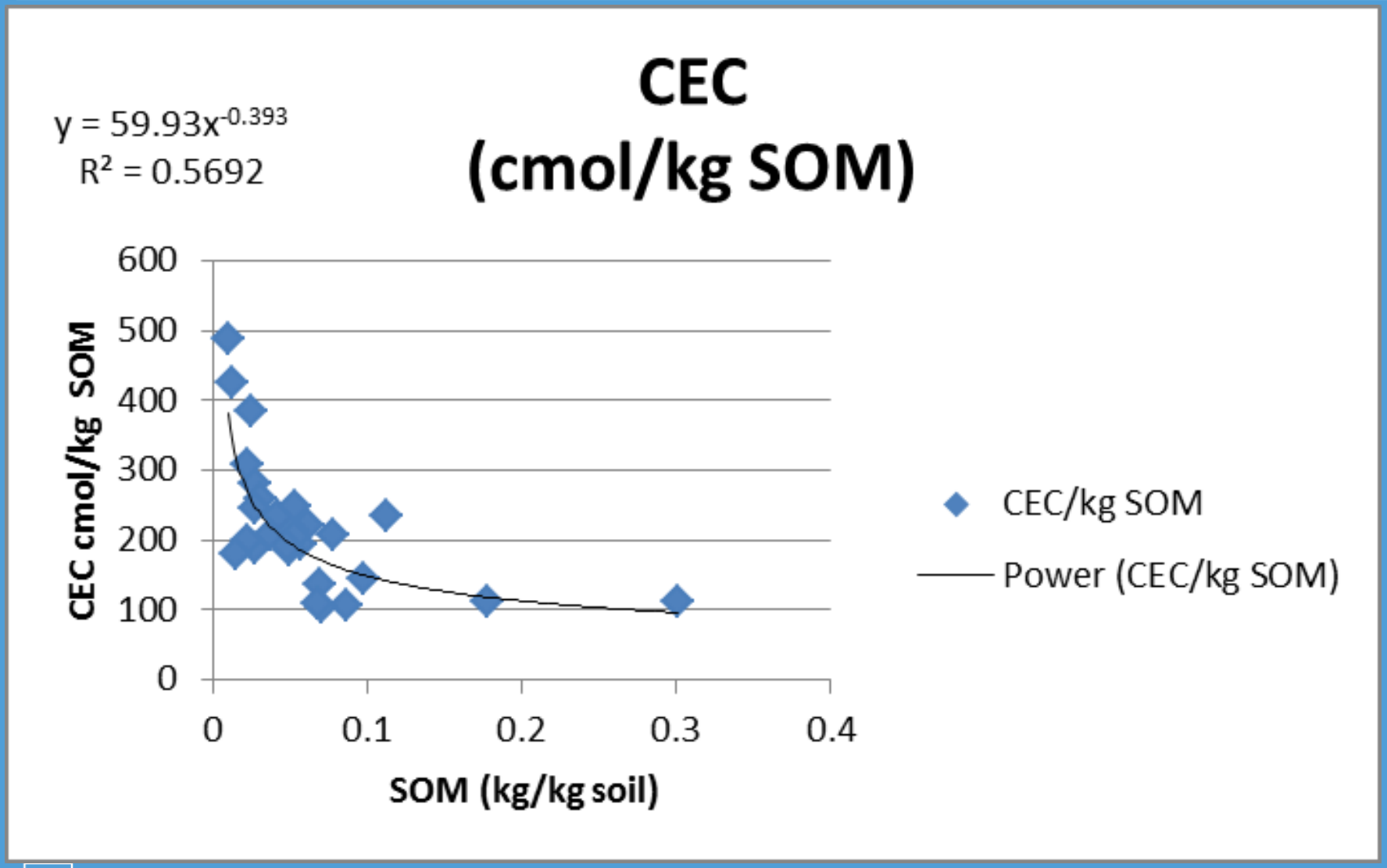
CEC reclaimed peat soils



