How soil sodification and pH restrict microbially mediated organic carbon turnover and aggregate formation: An artificial soil microcosm study

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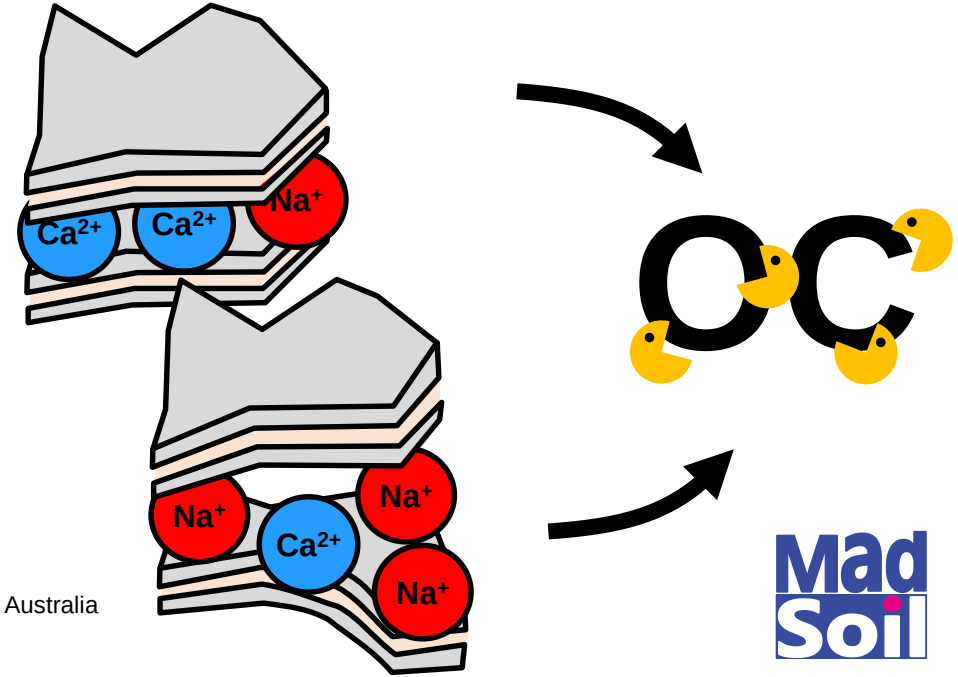

Research questions

Disentangle the effect of sodicity and pH on soil aggregation and microbial turnover of carbon

1. Does sorbed Na^+ inhibit microbially mediated structure formation and microbial carbon turnover?
2. Does the formation of water-stable aggregates interfere and affect C turnover?

Mineral components

- 2:1 montmorillonite clay mineral
- Mixed with quartz grains

Organic components

- Cattle slurry ground <200 µm with C/N of 11.5
- Microbial inoculate: Cambisol (pH_{H2O} 7.5, Germany) and a Calcaric Solonchak (pH_{H2O} 9.3, Spain)

Sand (%)	Silt (%)	Clay (%)	Slurry (%)
30	38	30	2

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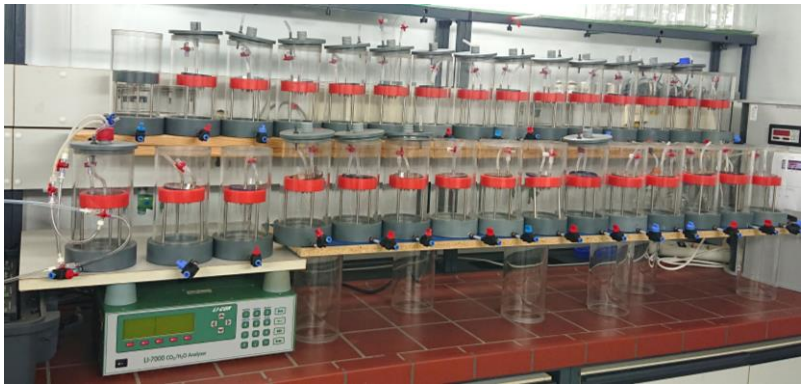
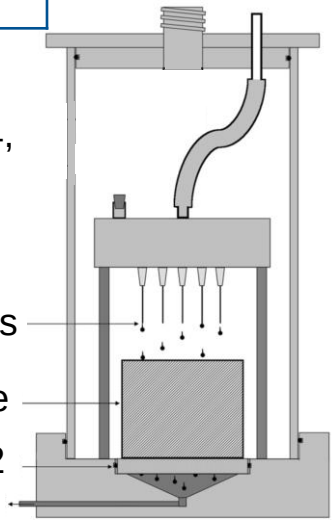
Incubation setup

