



Supplement of

Large errors in soil carbon measurements attributed to inconsistent sample processing

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Table S1: Results of an informal survey among 51 soil testing laboratories where laboratories were asked to provide a method for soil sieving (i.e., initial homogenization) of bulk soils. Participants remain anonymous. NAPT is an acronym for the North American Proficiency Testing program.

Lab ID	NAPT certification	Sieving procedure	Lab ID	NAPT certification	Sieving procedure
A	Yes	no specification	AH	Yes	unspecified
AO	No	NA	AS	Yes	Dynacrush flail grinder
AN	Yes	Hammermill grinder	K	Yes	unspecified
AG	No	AgVise grinder	AP	Yes	Dynacrush flail grinder
AQ	No	Dynacrush flail grinder	L	Yes	unclear "very fine"
E	Yes	Flail grinder	BD	Yes	Dynacrush flail grinder
F	Yes	Flail grinder	O	Yes	Flail grinder
G	Yes	Customized grinder	AW	Yes	Dynacrush flail grinder
B	Yes	Customized grinder	AM	Yes	Dynacrush flail grinder
H	Yes	Dynacrush flail grinder	P	Yes	Dynacrush flail grinder
I	Yes	Dynacrush flail grinder	AX	Yes	Custom grinder
AU	Yes	Flail grinder	AZ	Yes	Grinder unspecified
C	Yes	NASCO grinder	Q	Yes	unspecified
D	No	Mortar & pestle	R	Yes	unspecified
AD	Yes	Mortar & pestle	S	Yes	Grinder - manual
AC	Yes	Grinder unspecified	T	Yes	Grinder unspecified
BC	Yes	AgVise grinder	AR	Yes	Dynacrush flail grinder
J	Yes	Dynacrush flail grinder	AY	Yes	Dynacrush flail grinder
AT	Yes	unspecified	U	Yes	Grinder unspecified
AI	Yes	Dynacrush flail grinder	W	Yes	Hammermill grinder
BB	Yes	Dynacrush flail grinder	X	Yes	Grinder unspecified
AB	Yes	Hammermill grinder	AE	Yes	AgVise grinder
AJ	Yes	unspecified	Y	Yes	Hammermill grinder
AV	Yes	unspecified	Z	Yes	unspecified
AK	Yes	unspecified	AA	Yes	unspecified
BA	Yes	Dynacrush flail grinder			

Table S2: The external service laboratory methods outlined for sieving, fine grinding, and drying for the measurements of % total carbon (TC), % soil inorganic carbon (SIC), and % soil organic carbon (SOC). The quantification methods for % TC, SIC, and SOC are presented where EA stands for dry combustion by elemental analyzer.

Lab ID	Sieving	Fine grinding	Drying	TC quantification	SIC quantification	SOC quantification
I	Mechanical grinder to 2 mm	no	air-dried	EA	TC-SOC	acidify EA
II	Mechanical grinder to 2 mm	no	45 °C	EA	TC-SOC	acidify EA
III	Mechanical grinder to 1 mm	no	air-dried	EA	TC-SOC	acidify EA
IV	Mechanical grinder to 2mm	no	air-dried	EA	TC-SOC	acidify EA
V	8 mm + mortar and pestle to 2mm	Ball mill	air-dried with moisture correction	EA	Pressure transducer	TC-SIC
VI	Mechanical grinder to 2mm	no	air-dried with 1-2 % moisture correction	EA	Pressure transducer	TC-SIC
VII	Mortar and pestle to 2mm	no	105 °C	EA	EA	EA
VII I	Mortar and pestle to 2mm	no	air-dried	EA	gravimetric	TC-SIC

Table S3: Summary for each model built using the United States Department of Agriculture Natural Resources Conservation Service National Soil Survey Center-Kellogg Soil Survey coupled with partial least squares regression in OPUS (OPUS version 8.5, Bruker Optik GmbH 2020) describing the soil property of interest for prediction, spectral library boundaries, spectral pre-processing for model optimization, and the validation model R² and root mean square error of prediction (RMSEP).

