<u>Lability classification of soil organic matter in the northern permafrost region</u>

<u>Kuhry et al., Supplement</u>

<u>Captions for Tables and Figures in Supplemental Materials</u>

Table S1. Overview of field study areas and incubated samples

Figure S1. Cross correlations between geochemical parameters for all samples in the four incubation experiments: a-c, PAGE21; d-f, CryoCarb 1-Kolyma; g-i, CryoCarb 2-Taymyr; j-l, CryoCarb 3-Seida. All regressions significant ($p<0.05$).

Figure S2. Correlations between geochemical parameters and µgC-CO_2 production per gram dry weight (gdw) for all samples in the four incubation experiments: a-c, PAGE21; d-f, CryoCarb 1-Kolyma; g-i, CryoCarb 2-Taymyr; j-l, CryoCarb 3-Seida. All regressions significant ($p<0.05$).

Figure S3. µgC-CO_2 production per gram dry weight as a function of %C of the sample for the different landscape unit classes in the CryoCarb 2-Taymyr (a, top panel) and CryoCarb 3-Seida (b, lower panel) incubation experiments: Alluvial class (red line and diamonds, CryoCarb 2-Taymyr experiment only); Mineral class (brown line and squares); Peaty wetland class (light green line and circles); Peatland class (dark green line and circles). All regressions significant, $p<0.05$, except for peat deposits in the CryoCarb 2-Taymyr dataset (n.s.).

Figure S4. µgC-CO_2 production per gram dry weight as a function of C/N of the sample for the different landscape unit classes in the PAGE21 (a, top panel left), CryoCarb 1-Kolyma (b, lower panel left), CryoCarb 2-Taymyr (c, top panel right) and CryoCarb 3-Seida (d, lower panel right) incubation experiments: Alluvial class (red line and diamonds); Eolian class (blue line and triangles); Mineral class (brown line and squares); Peaty wetland class (dark green line and circles); Peatland class (light green line and circles). All regressions significant, $p<0.05$, except for peaty wetland and peat deposits in the PAGE21 dataset and peat deposits in the CryoCarb 1-Kolyma and CryoCarb 3-Seida datasets (n.s.). Note that not all landscape unit classes are represented in all four incubation experiments.

Figure S5. a) µgC-CO_2 production per gram carbon as a function of %C of the sample and b) µgC-CO_2 production per cm^3 as a function of %C of the sample, for the different landscape classes in the PAGE21 dataset: Alluvial class (red line and diamonds); Eolian class (blue line and triangles); Mineral class (brown line and squares); Peaty wetland class (dark green line and circles); Peatland class (light green line and circles). Non-significant regressions, $p>0.05$, are marked n.s.

Figure S6. C content (as %C of dry weight) in samples of (a) the PAGE21 and (b) the CryoCarb 1-Kolyma incubation experiments, grouped according to soil horizon criteria. Abbreviations: AL-OL = Active layer topsoil organics; AL-Min = Active layer mineral; AL-Ce = Active layer C-enriched; P-Min = Permafrost layer mineral; P-Ce = Permafrost layer C-enriched; AL-Pty =

Active layer thin peat (CryoCarb 1-Kolyma experiment only); AL-Pt = Active layer peat; P-Pt = Permafrost layer peat (CryoCarb 1-Kolyma experiment only); AL-Lss OL = Active layer topsoil organics in Late Holocene loess deposits (PAGE21 experiment only); AL-Lss Min = Active layer mineral in Late Holocene loess deposits (PAGE21 experiment only); P-Lss Min = Permafrost layer mineral in Late Holocene loess deposits (PAGE21 experiment only); P-Yed = Permafrost Pleistocene Yedoma deposits (CryoCarb 1-Kolyma experiment only); Th-Yed = Thawed out Pleistocene Yedoma deposits (CryoCarb 1-Kolyma experiment only). Box-whisker plots show mean and standard deviation (in red) and median, first and third quartiles and min/max values (in black), for the different soil horizon groups.

Table in Supplement

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Figures in Supplement

Pages 4-11

Table S1

Study area	Geographic location	Approximate coordinates	Permafrost zone	Vegetation zone	Mean Annual/July Temperatures	Nr profiles / incubated soil samples	Partner and incubation experiment	Time of soil sampling
Ny Ålesund	Svalbard	78.9 N, 11.7 E	Continuous	Tundra	-5.8/+5.2	16 / 24	UCOP_PAGE21	Summer 2013
Adventdalen	Svalbard	78.2 N, 15.9 E	Continuous	Tundra	-6.0/+6.2	35 / 79	UCOP_PAGE21	Summer 2013
Lena Delta	N Siberia	72.3 N, 126.3 E	Continuous	Tundra	-12.5/+10.1	43 / 122	UCOP_PAGE21	Summer 2013
Logata	Taymir Peninsula, N Siberia	73.4 N, 98.4 E	Continuous	Tundra	-14.3/+11.2	33 / 218	USB_CryoCarb 2	Summer 2011
Shalaurovo	Lower Kolyma, NE Siberia	69.5 N, 161.7 E	Continuous	Tundra	-12.1/+11.7	22 / 279	USB_CryoCarb 1	Summer 2010
Arymas	Taymir Peninsula, N Siberia	72.5 N, 101.7 E	Continuous	Tundra, Forest Islands	-13.3/+12.2	34 / 284	USB_CryoCarb 2	Summer 2011
Cherskiy	Lower Kolyma, NE Siberia	68.8 N, 161.6 E	Continuous	Forest (-Tundra), Lowland, Alpine	-11.1/+12.7	16 / 174	USB_CryoCarb 1	Summer 2010
Seida	NW Russia	67.1 N, 62.9 E	Discontinuous	Tundra, Forest Islands	-6.1/+13.0	8 / 80	USB_CryoCarb 3	Summer 2008
Stordalen Mire	Abisko, N Sweden	68.3 N, 19.1 E	Sporadic	Alpine treeline ecotone	-0.2/+11.6	5 / 13	UCOP_PAGE21	Summer 2013

Figure S1.

