Co- Evolution of soil and organic substances: properties of clay- sized aggregates along a soil chronosequence in the Marchfeld

Jasmin Schiefer[1], Georg J. Lair[1*], Heyder F. Nascimento[1], Franz Ottner[2], Winfried E.H. Blum[1]

[1] Institute of Soil Research, University of Natural Resources and Life Sciences, Peter-Jordan-Straße 82, 1190 Vienna, Austria
[2] Institute of Applied Geology, University of Natural Resources and Life Sciences, Peter-Jordan-Straße 70, 1190 Vienna, Austria
* Correspondence: georg.lair@boku.ac.at

Introduction

Soil organic matter mainly governs the functions and properties of soil and influences the aggregate stability.
Clay- sized particles contain the largest and most stabile portion of organic matter (Balabane and Plante, 2004). This work analyzes changes and properties of these small sized particles in soils along a chronosequence in the Marchfeld.

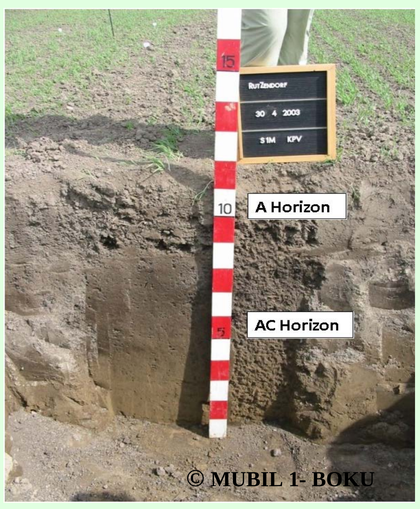

Figure 1: Chernozem in the Marchfeld

Objectives

- Characterization of clay sized aggregates gained from topsoil (A- horizon) and subsoil (AC- horizon) along a substrate age gradient from 10- 6000 years in the alluvial plain of the Danube river east of Vienna
- Quantify the impact of different land-use management (cropland, forest and grassland) on the formation and characterization of soil organic matter in the clay-sized aggregates.

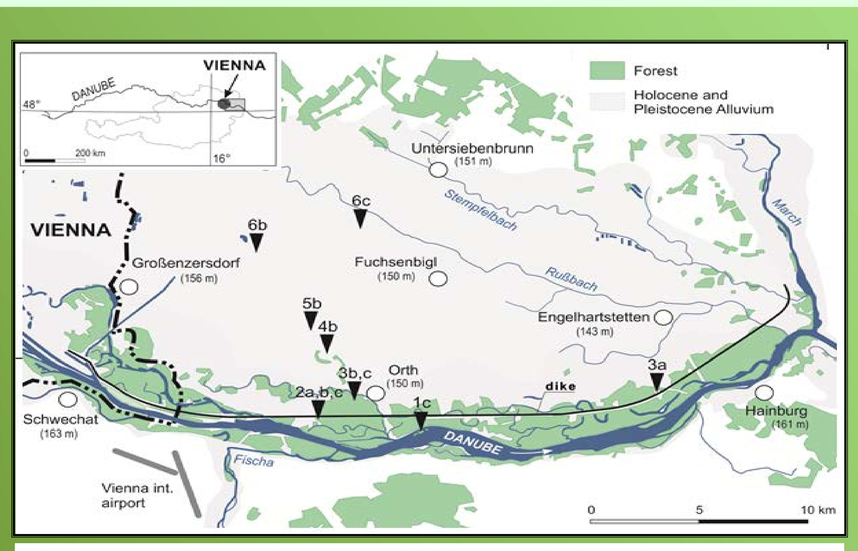

Figure 2: Study area in the Marchfeld, east of Vienna/Austria. Triangles indicate the sampling sites follow-ing a substrate age gradient.Site 1= 10 yrs; site 2= 80 yrs; site 3= 350 yrs; site 4= 2600 yrs; site 5= 2300 yrs; site 6= 4000/ 4500 yrs; a=grassland; b= cropland; c= forest

Material und Methods

Study area

The study area (see Fig. 2) is situated in a continental climate (mean annual temperature ~9°C, mean annual precipitation ~550mm) in the Marchfeld. The soils developed on Danube sediments and are classified as Fluvisols (sites 1, 2 and 3) and Chernozems (sites 4, 5 and 6) (Gerzabek et al., 2010). The age of the soils were estimated in an earlier study using a chronofunction relating to Fe oxide crystallinity in soils, ^{137}Cs and optically simulated luminescence (Lair et al., 2009). The history of land use management was discovered by historical maps.

Preparation and Method

Ultrasonic dispersion was used as first step to gently break down the macro-aggregates without disrupting the microaggregates.
According to Stemmer et al. (1998) the clay fraction was received by centrifugation with 2 min 150 *g*. To remove the DOC of the bulk soil the clay fraction was ultra-centrifuged with 7500 *g.* The supernatant was discarded and the clay sized fraction was freeze dried and used for analysis:

- Basic chemical and physical properties (carbonates, oxides, XRD and particle size distribution)
- SimultaneousThermal Analysis gives information about labile and more stabile carbon pools (see Fig. 4C).
- ^{13}C- Nuclear Magnetic Resonance quantifies functional groups of the organic matrix