Soil Property	Area Name	Spectral pre-processing	R ²	RMSEP
Total Carbon	Colorado	First derivative + Vector normalization (SNV)	0.9506	0.433
Total Carbon	Wyoming	First derivative + Vector normalization (SNV)	0.9543	0.442
Total Carbon	Iowa or Nebraska	First derivative + Vector normalization (SNV)	0.9625	0.309
Total Carbon	Kansas	First derivative + Vector normalization (SNV)	0.984	0.44
Inorganic Carbon	Colorado	First derivative + Straight line subtraction	0.9899	0.834
Inorganic Carbon	Wyoming	First derivative	0.9925	0.761
Inorganic Carbon	Iowa or Nebraska	First derivative + MSC	0.9768	1.56
Inorganic Carbon	Kansas	First derivative + Straight line subtraction	0.9959	0.798
Organic Carbon	Colorado	First derivative + Vector normalization (SNV)	0.963	0.398
Organic Carbon	Wyoming	First derivative + Vector normalization (SNV)	0.9604	0.318
Organic Carbon	Iowa or Nebraska	First derivative + Vector normalization (SNV)	0.9553	0.318
Organic Carbon	Kansas	First derivative + MSC	0.9564	0.257

Table S4: The absolute difference (Δ) reported for % total carbon (TC), % soil inorganic carbon (SIC), and % soil organic carbon (SOC) for soil samples B, C, J, and D sent to the eight external service soil testing laboratories calculated by subtracting the field moist soil sample from the air-dried soil sample sent. The laboratories are identified by a roman numeral with the true directional difference reported in parentheses.

Soil	Lab	(Δ TC)	(Δ SIC)	(Δ SOC)
B	I	3.67, 4.07 (-0.40)	0.45, 0.86 (-0.41)	3.22, 3.21 (+0.01)
C	I	1.23, 1.43 (-0.16)	0.02, 0.16 (-0.14)	1.25, 1.27 (-0.02)
J	I	3.37, 3.37 (0.00)	0.09, 0.01 (+0.08)	3.28, 3.36 (-0.08)
D	I	1.55, 1.66 (-0.11)	0.72, 0.83 (-0.11)	0.83, 0.83 (0.00)