Control treatments without slurry

Treatment	ESP low	ESP mod	ESP high	ESP low + slurry	ESP mod + slurry	ESP high + slurry
pH 7						
pH 8.5						

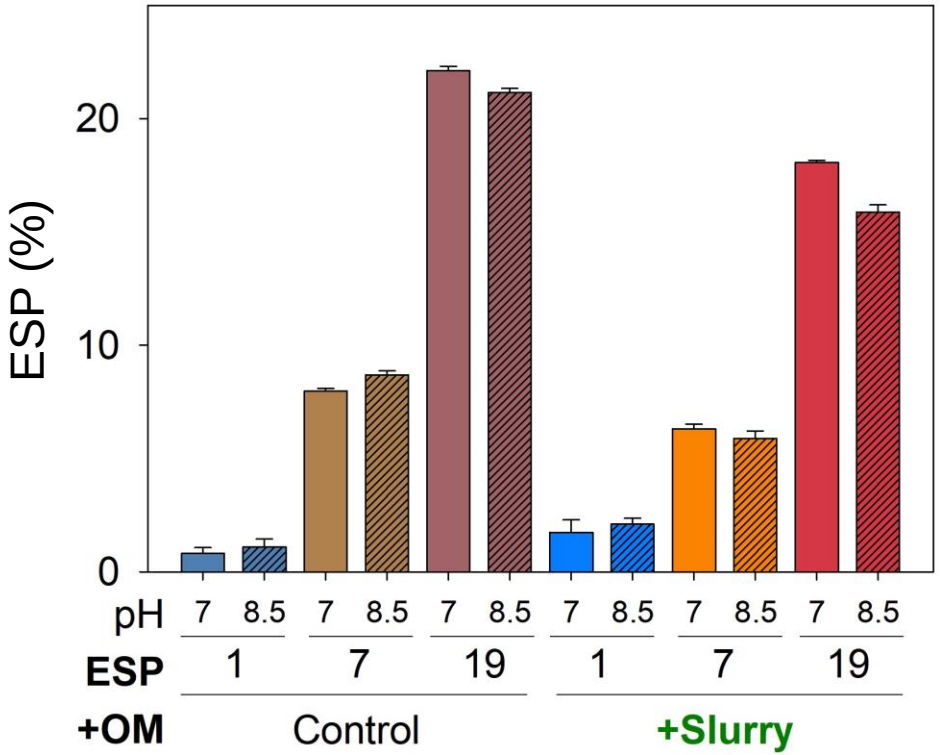


- CO_2 production measured at 1, 2, 3, 4, 6, 8, 11, 14, 18, 24, 30 days
- Rainfall events (5 mm) at 7 and 15 days
- Soil core
- Ceramic plate at pF 2.2
- Collection of leachate



(Poll et al. 2013)

Exchangeable cation composition



- Washed 3x with $NaCl/CaCl_2$ solutions at ionic strength of 60 mM
- CEC of 16 $cmol_c\ kg^{-1}$ on average
- Low, moderate and high sodicity at pH 7 and 8.5 as adjusted