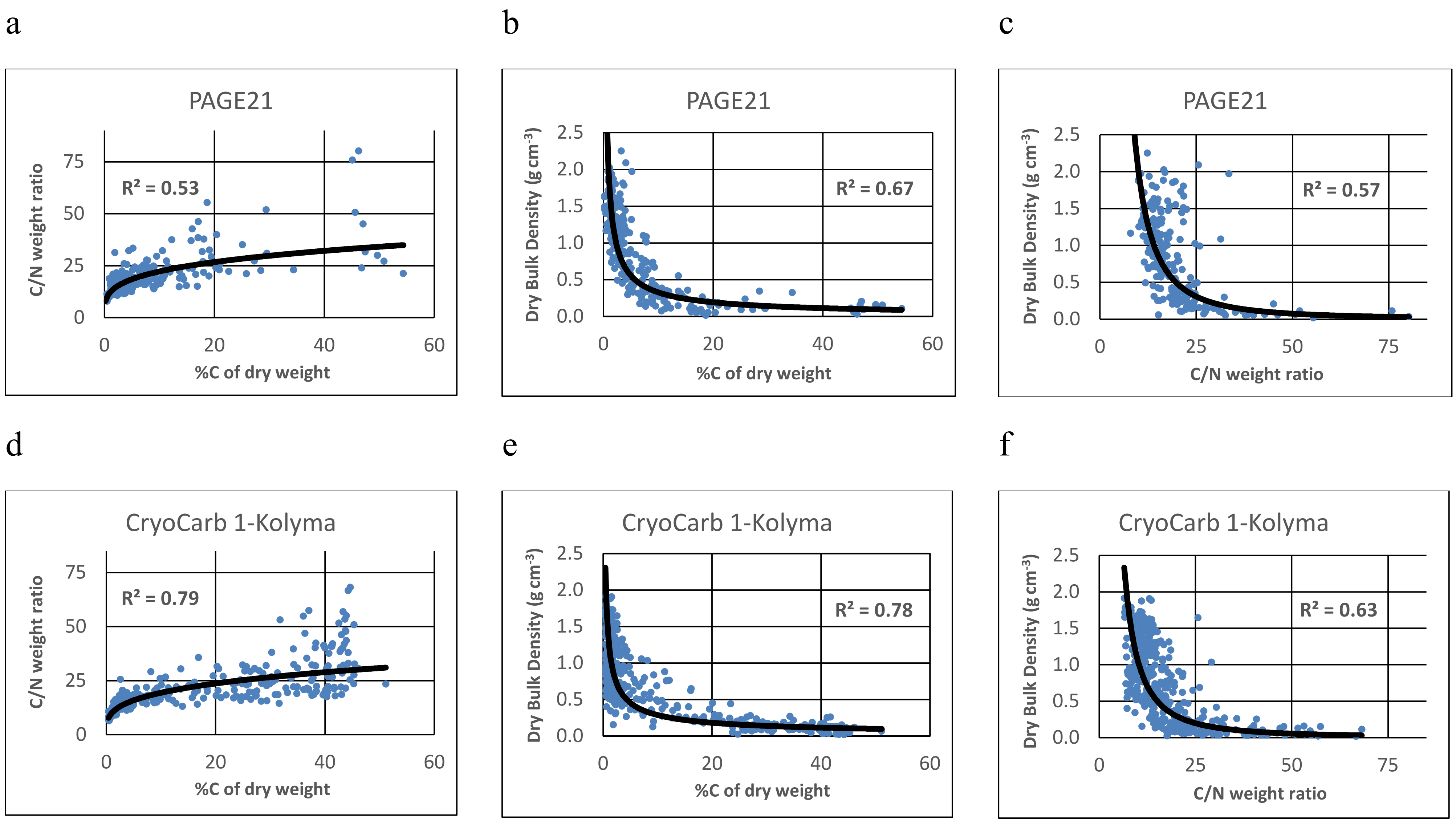
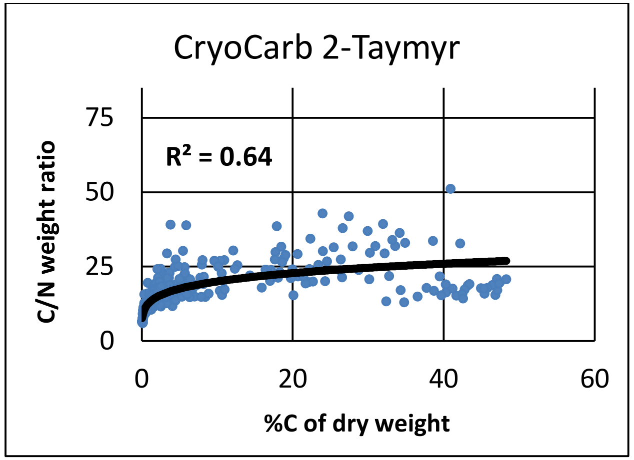

a
PAGE21
C/N weight ratio
%C of dry weight
R² = 0.53
0 25 50 75
0 20 40 60
b
PAGE21
Dry Bulk Density (g cm⁻³)
%C of dry weight
R² = 0.67
0.0 0.5 1.0 1.5 2.0 2.5
0 20 40 60
c
PAGE21
Dry Bulk Density (g cm⁻³)
C/N weight ratio
R² = 0.57
0.0 0.5 1.0 1.5 2.0 2.5
0 25 50 75
d
CryoCarb 1-Kolyma
C/N weight ratio
%C of dry weight
R² = 0.79
0 25 50 75
0 20 40 60
e
CryoCarb 1-Kolyma
Dry Bulk Density (g cm⁻³)
%C of dry weight
R² = 0.78
0.0 0.5 1.0 1.5 2.0 2.5
0 20 40 60
f
CryoCarb 1-Kolyma
Dry Bulk Density (g cm⁻³)
C/N weight ratio
R² = 0.63
0.0 0.5 1.0 1.5 2.0 2.5
0 25 50 75

Figure S1, cont'd.

g



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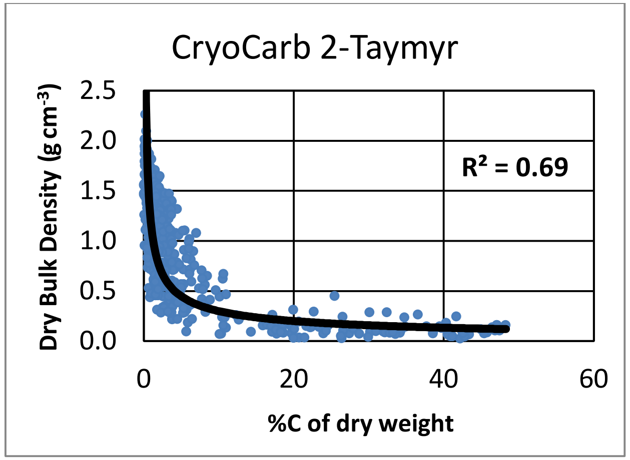

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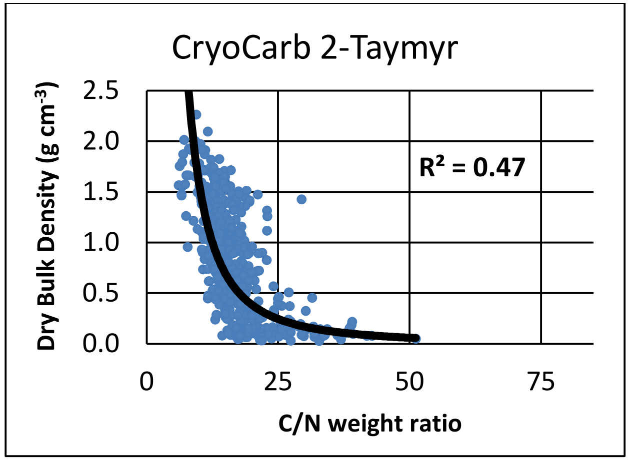

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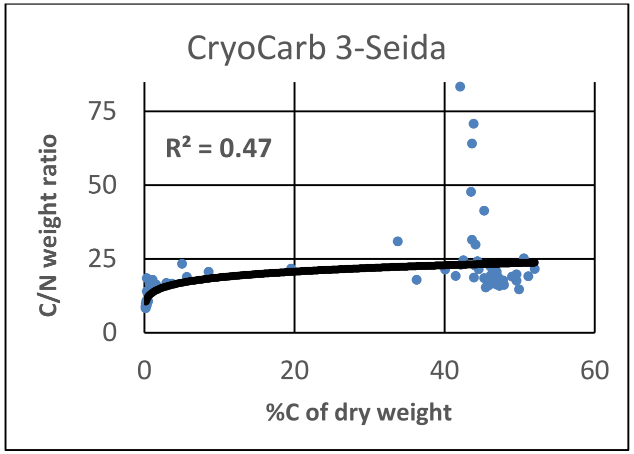