B	II	2.60, 2.73 (-0.13)	0.54, 0.28 (+0.26)	2.06, 2.45 (-0.39)
C	II	1.11, 1.36 (-0.25)	0.22, 0.32 (-0.10)	0.89, 1.04 (-0.15)
J	II	7.57, 2.95 (+4.62)	4.12, 0.06 (+4.06)	3.45, 2.89 (+0.56)
D	II	1.45, 1.43 (+0.02)	0.76, 0.60 (+0.07)	0.77, 0.83 (-0.05)
B	III	4.52, 2.63 (+1.89)	0.46, 0.01 (+0.45)	4.07, 2.62 (+1.45)
C	III	1.32, 1.21 (+0.11)	0.08, 0.06 (+0.02)	1.24, 1.15 (+0.09)
J	III	3.37, 3.16 (+0.21)	0.00, 0.02 (-0.02)	3.37, 3.13 (+0.24)
D	III	1.53, 1.54 (-0.01)	0.73, 0.74 (-0.01)	0.80, 0.80 (0.00)
B	IV	6.51, 4.72 (+1.79)	1.72, 0.59 (+1.13)	4.79, 4.13 (+0.66)
C	IV	1.22, 0.92 (+0.30)	0.14, 0.00 (+0.14)	1.08, 1.39 (-0.31)
J	IV	2.99, 2.89 (+0.10)	0.00, 0.00 (0.00)	3.38, 2.97 (+0.41)
D	IV	1.66, 1.02 (-0.36)	0.52, 1.41 (-0.89)	1.14, 0.61 (+0.53)
B	V	3.17, 2.94 (+0.23)	0.56, 0.53 (+0.03)	2.61, 2.40 (+0.21)
C	V	1.34, 1.16 (+0.18)	0.03, 0.03 (0.00)	1.32, 1.14 (+0.18)
J	V	4.03, 3.67 (+0.36)	0.04, 0.02 (+0.01)	3.99, 3.65 (+0.35)
D	V	1.53, 1.69 (-0.16)	0.80, 0.80 (0.00)	0.73, 0.89 (-0.16)
B	VI	2.98, 3.06 (-0.08)	0.41, 0.40 (+0.01)	2.57, 2.66 (-0.09)
C	VI	1.24, 1.20 (+0.04)	0.00, 0.00 (0.00)	1.24, 1.20 (+0.04)
J	VI	3.34, 3.32 (+0.02)	0.00, 0.00 (0.00)	3.34, 3.32 (+0.02)
D	VI	1.52, 1.52 (0.00)	0.78, 0.06 (+0.72)	0.74, 1.46 (-0.72)
B	VII	3.03, 3.45 (-0.42)	0.52, 0.94 (-0.42)	2.51, 2.51 (0.00)
C	VII	1.31, 1.36 (-0.05)	0.00, 0.00 (0.00)	1.31, 1.36 (-0.05)
J	VII	3.36, 3.31 (+0.15)	0.00, 0.00 (0.00)	3.36, 3.31 (+0.15)
D	VII	1.71, 1.57 (+0.14)	0.53, 0.52 (+0.01)	1.18, 1.05 (+0.13)
B	VIII	4.08, 4.05 (+0.03)	0.68, 1.03 (-0.35)	3.40, 3.02 (+0.38)
C	VIII	1.25, 1.22 (+0.03)	0.18, 0.29 (-0.11)	1.07, 0.93 (+0.14)
J	VIII	3.25, 3.78 (-0.53)	0.28, 0.17 (+0.11)	2.97, 3.61 (-0.64)
D	VIII	1.54, 1.59 (-0.05)	1.02, 1.19 (-0.17)	0.52, 0.40 (+0.12)