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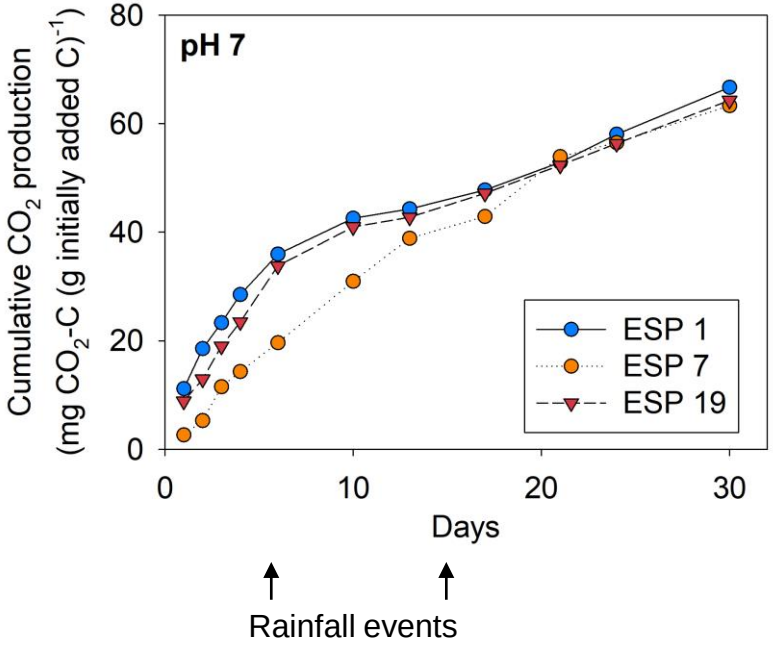
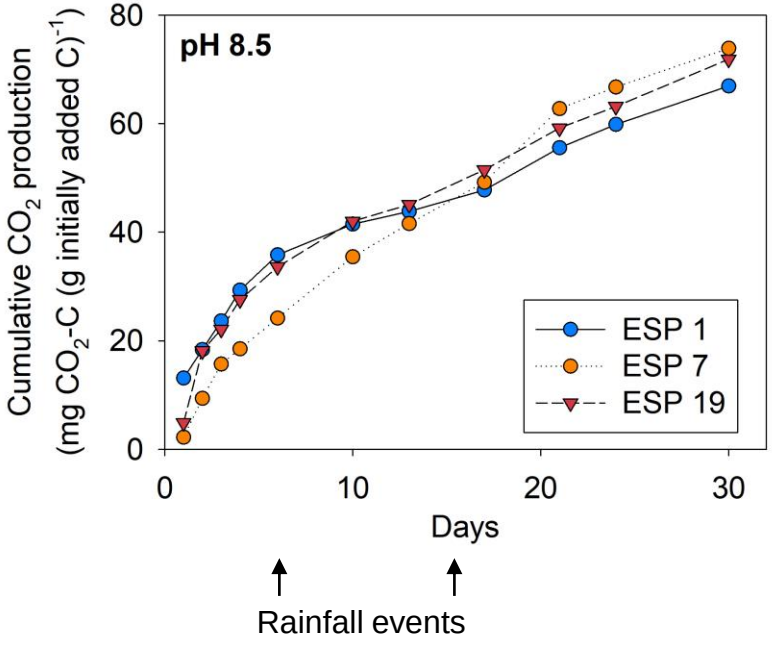
CO_2 production over time

- CO_2 from **ESP 1** highest at beginning, **ESP 7** delayed, **ESP 19** catching up
- Final CO_2 production slightly higher at pH 8.5