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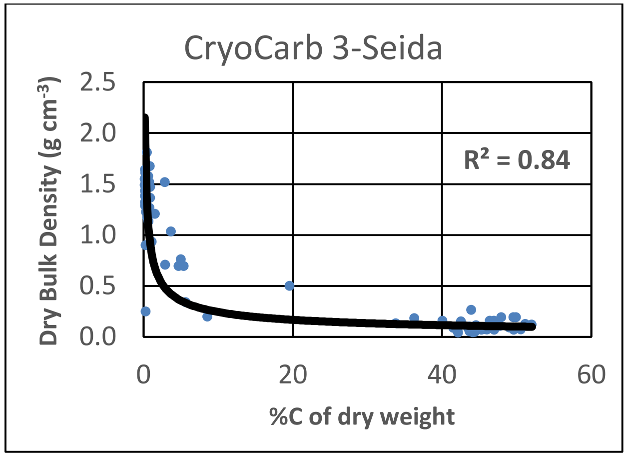

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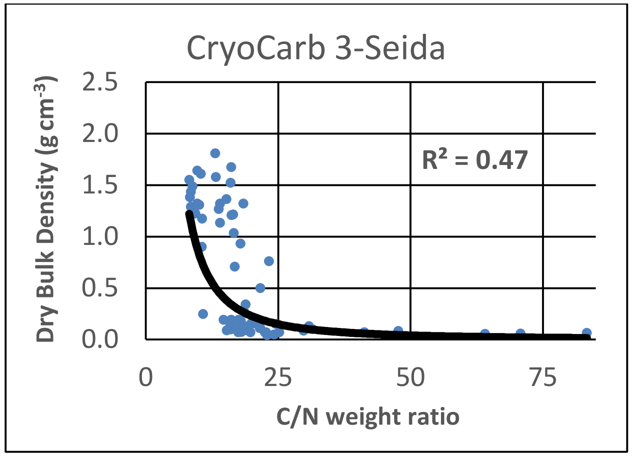
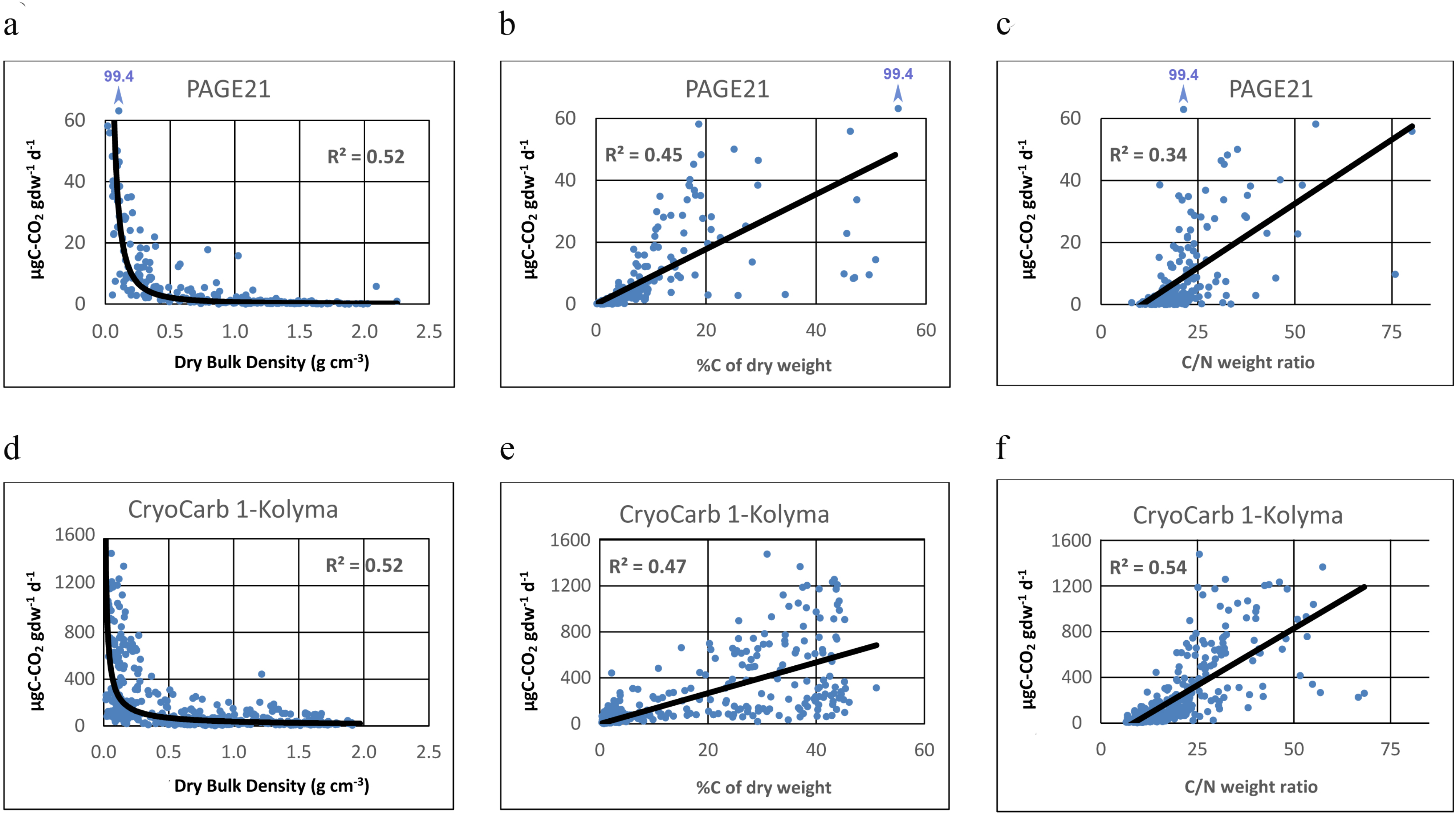


Figure S2.



a
99.4
PAGE21
R² = 0.52
μgC-CO2 gdw-1 d-1
60
40
20
0
0.0
0.5
1.0
1.5
2.0
2.5
Dry Bulk Density (g cm-3)
b
PAGE21
99.4
R² = 0.45
μgC-CO2 gdw-1 d-1
60
40
20
0
0
20
40
60
%C of dry weight
c
99.4
PAGE21
R² = 0.34
μgC-CO2 gdw-1 d-1
60
40
20
0
0
25
50
75
C/N weight ratio
d
CryoCarb 1-Kolyma
R² = 0.52
μgC-CO2 gdw-1 d-1
1600
1200
800
400
0
0.0
0.5
1.0
1.5
2.0
2.5
Dry Bulk Density (g cm-3)
e
CryoCarb 1-Kolyma
R² = 0.47
μgC-CO2 gdw-1 d-1
1600
1200
800
400
0
0
20
40
60
%C of dry weight
f
CryoCarb 1-Kolyma
R² = 0.54
μgC-CO2 gdw-1 d-1
1600
1200
800
400
0
0
25
50
75
C/N weight ratio

Figure S2, cont'd.