Table S5: Data averages and standard error for % plant material and % rocks removed for each sieving procedure, including R (8 + 2 mm), S1 (4 mm), S2 (2 mm with rolling pin), and S3 (mechanical grinder) as described in Figure 1 of the main text. Significance by ANOVA is indicated by asterisks (*). Soils are lettered and significant differences for each soil (S)*procedure (P) combination are indicated by the superscript

	Method Test	Procedure	Procedure ID	A	B	C	D	E	F	G	H	I	J	K	L	Significance levels
% plant material	Sieving	8+2 mm	R	0.22 ± 0.03 ^A	0.35 ± 0.04 ^A	0.31 ± 0.05 ^A	0.04 ± 0.01 ^A	0.25 ± 0.04 ^A	0.15 ± 0.02 ^A	0.38 ± 0.03 ^A	0.99 ± 0.04 ^A	0.12 ± 0.03 ^A	0.04 ± 0.01 ^A	0.04 ± 0.01 ^A	0.05 ± 0.02 ^A	S ***
		4 mm	S1	0.26 ± 0.04 ^A	0.34 ± 0.05 ^A	0.28 ± 0.07 ^A	0.08 ± 0.05 ^A	0.12 ± 0.01 ^{AB}	0.09 ± 0.02 ^{AC}	0.29 ± 0.03 ^{AC}	0.92 ± 0.17 ^A	0.07 ± 0.05 ^{AC}	0.13 ± 0.08 ^A	0.03 ± 0.01 ^A	0.05 ± 0.05 ^A	P ***
		2 mm	S2	0.17 ± 0.03 ^A	0.34 ± 0.11 ^A	0.15 ± 0.04 ^{AB}	0.11 ± 0.08 ^A	0.03 ± 0.01 ^B	0.01 ± 0.01 ^{BC}	0.13 ± 0.03 ^{BC}	1.15 ± 0.14 ^A	0.01 ± 0.01 ^{BC}	0.05 ± 0.03 ^A	0.01 ± 0.01 ^A	0.02 ± 0.02 ^A	S*P **
		Grinder	S3	0.12 ± 0.03 ^A	0.12 ± 0.04 ^B	0.06 ± 0.02 ^B	0.02 ± 0.01 ^A	0.05 ± 0.02 ^B	0.01 ± 0.01 ^B	0.07 ± 0.02 ^B	0.33 ± 0.12 ^B	0.04 ± 0.04 ^{BC}	0.09 ± 0.09 ^A	0 ± 0 ^A	0 ± 0 ^A	
% rocks	Sieving	8+2 mm	R	1.13 ± 0.15 ^{AC}	0.31 ± 0.13 ^A	4.73 ± 0.58 ^A	0.13 ± 0.05 ^A	0.14 ± 0.14 ^A	4.1 ± 0.68 ^A	0.85 ± 0.09 ^A	12.02 ± 0.79 ^A	0.03 ± 0.02 ^A	0.07 ± 0.04 ^A	1.14 ± 0.56 ^B	0.98 ± 0.22 ^A	S ***
		4 mm	S1	0.32 ± 0.14 ^{BC}	0.21 ± 0.13 ^A	2.03 ± 0.45 ^B	0.16 ± 0.07 ^A	0 ± 0 ^A	2.89 ± 0.43 ^A	0.13 ± 0.08 ^B	5.78 ± 0.54 ^B	0 ± 0 ^A	0 ± 0 ^A	0.57 ± 0.2 ^B	0.23 ± 0.04 ^{AB}	P ***
		2 mm	S2	1.81 ± 0.54 ^A	0.11 ± 0.06 ^A	5.64 ± 0.53 ^A	0.31 ± 0.12 ^A	0 ± 0 ^A	4.06 ± 0.6 ^A	0.73 ± 0.24 ^{AC}	14.38 ± 1.34 ^A	0.03 ± 0.02 ^A	0.04 ± 0.04 ^A	3.78 ± 1.93 ^A	0.8 ± 0.15 ^A	S*P ***
		Grinder	S3	0.33 ± 0.25 ^B	0 ± 0 ^A	2.28 ± 1.26 ^B	0.39 ± 0.29 ^A	0 ± 0 ^A	2.32 ± 0.48 ^A	0.21 ± 0.14 ^{BC}	11.58 ± 0.98 ^A	0 ± 0 ^A	0 ± 0 ^A	0.72 ± 0.61 ^B	0 ± 0 ^B	

Table S6: Data averages and standard error for % total carbon (TC) for each sieving, grinding, and drying procedure as described in Figure 1 of the main text. Significance by ANOVA is indicated by asterisks (*). Soils are lettered and significant differences for each soil (S)*procedure (P) combination are indicated by the superscript.