CEC reclaimed peat soils



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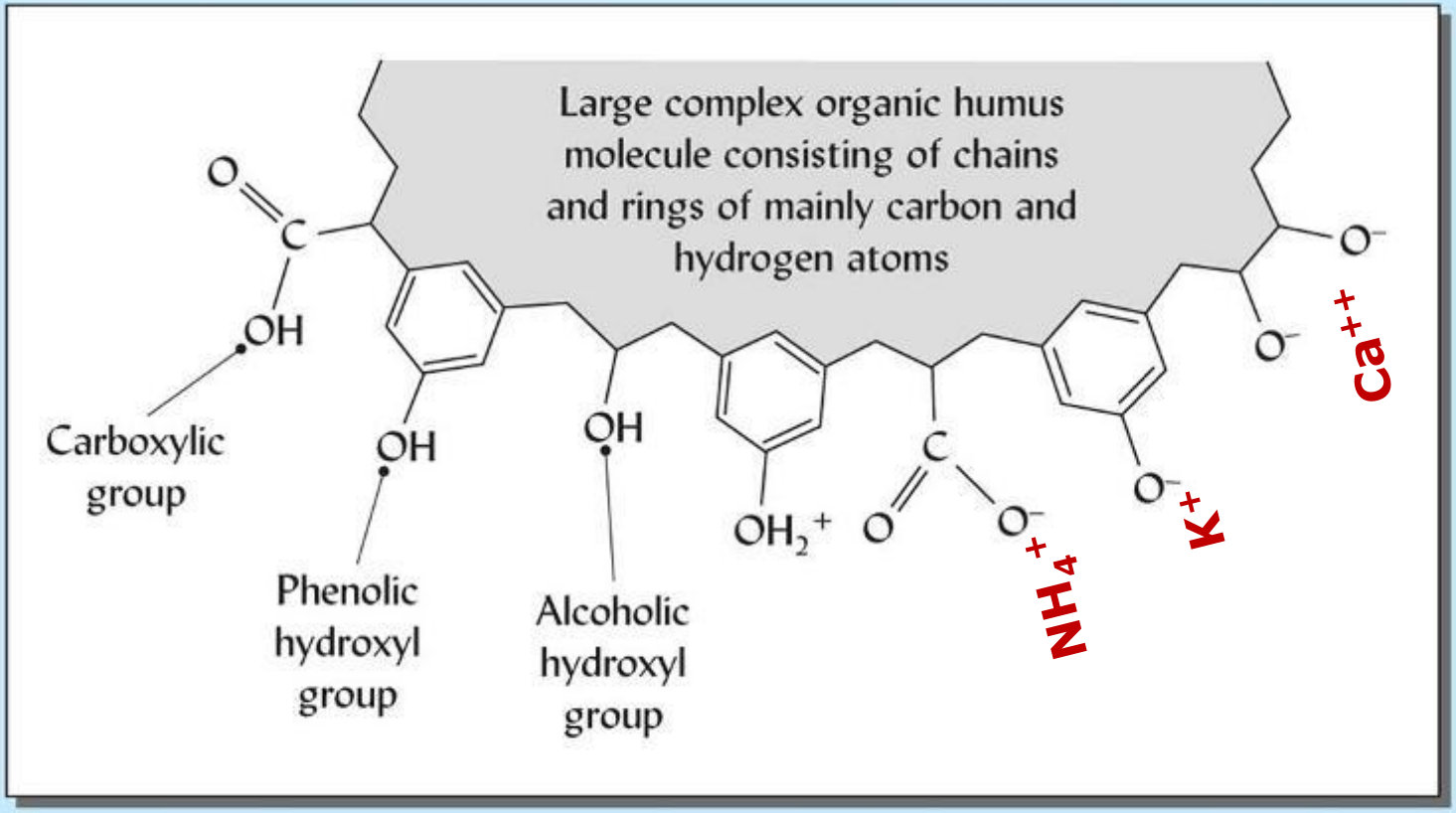
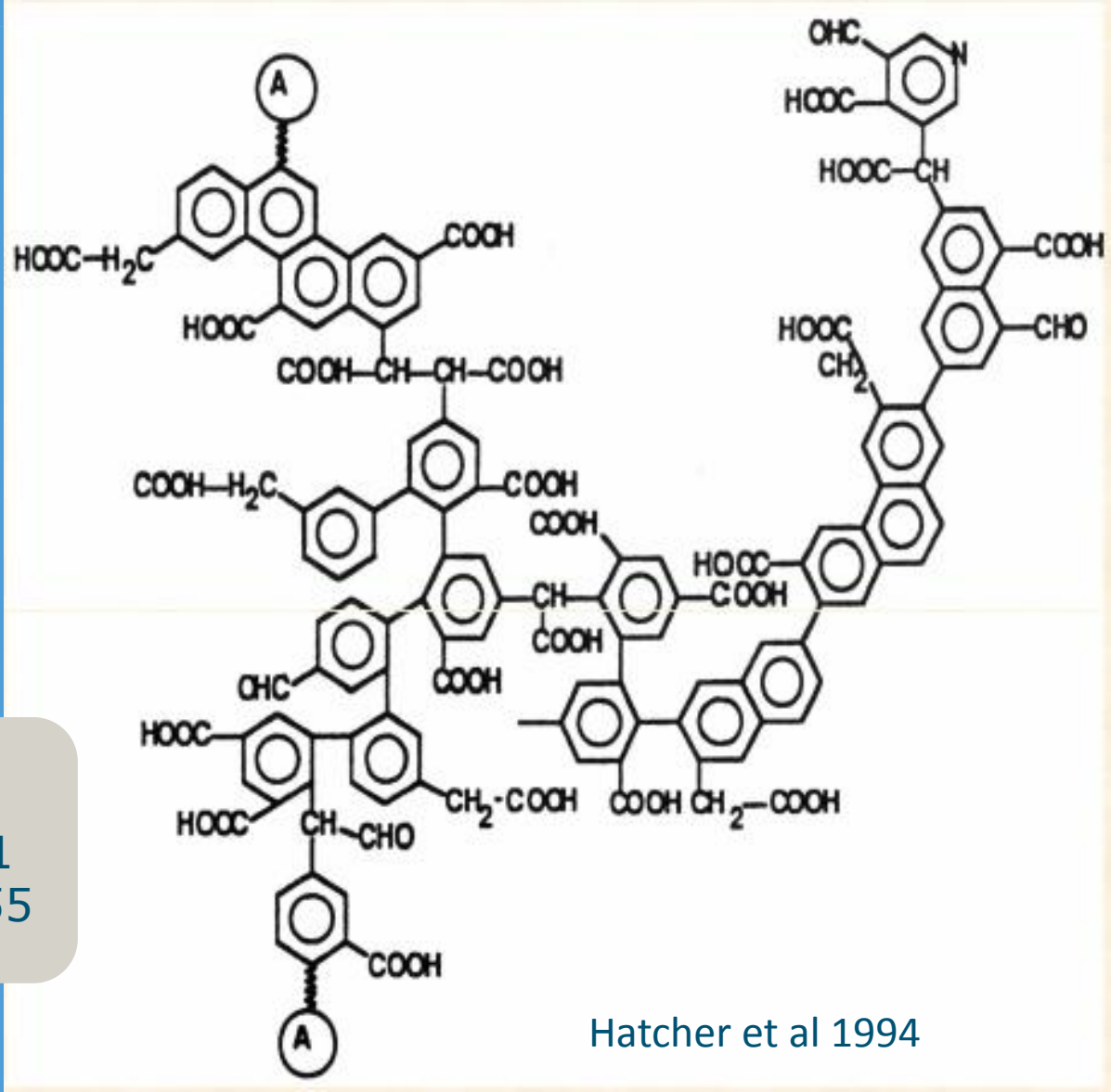