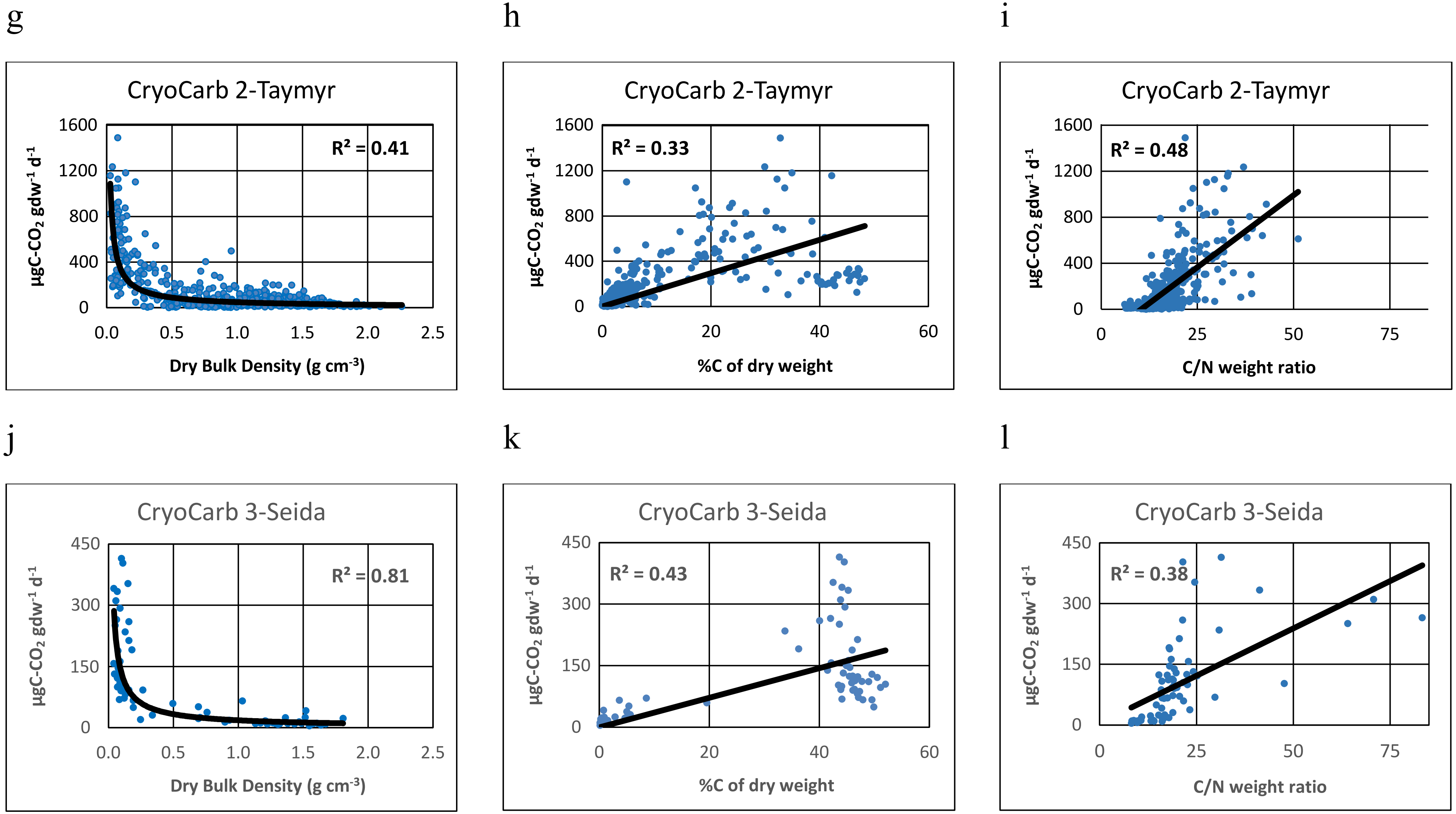
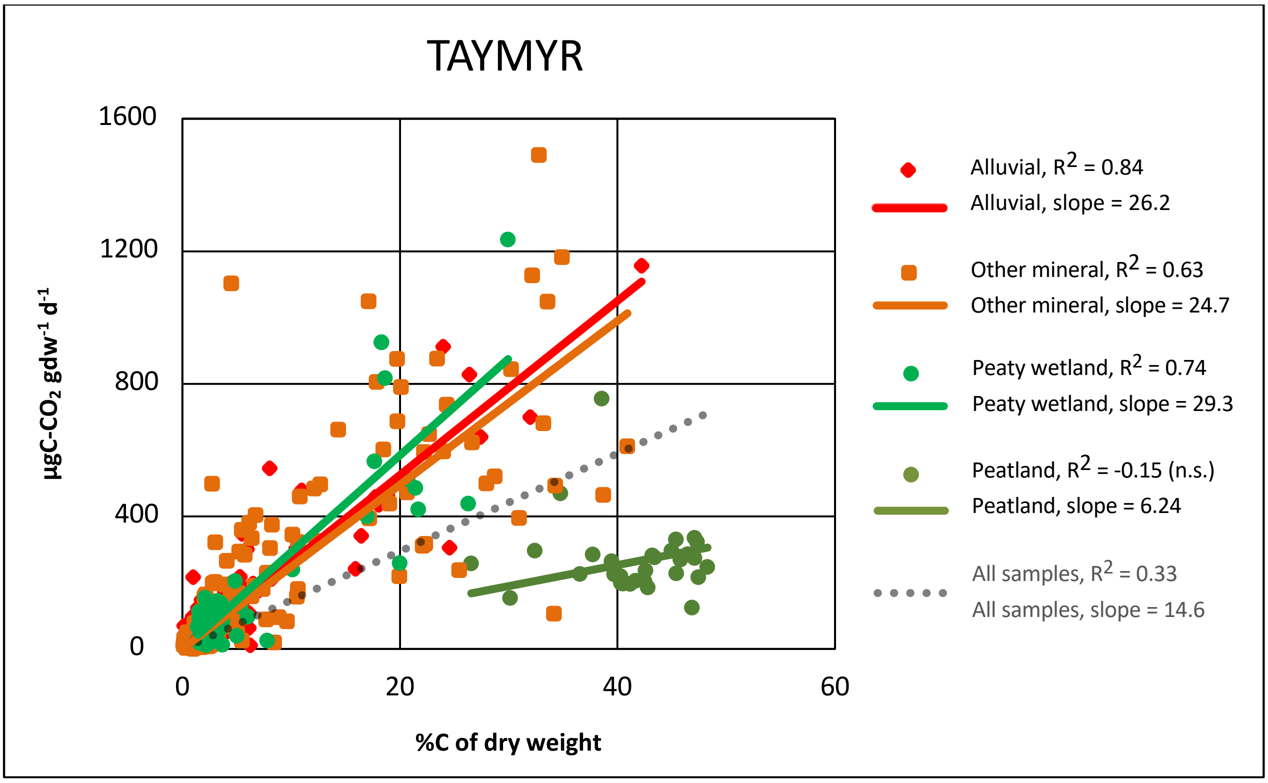