	Method Test	Procedure	Procedure ID	A	B	C	D	E	F	G	H	I	J	K	L	Significance levels
% Total C	Sieving	8+2 mm	R	4.26 ± 0.14 ^A	3.11 ± 0.16 ^A	1.31 ± 0.04 ^A	1.7 ± 0.02 ^A	1.1 ± 0.02 ^A	1.07 ± 0.02 ^A	1.38 ± 0.04 ^A	7.21 ± 0.02 ^A	1.41 ± 0.05 ^A	3.3 ± 0.07 ^A	2.5 ± 0.09 ^A	2.98 ± 0.13 ^{AB}	S ***
		4 mm	S1	4.31 ± 0.15 ^A	3.35 ± 0.31 ^A	1.27 ± 0.04 ^A	1.68 ± 0.02 ^A	1.13 ± 0.03 ^A	1.02 ± 0.01 ^A	1.33 ± 0.03 ^{AB}	7.05 ± 0.06 ^A	1.4 ± 0.04 ^A	3.23 ± 0.03 ^A	2.55 ± 0.05 ^A	3.19 ± 0.08 ^A	P ***
		2 mm	S2	4.39 ± 0.08 ^A	3.09 ± 0.08 ^A	1.31 ± 0.03 ^A	1.69 ± 0.01 ^A	1.09 ± 0.02 ^A	1.02 ± 0.01 ^A	1.32 ± 0.03 ^{AB}	7.28 ± 0.15 ^A	1.42 ± 0.02 ^A	3.38 ± 0.09 ^A	2.44 ± 0.09 ^{AB}	3.05 ± 0.07 ^A	S*P *
		Grinder	S3	4.15 ± 0.26 ^A	3.3 ± 0.21 ^A	1.31 ± 0.02 ^A	1.62 ± 0.02 ^A	1.07 ± 0.03 ^A	0.88 ± 0.04 ^B	1.2 ± 0.07 ^B	7.05 ± 0.37 ^A	1.46 ± 0.07 ^A	3.48 ± 0.24 ^A	2.2 ± 0.05 ^B	2.7 ± 0.12 ^B	
	Fine grinding	Roller Table	R	4.26 ± 0.14 ^A	3.11 ± 0.16 ^A	1.31 ± 0.04 ^A	1.7 ± 0.02 ^A	1.1 ± 0.02 ^A	1.07 ± 0.02 ^A	1.38 ± 0.04 ^A	7.21 ± 0.02 ^A	1.41 ± 0.05 ^A	3.3 ± 0.07 ^A	2.5 ± 0.09 ^A	2.98 ± 0.13 ^A	S ***
		Ball mill	G1	4.17 ± 0.05 ^A	3 ± 0.17 ^A	1.19 ± 0.02 ^B	1.71 ± 0.01 ^A	1.1 ± 0.01 ^A	0.98 ± 0.01 ^B	1.22 ± 0.02 ^B	7.37 ± 0.04 ^A	1.38 ± 0.02 ^A	3.37 ± 0.06 ^A	2.16 ± 0.02 ^B	2.71 ± 0.02 ^B	P ***
		None	G2	3.73 ± 0.06 ^B	3.12 ± 0.24 ^A	1.28 ± 0.03 ^{AB}	1.63 ± 0.03 ^A	1.14 ± 0.07 ^A	0.95 ± 0.02 ^B	1.35 ± 0.03 ^A	7.11 ± 0.17 ^A	1.36 ± 0.03 ^A	3.16 ± 0.11 ^A	2.12 ± 0.07 ^B	2.71 ± 0.12 ^B	S*P ***
	Drying	105 C	R	4.26 ± 0.14 ^A	3.11 ± 0.16 ^A	1.31 ± 0.04 ^A	1.7 ± 0.02 ^A	1.1 ± 0.02 ^A	1.07 ± 0.02 ^A	1.38 ± 0.04 ^{AB}	7.21 ± 0.02 ^A	1.41 ± 0.05 ^A	3.3 ± 0.07 ^A	2.5 ± 0.09 ^A	2.98 ± 0.13 ^A	S ***
		60 C	D1	4.38 ± 0.08 ^A	3.11 ± 0.09 ^A	1.2 ± 0.03 ^A	1.7 ± 0.02 ^A	1.08 ± 0.02 ^A	1.01 ± 0.01 ^A	1.5 ± 0.04 ^A	7.09 ± 0.03 ^A	1.42 ± 0.03 ^A	3.17 ± 0.06 ^A	2.36 ± 0.08 ^A	3.22 ± 0.15 ^A	P **
		air-dried	D2	4.08 ± 0.13 ^A	2.86 ± 0.15 ^A	1.3 ± 0.04 ^A	1.63 ± 0.04 ^A	1.08 ± 0.03 ^A	1.02 ± 0.03 ^A	1.35 ± 0.1 ^B	7.07 ± 0.06 ^A	1.43 ± 0.02 ^A	3.11 ± 0.07 ^A	2.34 ± 0.06 ^A	3.01 ± 0.13 ^A	S*P .

Table S7: Data averages and standard error for % soil inorganic carbon (SIC) for each sieving, grinding, and drying procedure as described in Figure 1 of the main text. Significance by ANOVA is indicated by asterisks (*). Soils are lettered and significant differences for each soil (S)*procedure (P) combination are indicated by the superscript.