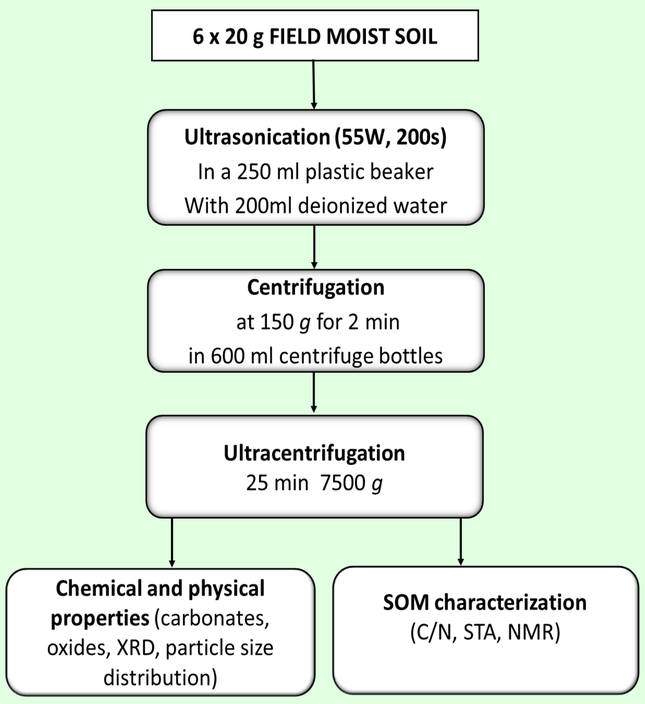

Figure 3: Protocol to gain the clay- sized particles and measurement methods

Preliminary Results

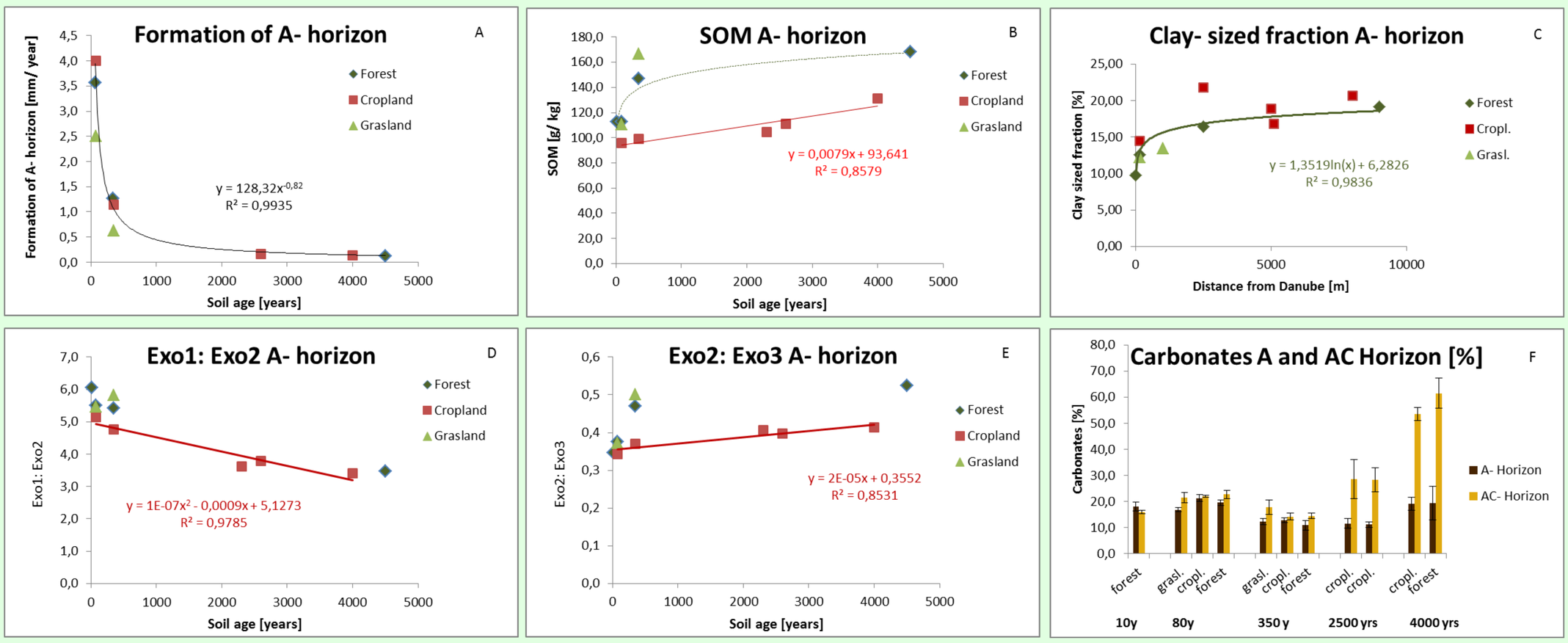

Figure 4: Preliminary results of soil formation and co-evoluting SOM (A, B). The clay sized fraction is increasing with a further distance from the Danube (C). Exo1: Exo2 is decreasing (D) and Exo2: Exo3 is increasing (E) with time. This shows that the labile pool Exo1 is decreasing with time and that SOM becomes more stabile in older soils. Carbonate content increases in the AC-horizon with time (F).

References

Balabane M. and Plante A.F. (2004): Aggregation and carbon storage in silty soil using physical fractionation techniques. European Journal of Soil Science 55, 415-427.
Gerzabek M.H., Lair G.J., Fiebig M., Zehetner F. (2010): Development of soil properties in a riverine floodplain with time- results from a chronosequence study in the National Park Donau- Auen in Autria.World congress of Soil Science, Brisbane.
Lair, G. J., Zehetner, F., Hrachowitz, M., Franz, N., Maringer, F. J., and Gerzabek, M. H. (2009): Dating of soil layers in a young floodplain using iron oxide crystallinity. Quat. Geochronol. 4, 260–266.
Stemmer M.,Gerzabek M.H., Kandeler E. (1998): Organic matter and enzyme activity in particle size fractions of soil obtained after low-energy sonication. Soil Biology & Biochemistry 30, 9-17.

Jahrestagung der ÖBG von 27.- 28. 06. 2012 in Innsbruck