

*Supplement of*

**Limited protection of macro-aggregate occluded organic carbon in Siberian  
steppe soils**

5 **N. Bischoff et al.**

*Correspondence to:* N. Bischoff (bischoff@ifbk.uni-hannover.de)

## Supplements

### Calculation of the share of steppe soils in the global soil OC stocks down to 1m depth

Steppe soils are typically the group of Kastanozems (KS), Chernozems (CH) and Phaeozems (PH; FAO, 2001).

Average OC stocks of these soils are found in Batjes (1996) and their global area is estimated in the IUSS

- 5 Working Group WRB (2014). By multiplying the average OC stock of these soil types by their global area and dividing the result by the global soil OC stock of about 1505 Pg OC (Batjes, 1996), we can estimate the share of steppe soils in the global soil OC stock down to 1m depth. This was done as, to our knowledge, there is no study yet, which modelled the portion of steppe soils on the global soil OC stock. The equation is as following:

$$y = \frac{\text{average OC stock (KS)} \times \text{area (KS)} + \text{average OC stock (CH)} \times \text{area (CH)} + \text{average OC stock (PH)} \times \text{area (PH)}}{\text{OC stock (worldwide)}}$$

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where y is the share of steppe soils in the global soil OC stock.

## Tables

**Table S 1: Organic carbon (OC) and total nitrogen (TN) of the three fractions bulk soil, intact macro-aggregates, and crushed macro-aggregates for the respective land-use and steppe type.**

Steppe	Land-use	Fraction	n	OC mg g <sup>-1</sup>	TN mg g <sup>-1</sup>	C : N -
Forest steppe	extensive pasture	bulk	3	54.6 ± 5.4	4.5 ± 0.4	12.2 ± 0.2
		intact	3	53.3 ± 6.5	4.4 ± 0.5	12.0 ± 0.2
		crushed	3	52.2 ± 5.7	4.4 ± 0.4	11.8 ± 0.2
	forage crop	bulk	3	49.3 ± 1.7	4.1 ± 0.2	12.1 ± 0.0
		intact	3	48.7 ± 1.2	4.1 ± 0.1	12.0 ± 0.1
		crushed	3	45.5 ± 1.1	3.9 ± 0.1	11.6 ± 0.1
	arable 5 yr	bulk	3	39.1 ± 1.4	3.3 ± 0.1	11.7 ± 0.2
		intact	3	39.2 ± 2.4	3.3 ± 0.2	12.0 ± 0.1
		crushed	3	38.4 ± 2.6	3.2 ± 0.1	11.8 ± 0.3
	arable 30 yr	bulk	3	40.4 ± 1.6	3.4 ± 0.1	11.8 ± 0.1
		intact	3	39.1 ± 2.3	3.4 ± 0.2	11.6 ± 0.0
		crushed	3	37.4 ± 1.4	3.3 ± 0.1	11.3 ± 0.0
Typical steppe	fallow 30 yr (pasture)	bulk	2	21.6 ± 2.3	2.0 ± 0.2	10.9 ± 0.1
		intact	2	20.6 ± 2.8	1.9 ± 0.2	10.6 ± 0.3
		crushed	2	20.4 ± 2.6	2.0 ± 0.2	10.3 ± 0.3
	arable 1 yr	bulk	3	13.3 ± 0.3	1.3 ± 0.0	10.0 ± 0.1
		intact	3	14.1 ± 0.9	1.4 ± 0.1	10.0 ± 0.2
		crushed	3	13.3 ± 0.5	1.3 ± 0.0	10.2 ± 0.2
	arable 3 yr	bulk	3	14.9 ± 1.6	1.5 ± 0.2	9.8 ± 0.2
		intact	3	16.6 ± 2.6	1.7 ± 0.3	9.9 ± 0.2
		crushed	3	15.6 ± 2.5	1.6 ± 0.2	9.8 ± 0.2
	arable 10 yr	bulk	2	18.8 ± 1.5	1.8 ± 0.1	10.6 ± 0.2
		intact	2	20.0 ± 0.7	1.9 ± 0.0	10.6 ± 0.3
		crushed	2	18.5 ± 0.9	1.8 ± 0.0	10.5 ± 0.2