	Method Test	Procedure	Procedure ID	A	B	C	D	E	F	G	H	I	J	K	L	Significance levels
% SIC	Sieving	8+2 mm	R	0.68 ± 0.02 ^A	0.56 ± 0.05 ^A	NA	0.86 ± 0.01 ^A	NA	NA	NA	4.86 ± 0.19 ^A	NA	NA	0.17 ± 0 ^A	0.43 ± 0.04 ^A	S ***
		4 mm	S1	0.72 ± 0.03 ^A	0.65 ± 0.02 ^A	NA	0.86 ± 0.01 ^A	NA	NA	NA	4.6 ± 0.08 ^A	NA	NA	0.16 ± 0.02 ^A	0.49 ± 0.01 ^A	P *
		2 mm	S2	0.77 ± 0.03 ^A	0.66 ± 0.02 ^A	NA	0.92 ± 0.01 ^A	NA	NA	NA	4.73 ± 0.22 ^A	NA	NA	0.18 ± 0.01 ^A	0.53 ± 0.02 ^A	S*P
		Grinder	S3	0.67 ± 0.04 ^A	0.63 ± 0.01 ^A	NA	0.84 ± 0.01 ^A	NA	NA	NA	5.2 ± 0.18 ^A	NA	NA	0.17 ± 0.01 ^A	0.52 ± 0.04 ^A	
	Fine grinding	Roller Table	R	0.68 ± 0.02 ^A	0.56 ± 0.05 ^A	NA	0.86 ± 0.01 ^A	NA	NA	NA	4.86 ± 0.19 ^A	NA	NA	0.17 ± 0 ^{AB}	0.43 ± 0.04 ^A	S
		Ball mill	G1	0.68 ± 0.03 ^A	0.63 ± 0.01 ^A	NA	0.86 ± 0.01 ^A	NA	NA	NA	4.73 ± 0.05 ^A	NA	NA	0.2 ± 0.01 ^A	0.48 ± 0.01 ^A	P
		None	G2	0.68 ± 0.02 ^A	0.63 ± 0.04 ^A	NA	0.83 ± 0.01 ^A	NA	NA	NA	4.85 ± 0.22 ^A	NA	NA	0.17 ± 0.03 ^B	0.47 ± 0.01 ^A	S*P
	Drying	105 C	R	0.68 ± 0.02 ^A	0.56 ± 0.05 ^A	NA	0.86 ± 0.01 ^A	NA	NA	NA	4.86 ± 0.19 ^A	NA	NA	0.17 ± 0 ^{AB}	0.43 ± 0.04 ^B	S ***
		60 C	D1	0.76 ± 0.03 ^A	0.65 ± 0.01 ^A	NA	0.91 ± 0.02 ^A	NA	NA	NA	5.07 ± 0.09 ^A	NA	NA	0.19 ± 0.02 ^A	0.54 ± 0.02 ^A	P ***
		air-dried	D2	0.73 ± 0.03 ^A	0.63 ± 0.02	NA	0.9 ± 0.01 ^A	NA	NA	NA	4.9 ± 0.12 ^A	NA	NA	0.15 ± 0.02 ^B	0.46 ± 0.02 ^{AB}	S*P

Table S8: Data averages and standard error for % soil organic carbon (SOC) for each sieving, grinding, and drying procedure as described in Figure 1 of the main text. Significance by ANOVA is indicated by asterisks (*). Soils are lettered and significant differences for each soil (S)*procedure (P)combination are indicated by the superscript.