NO_3^- NO_3^-

NH_4^+ K^+ Ca^{++}

Humic Acid structure



Hatcher et al 1994

C:O
Fulvic acids: 1
Humic acids : 0.55

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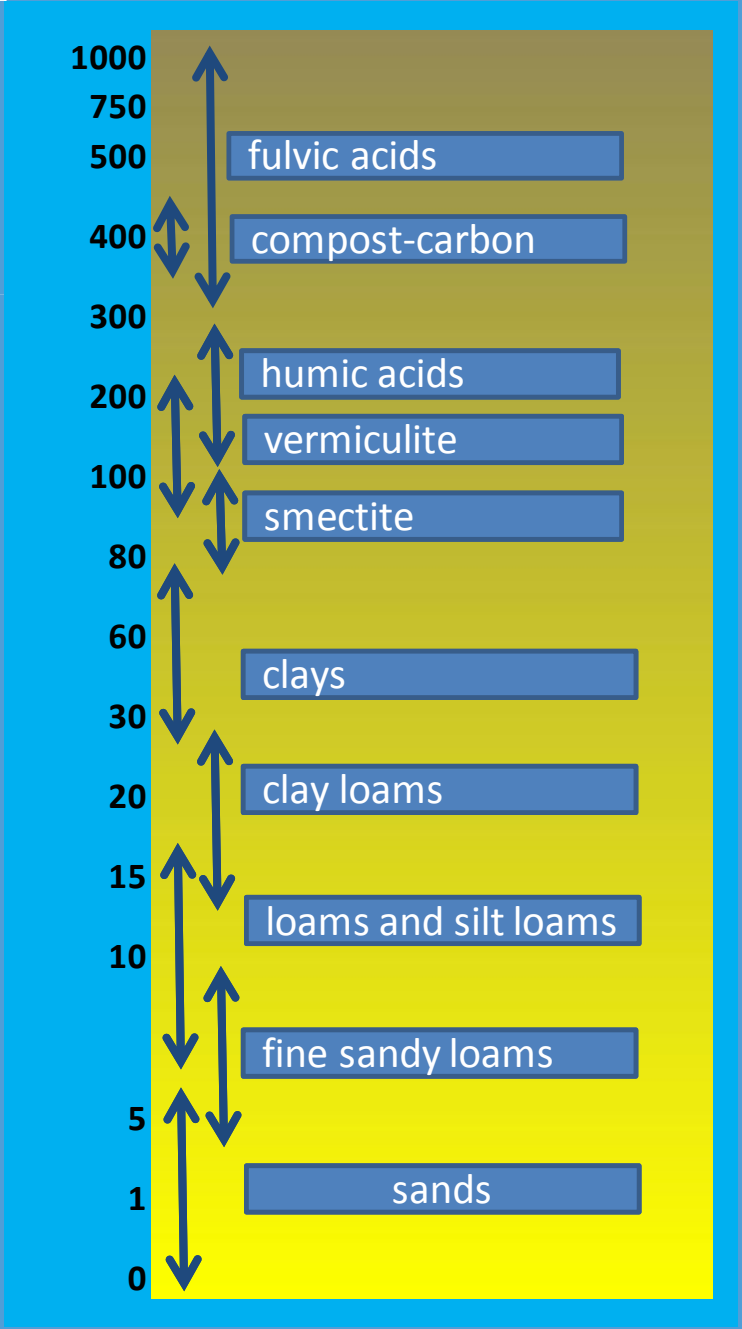
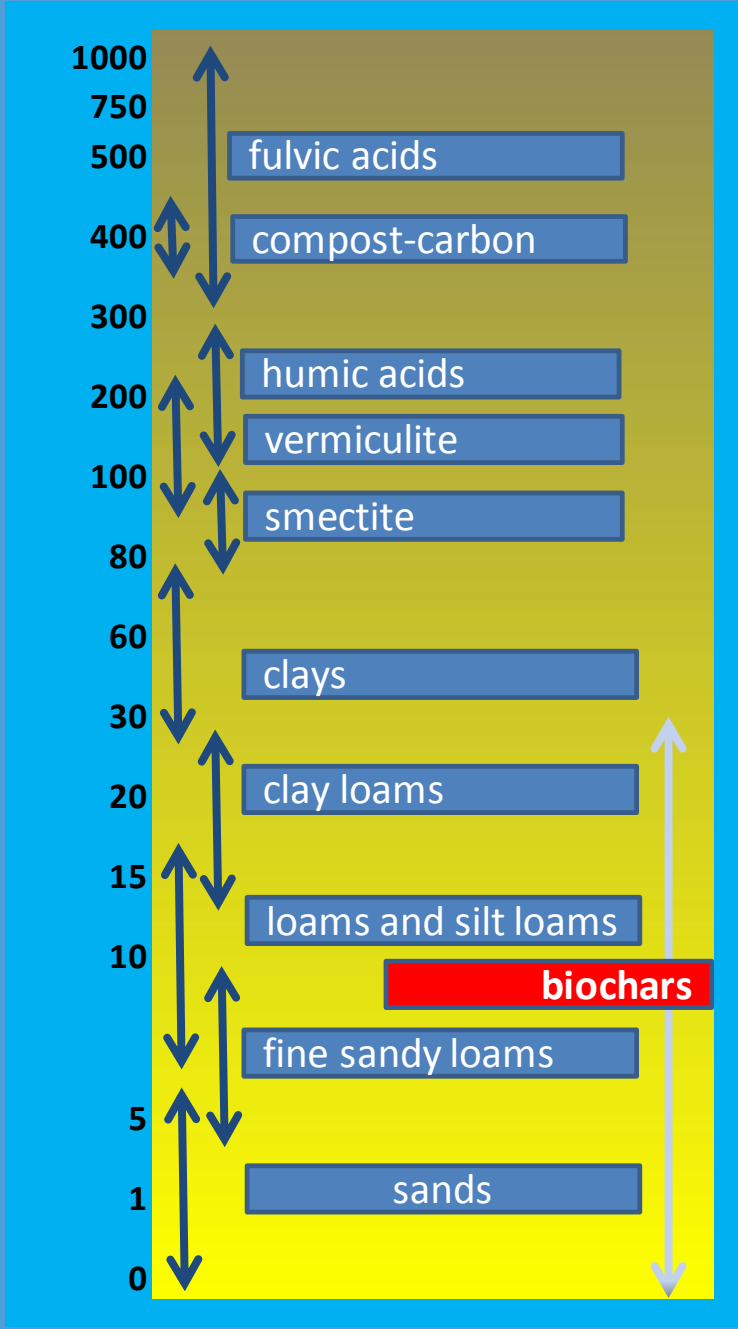
CEC (cmol/kg)