## Figures

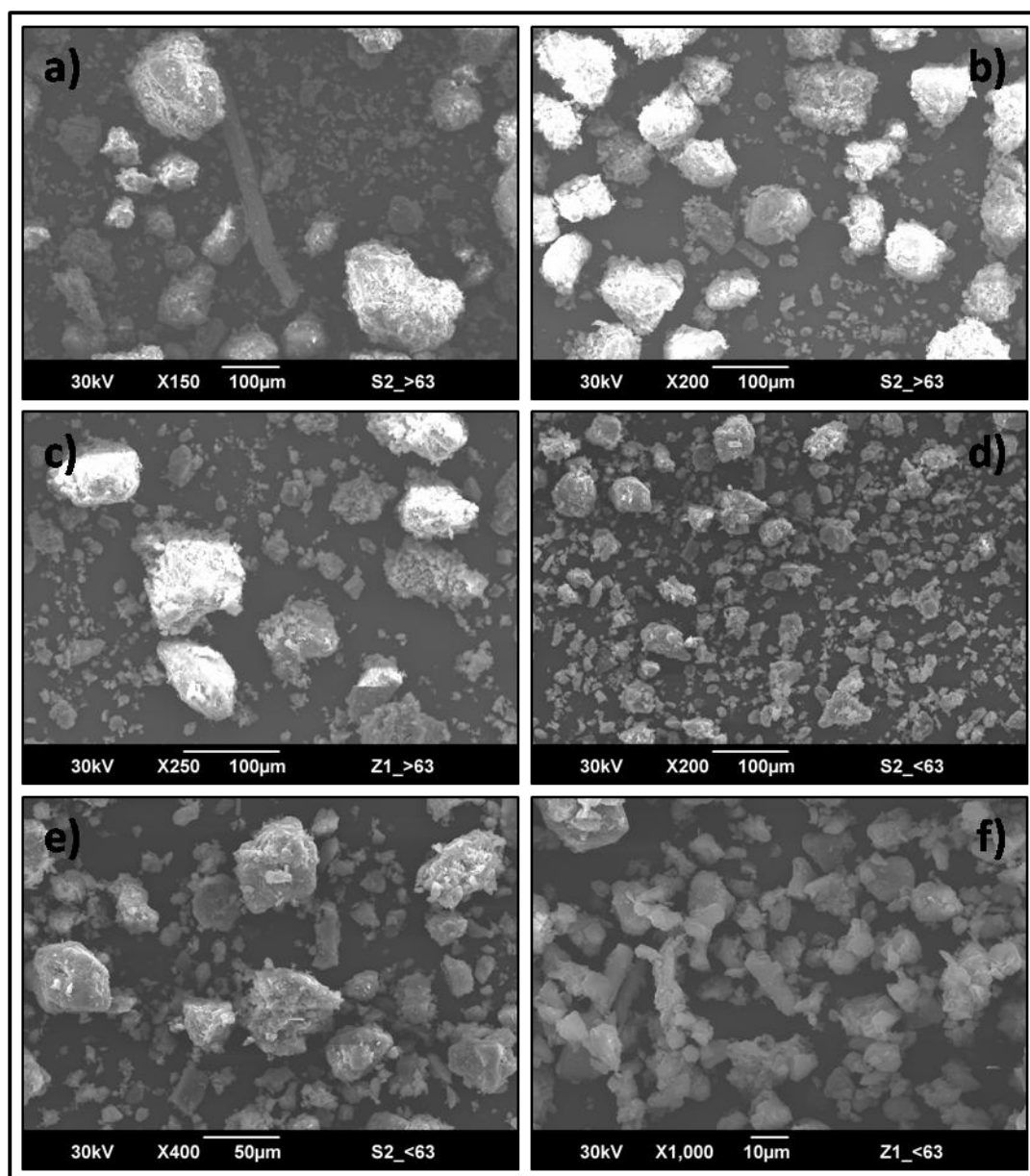