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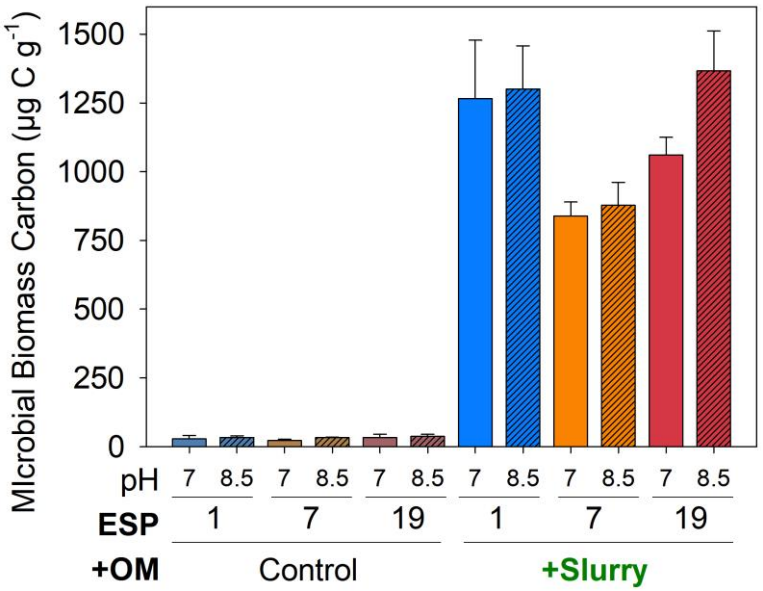
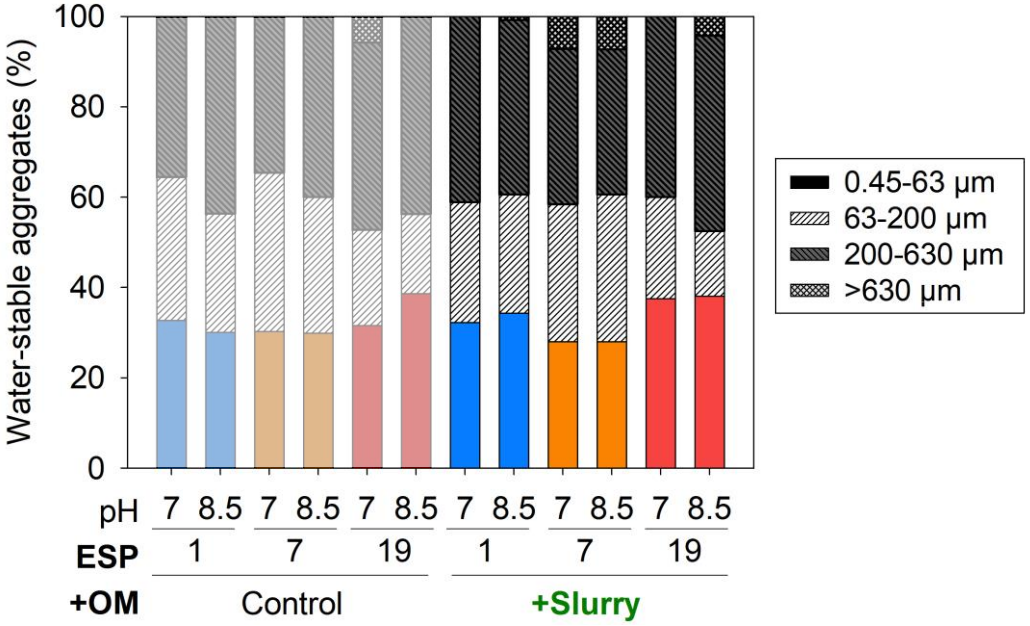
Microbial biomass and aggregation

- Least MBC at ESP 7



- Largest aggregates at ESP 7



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Conclusion

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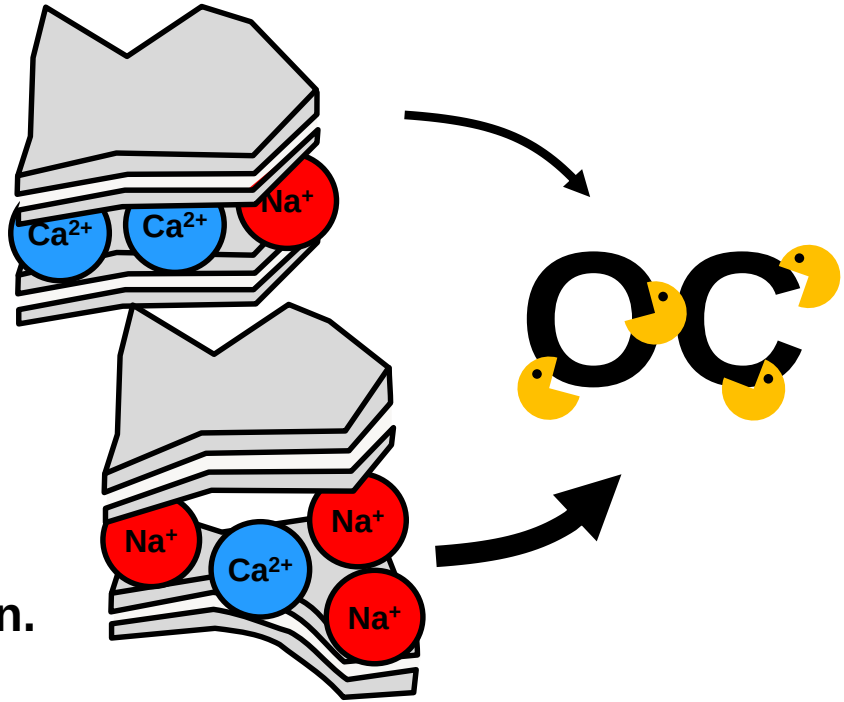
- Moderate sodicity (ESP 7) delayed microbial decomposition but did not affect aggregation
- High sodicity (ESP 19) led to mineralization in a similar range as treatment with low sodicity (ESP 1) due to hampered aggregate formation



Depending on the loading of Na^+, sodicity acts differently on microbial turnover of OC and its relationship with aggregate formation.

Thanks to DFG MadSoil