Figure S3

a


TAYMYR
1600
1200
800
400
0
0
20
40
60
µgC-CO2 gdw-1 d-1
%C of dry weight
Alluvial, R2 = 0.84
Alluvial, slope = 26.2
Other mineral, R2 = 0.63
Other mineral, slope = 24.7
Peaty wetland, R2 = 0.74
Peaty wetland, slope = 29.3
Peatland, R2 = -0.15 (n.s.)
Peatland, slope = 6.24
All samples, R2 = 0.33
All samples, slope = 14.6

b

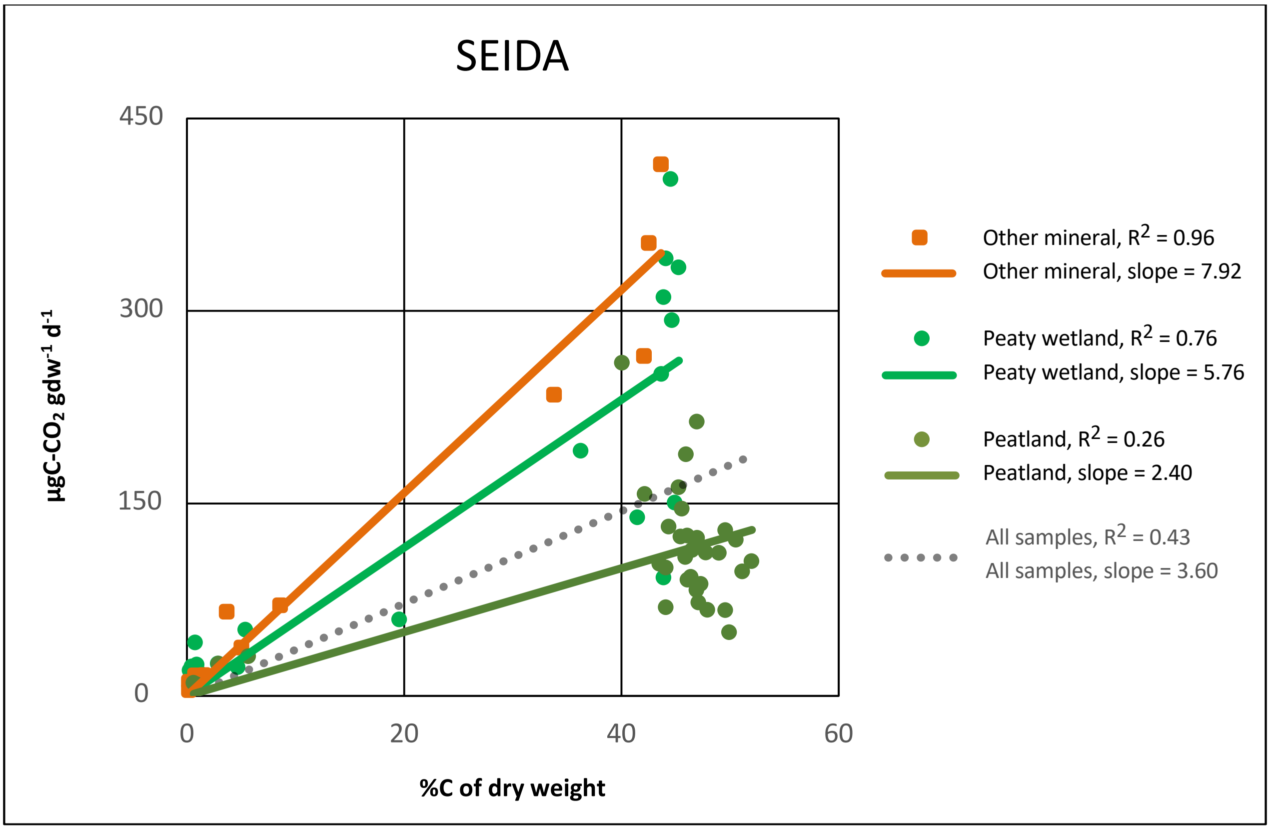
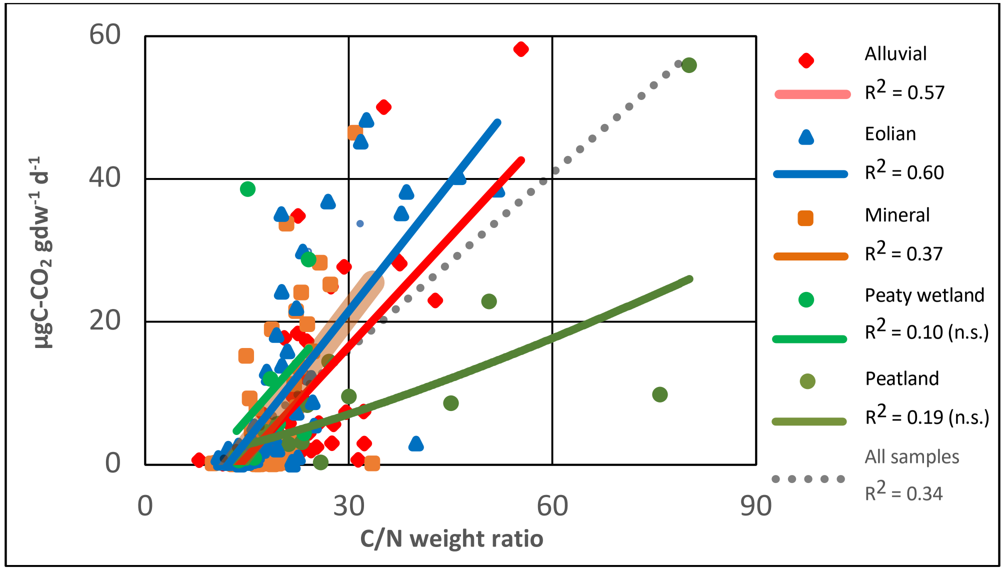
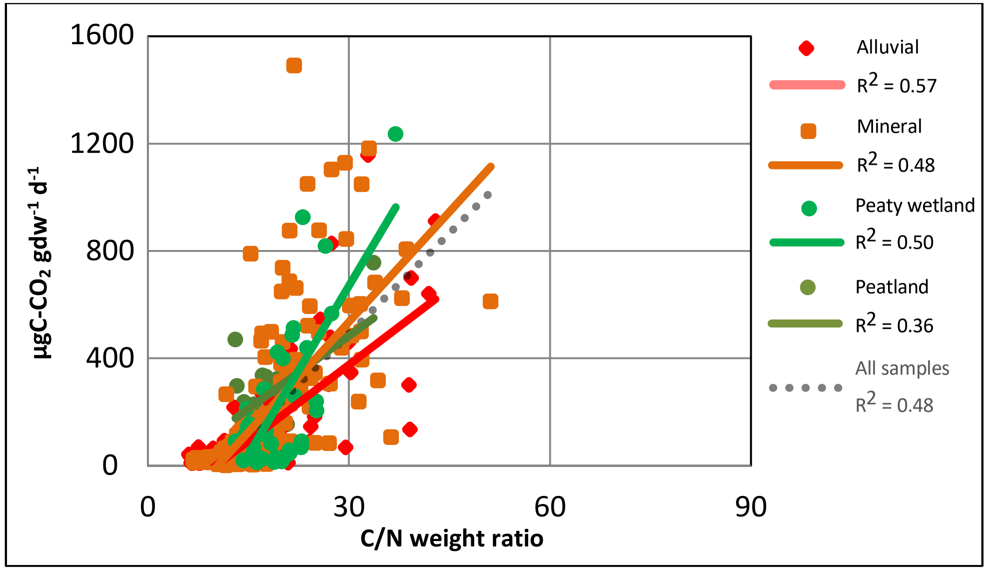

SEIDA
450
300
150
0
0
20
40
60
µgC-CO2 gdw-1 d-1
%C of dry weight
Other mineral, R2 = 0.96
Other mineral, slope = 7.92
Peaty wetland, R2 = 0.76
Peaty wetland, slope = 5.76
Peatland, R2 = 0.26
Peatland, slope = 2.40
All samples, R2 = 0.43
All samples, slope = 3.60

Figure S4.