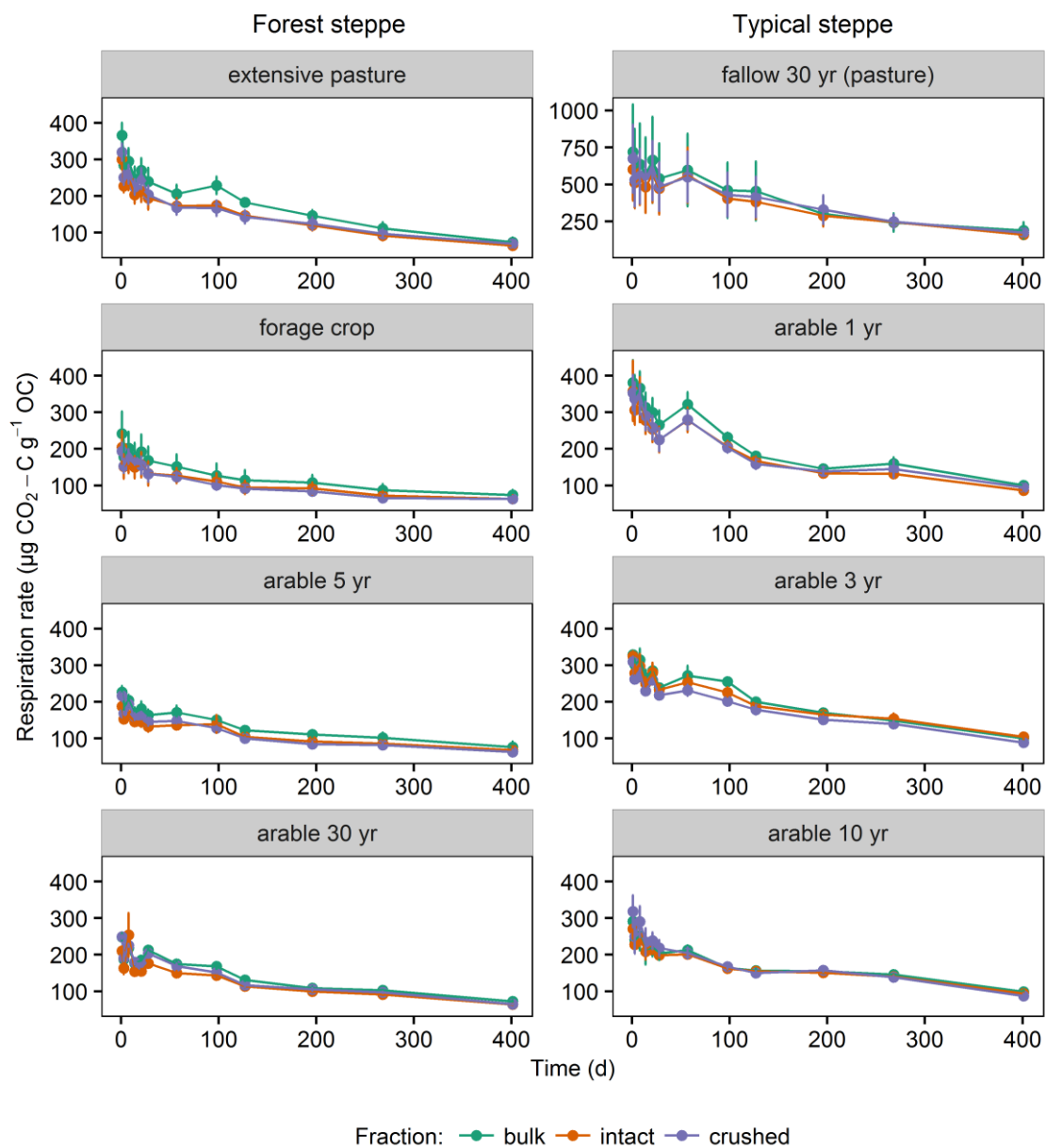