	Method Test	Procedure	Procedure ID	A	B	C	D	E	F	G	H	I	J	K	L	Significance levels
SOC %	Sieving	8+2 mm	R	3.58 ± 0.12 ^A	2.55 ± 0.2 ^A	1.31 ± 0.04 ^A	0.85 ± 0.02 ^A	1.1 ± 0.02 ^A	1.07 ± 0.02 ^A	1.38 ± 0.04 ^A	2.34 ± 0.2 ^A	1.41 ± 0.05 ^A	3.3 ± 0.07 ^A	2.33 ± 0.08 ^A	2.55 ± 0.12 ^{AB}	S ***
		4 mm	S1	3.6 ± 0.15 ^A	2.7 ± 0.33 ^A	1.27 ± 0.04 ^A	0.82 ± 0.02 ^A	1.13 ± 0.03 ^A	1.02 ± 0.01 ^A	1.33 ± 0.03 ^A	2.46 ± 0.13 ^A	1.4 ± 0.04 ^A	3.23 ± 0.03 ^A	2.39 ± 0.05 ^A	2.7 ± 0.08 ^A	P **
		2 mm	S2	3.62 ± 0.06 ^A	2.43 ± 0.09 ^A	1.31 ± 0.03 ^A	0.77 ± 0.02 ^A	1.09 ± 0.02 ^A	1.02 ± 0.01 ^A	1.32 ± 0.03 ^A	2.55 ± 0.33 ^A	1.42 ± 0.02 ^A	3.38 ± 0.09 ^A	2.26 ± 0.09 ^A	2.52 ± 0.07 ^{AB}	S*P
		Grinder	S3	3.48 ± 0.28 ^A	2.67 ± 0.21 ^A	1.31 ± 0.02 ^A	0.78 ± 0.02 ^A	1.07 ± 0.03 ^A	0.88 ± 0.04 ^A	1.2 ± 0.07 ^A	1.86 ± 0.45 ^B	1.46 ± 0.07 ^A	3.48 ± 0.24 ^A	2.03 ± 0.05 ^A	2.18 ± 0.1 ^B	
	Fine grinding	Roller Table	R	3.58 ± 0.12 ^A	2.55 ± 0.2 ^A	1.31 ± 0.04 ^A	0.85 ± 0.02 ^A	1.1 ± 0.02 ^A	1.07 ± 0.02 ^A	1.38 ± 0.04 ^A	2.34 ± 0.2 ^B	1.41 ± 0.05 ^A	3.3 ± 0.07 ^A	2.33 ± 0.08 ^A	2.55 ± 0.12 ^A	S ***
		Ball mill	G1	3.49 ± 0.07 ^{AC}	2.37 ± 0.18 ^A	1.19 ± 0.02 ^A	0.85 ± 0.02 ^A	1.1 ± 0.01 ^A	0.98 ± 0.01 ^{AB}	1.22 ± 0.02 ^B	2.64 ± 0.04 ^A	1.38 ± 0.02 ^A	3.37 ± 0.06 ^A	1.95 ± 0.02 ^B	2.23 ± 0.02 ^B	P ***
		None	G2	3.05 ± 0.06 ^{BC}	2.49 ± 0.26 ^A	1.28 ± 0.03 ^A	0.8 ± 0.04 ^A	1.14 ± 0.07 ^A	0.95 ± 0.02 ^B	1.35 ± 0.03 ^{AB}	2.26 ± 0.24 ^B	1.36 ± 0.03 ^A	3.16 ± 0.11 ^A	1.95 ± 0.06 ^B	2.23 ± 0.11 ^B	S*P ***
	Drying	105 C	R	3.58 ± 0.12 ^A	2.55 ± 0.2 ^A	1.31 ± 0.04 ^A	0.85 ± 0.02 ^A	1.1 ± 0.02 ^A	1.07 ± 0.02 ^A	1.38 ± 0.04 ^{AB}	2.34 ± 0.2 ^A	1.41 ± 0.05 ^A	3.3 ± 0.07 ^A	2.33 ± 0.08 ^A	2.55 ± 0.12 ^A	S ***
		60 C	D1	3.62 ± 0.07 ^A	2.46 ± 0.09 ^{AB}	1.2 ± 0.03 ^A	0.79 ± 0.04 ^{AB}	1.08 ± 0.02 ^A	1.01 ± 0.01 ^A	1.5 ± 0.04 ^A	2.02 ± 0.1 ^B	1.42 ± 0.03 ^A	3.17 ± 0.06 ^A	2.17 ± 0.08 ^A	2.68 ± 0.14 ^A	P ***
		air-dried	D2	3.35 ± 0.14 ^A	2.23 ± 0.17 ^B	1.3 ± 0.04 ^A	0.73 ± 0.04 ^B	1.08 ± 0.03 ^A	1.02 ± 0.03 ^A	1.35 ± 0.1 ^B	2.17 ± 0.16 ^{AB}	1.43 ± 0.02 ^A	3.11 ± 0.07 ^A	2.18 ± 0.05 ^A	2.54 ± 0.14 ^A	S*P .