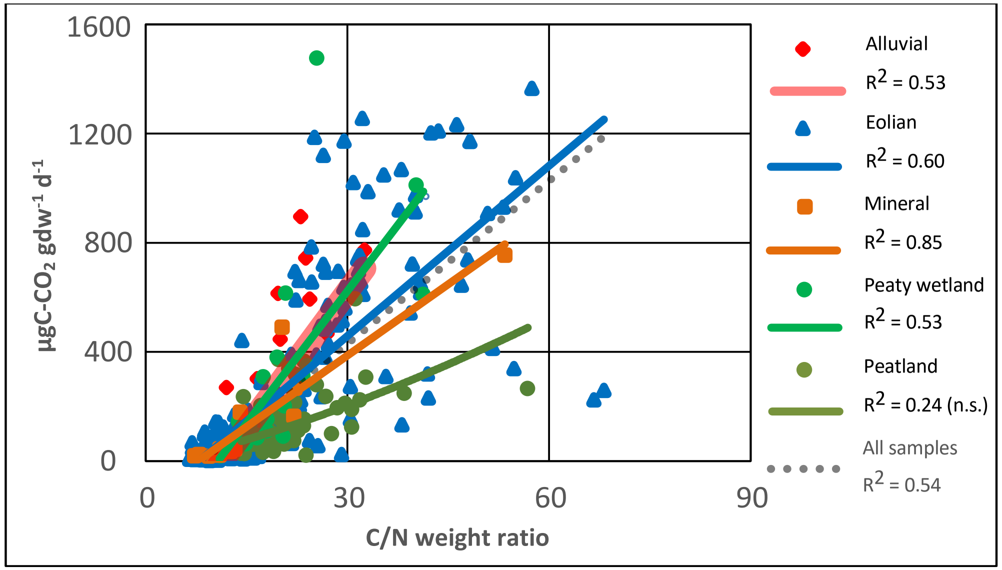
a. PAGE21



c. CryoCarb 2-Taymyr



b. CryoCarb 1-Kolyma



d. CryoCarb 3-Seida

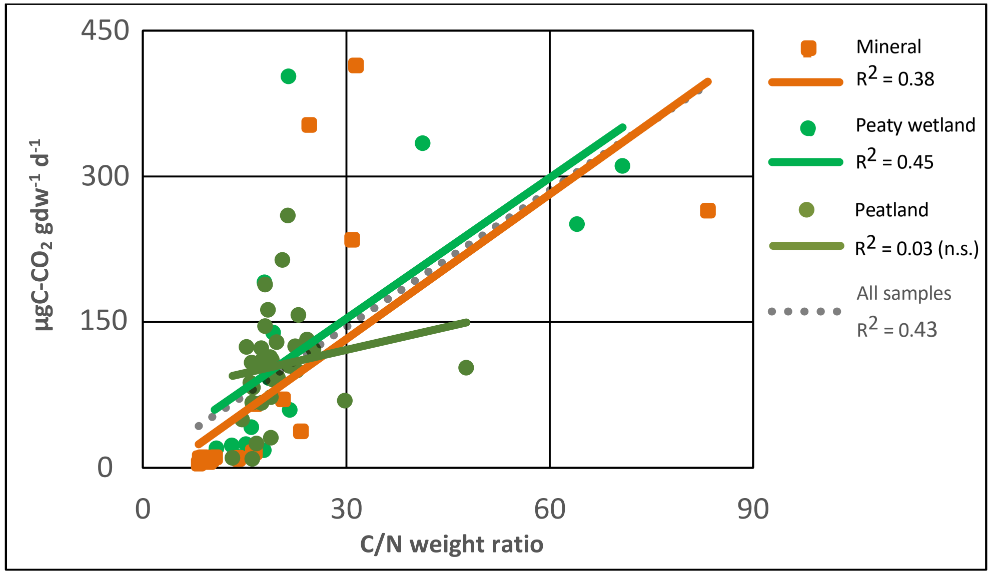
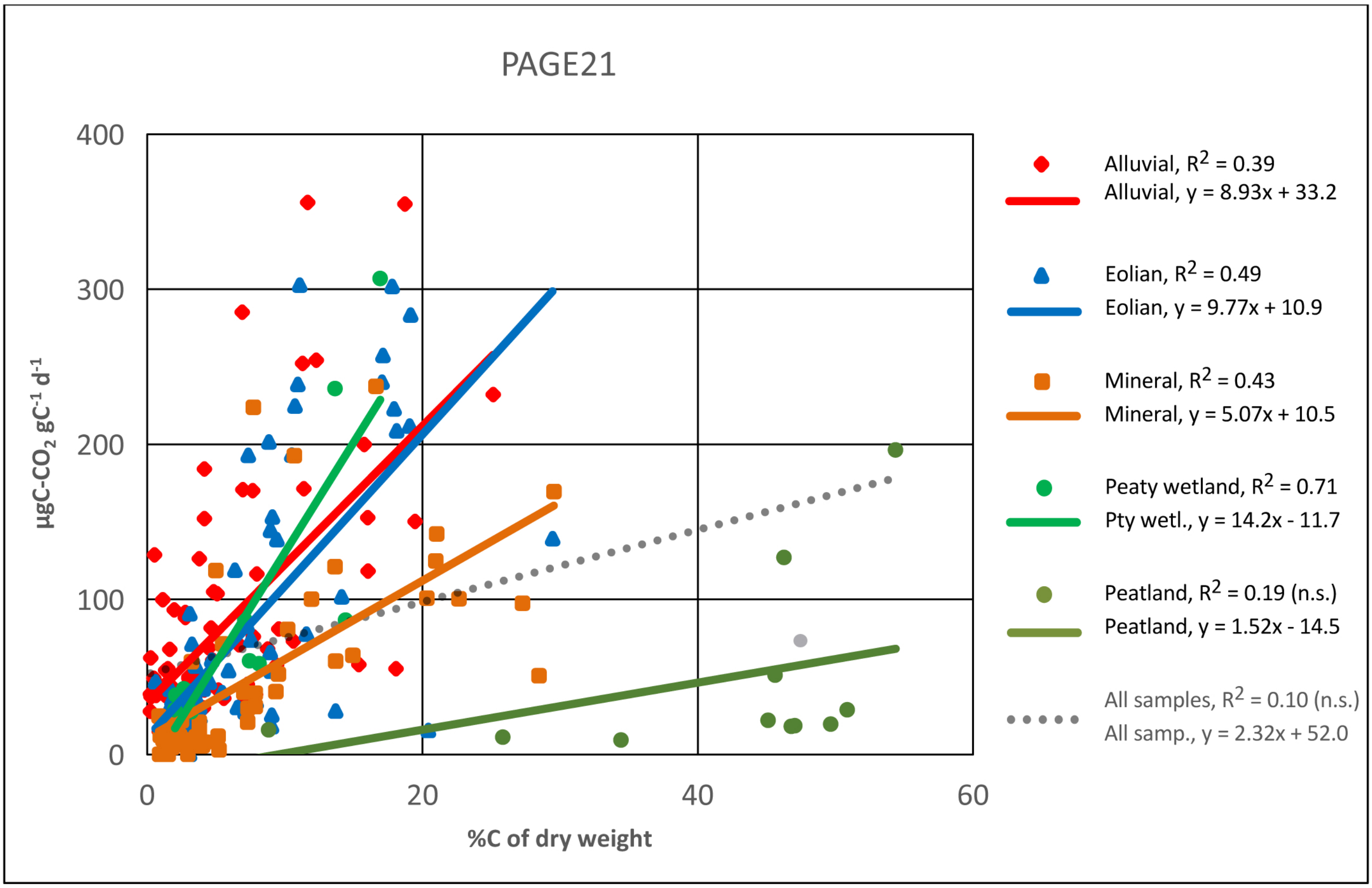