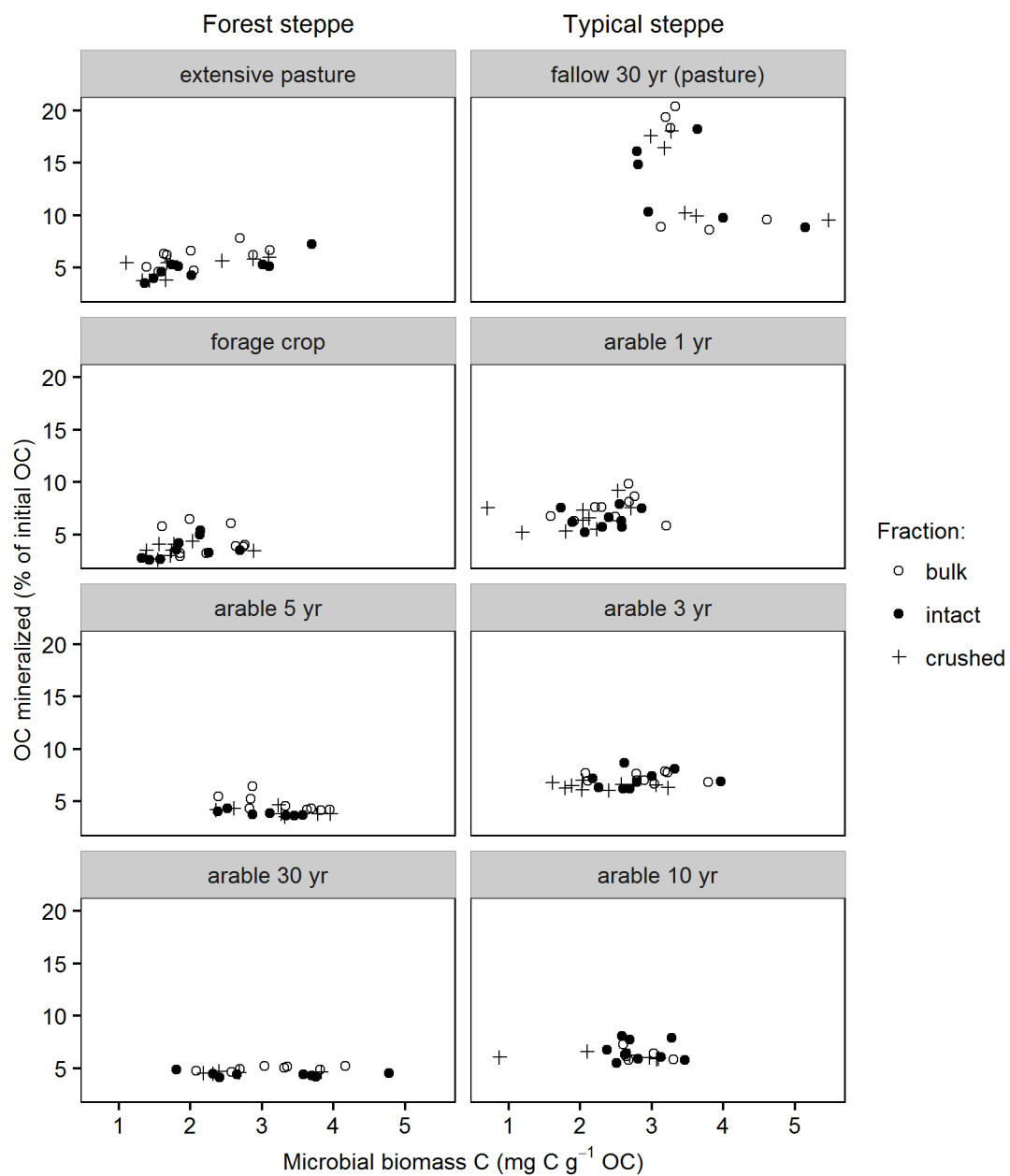