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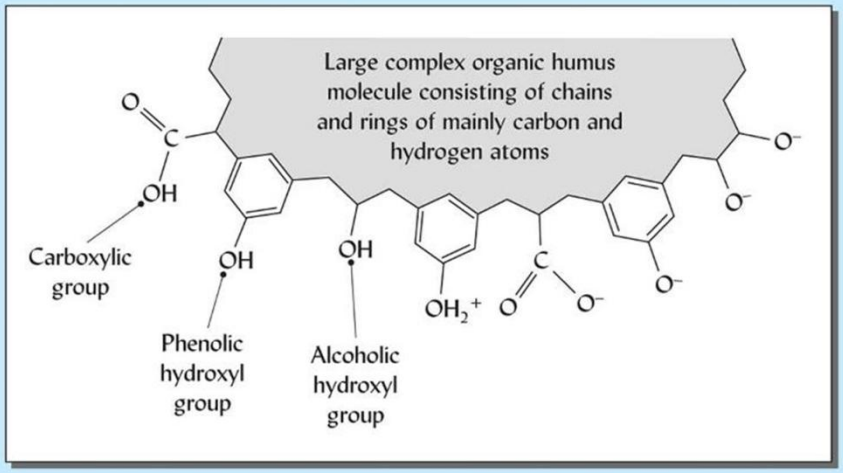
Modification of Biochar

- Activation (?)
- Adsorption of SOM
- Biological modification (?)
- Chemical modification, strong acids, bases, oxidation
    - Functional groups CEC
    - Functional groups AEC (NR_4^+)



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SOM and BIOCHAR - Algebra

- Biochar = organic carbon
- SOM = organic carbon

- Biochar ≠ SOM

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Conclusions

- Biochar can be used to sequester short cyclic C in the soil
- Fresh biochar is rather different from SOM
- It seems rather unlikely that (fresh) biochar can completely replace SOM
- Modification of biochar to improve its functionality is needed and possible

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