Figure S5.

a


PAGE21
400
300
200
100
0
0
20
40
60
μgC-CO2 gC-1 d-1
%C of dry weight
Alluvial, R2 = 0.39
Alluvial, y = 8.93x + 33.2
Eolian, R2 = 0.49
Eolian, y = 9.77x + 10.9
Mineral, R2 = 0.43
Mineral, y = 5.07x + 10.5
Peaty wetland, R2 = 0.71
Pty wetl., y = 14.2x - 11.7
Peatland, R2 = 0.19 (n.s.)
Peatland, y = 1.52x - 14.5
All samples, R2 = 0.10 (n.s.)
All samp., y = 2.32x + 52.0

b

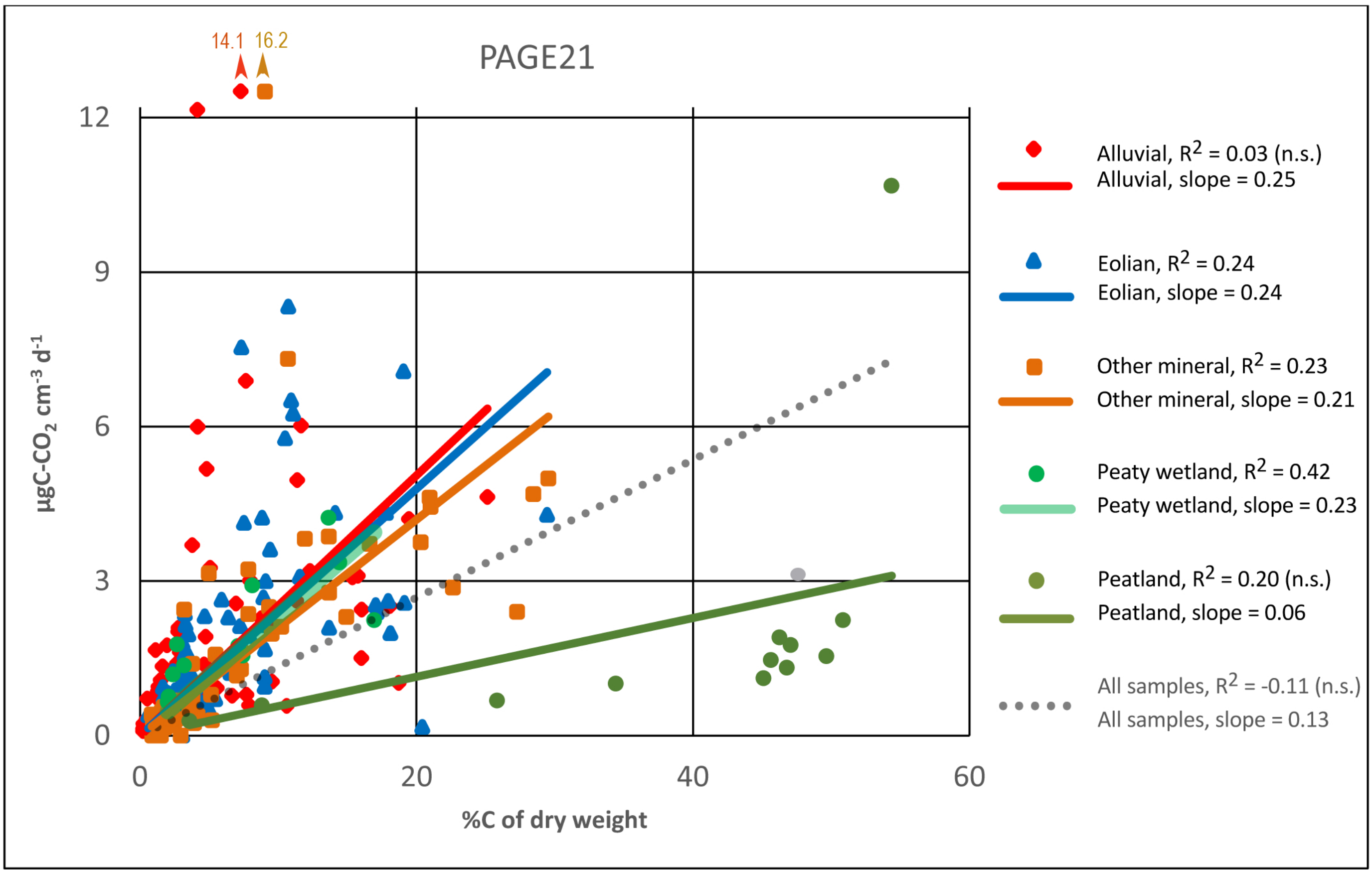
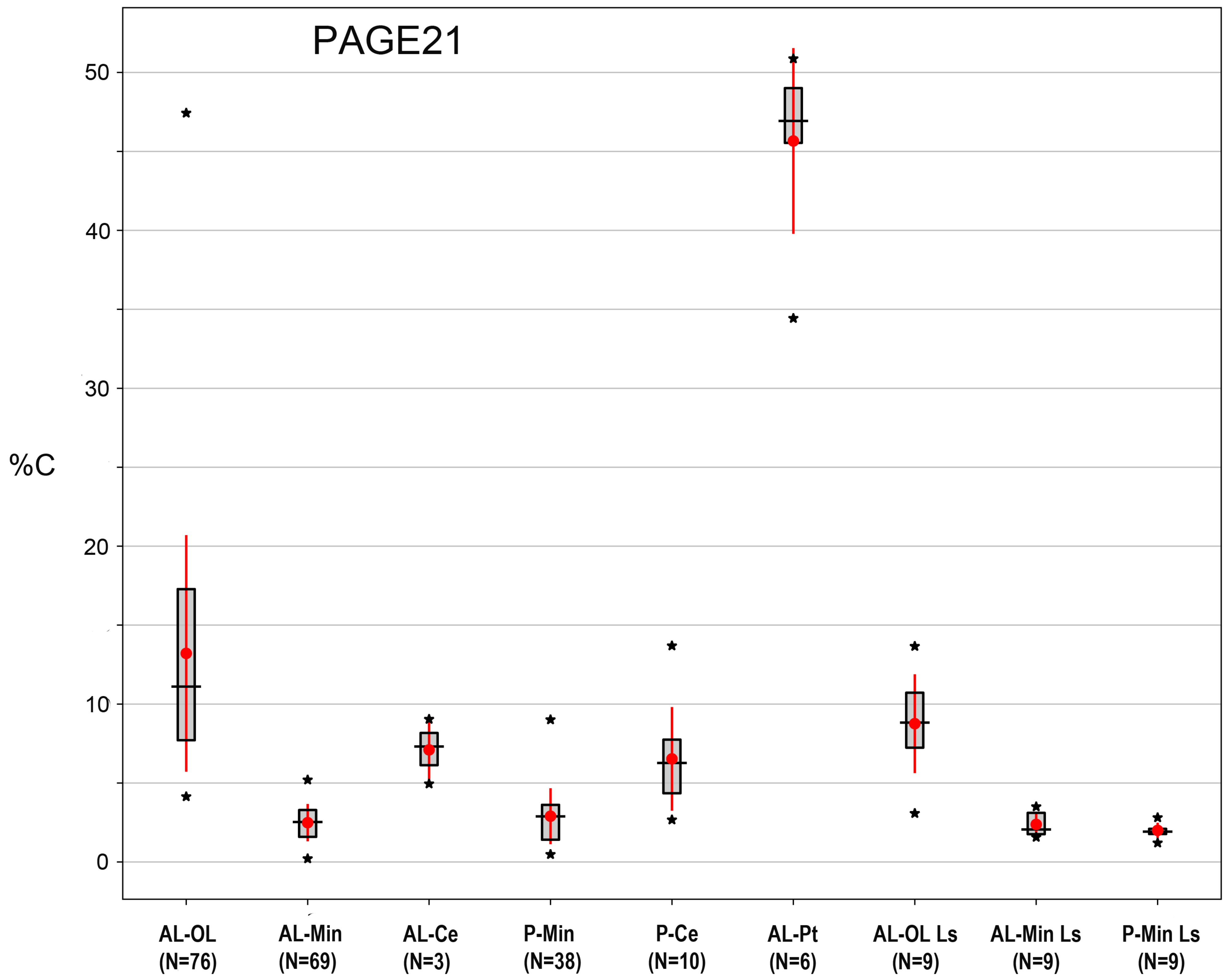
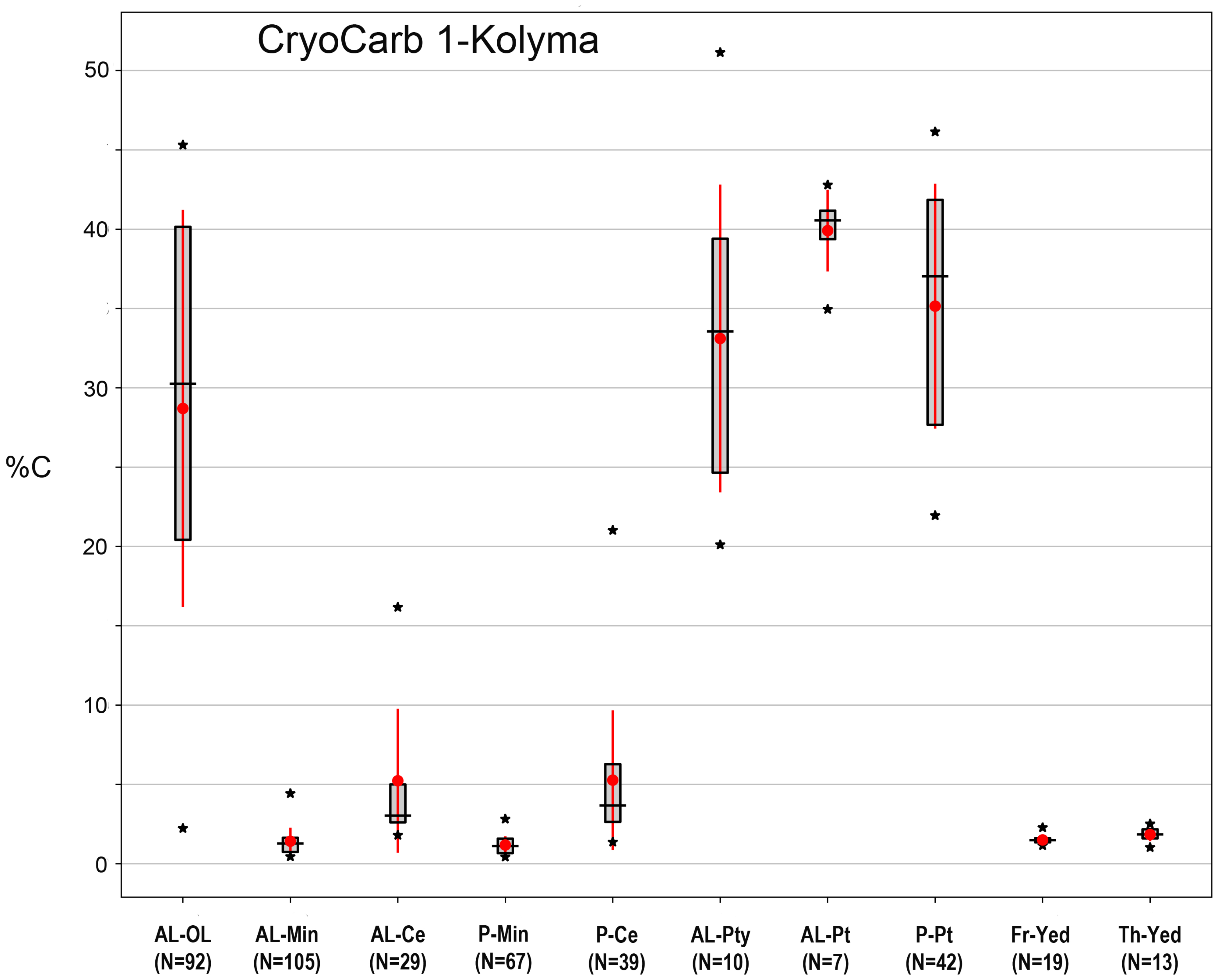

PAGE21
14.1
16.2
12
9
6
3
0
0
20
40
60
μgC-CO2 cm-3 d-1
%C of dry weight
Alluvial, R2 = 0.03 (n.s.)
Alluvial, slope = 0.25
Eolian, R2 = 0.24
Eolian, slope = 0.24
Other mineral, R2 = 0.23
Other mineral, slope = 0.21
Peaty wetland, R2 = 0.42
Peaty wetland, slope = 0.23
Peatland, R2 = 0.20 (n.s.)
Peatland, slope = 0.06
All samples, R2 = -0.11 (n.s.)
All samples, slope = 0.13

Figure S6.

a


PAGE21
%C
50
40
30
20
10
0
AL-OL (N=76)
AL-Min (N=69)
AL-Ce (N=3)
P-Min (N=38)
P-Ce (N=10)
AL-Pt (N=6)
AL-OL Ls (N=9)
AL-Min Ls (N=9)
P-Min Ls (N=9)

b


CryoCarb 1-Kolyma
%C
50
40
30
20
10
0
AL-OL (N=92)
AL-Min (N=105)
AL-Ce (N=29)
P-Min (N=67)
P-Ce (N=39)
AL-Pty (N=10)
AL-Pt (N=7)
P-Pt (N=42)
Fr-Yed (N=19)
Th-Yed (N=13)