Fig. S 1: Scanning electron micrographs of crushed macro-aggregates (<250 μm). a) fallow 30 yr (pasture) 63–250 μm, b) fallow 30 yr (pasture) 63–250 μm, c) arable 5 yr 63–250 μm, d) fallow 30 yr (pasture) <63 μm, e) fallow 30 yr (pasture) <63 μm, f) arable 5 yr <63 μm.

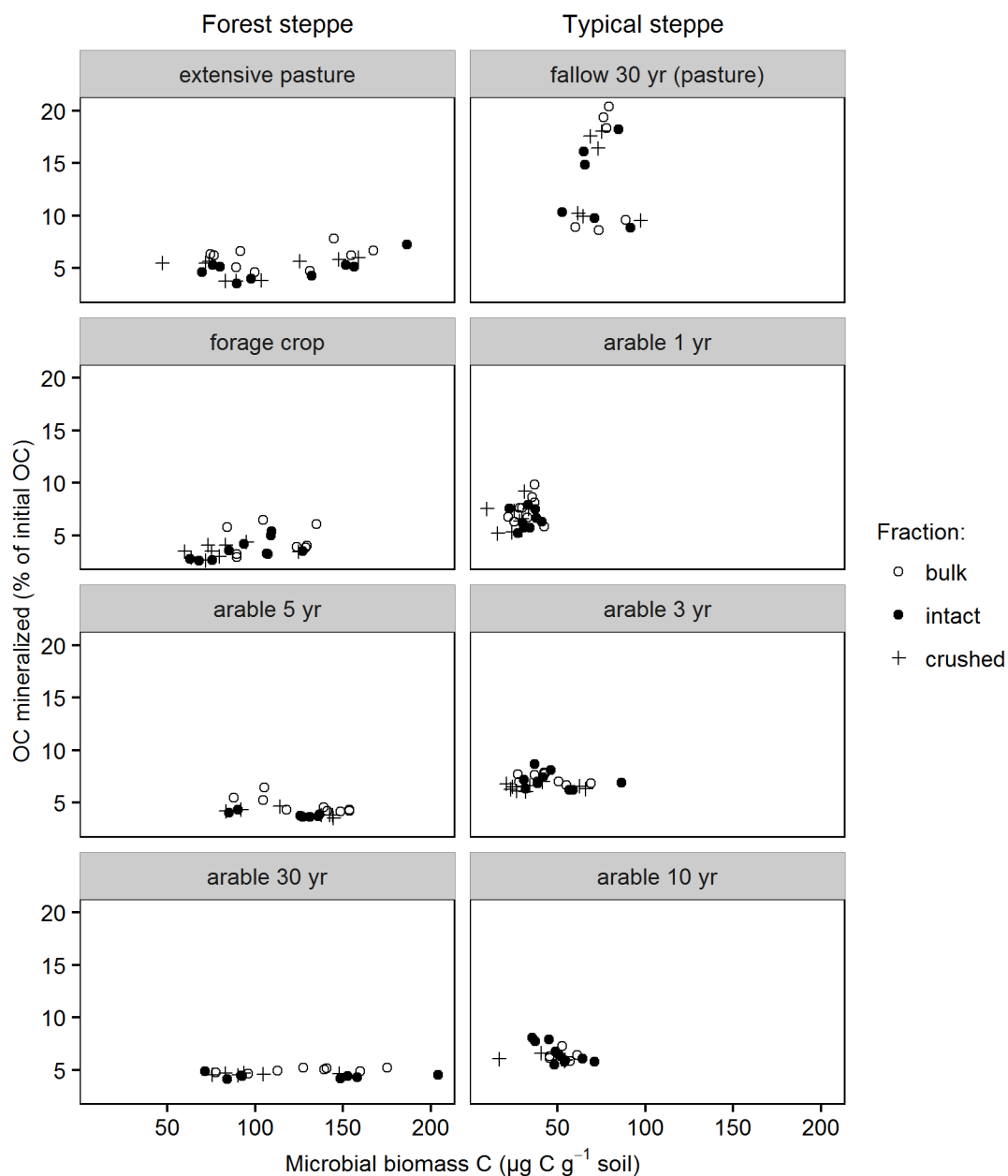
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**Fig. S 2: Time course of respiration rates ( $\mu\text{g CO}_2\text{-C g}^{-1}\text{ OC}$ ) for eight plots within two steppe types and for the three fractions bulk soil, intact macro-aggregates and crushed macro-aggregates. Shown are arithmetic means  $\pm$  SE for all 12 time points where  $\text{CO}_2$  gas samples were taken. Note the different y-scale for the fallow 30 yr (pasture).**



**Fig. S 3: Mineralized OC (% of initial OC) plotted against the microbial biomass C normalized to total OC (mg C g<sup>-1</sup> OC) for eight plots within two steppe types and the three fractions bulk soil, intact macro-aggregates, and crushed macro-aggregates.**



**Fig. S 4: Mineralized OC (% of initial OC) plotted against the microbial biomass C per soil mass ( $\mu\text{g C g}^{-1}$  soil) for eight plots within two steppe types and the three fractions bulk soil, intact macro-aggregates, and crushed macro-aggregates.**

## References

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