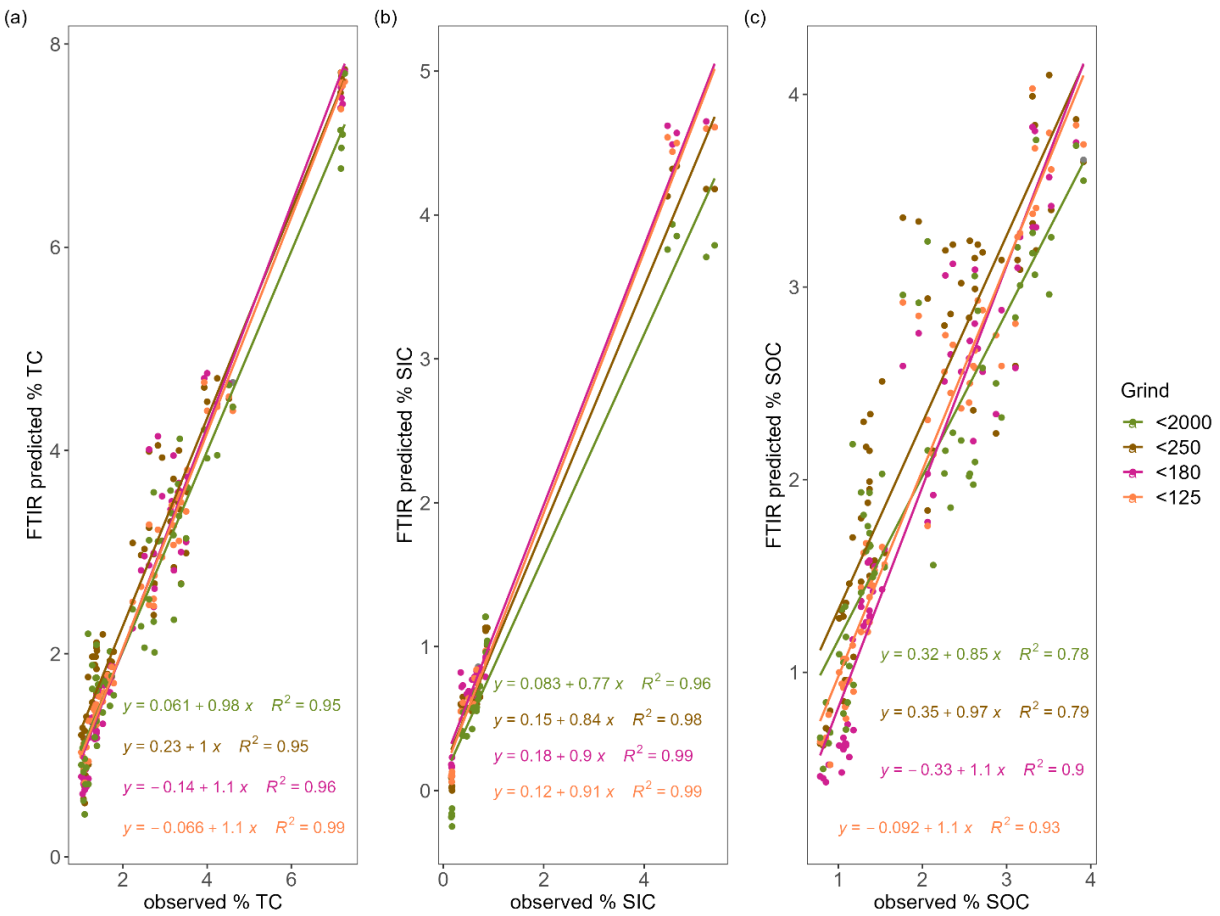


Figure S1: Fine grinding comparisons for predictions of % soil total carbon (TC) panel a, % soil inorganic carbon (SIC) panel b, and % soil organic carbon (SOC) panel c using Fourier transformed infrared spectroscopy (FTIR) where the FTIR predicted values are regressed against the observed values using dry combustion by an Elemental Analyzer for % TC, a pressure transducer for % SIC, and % SOC is calculated by % TC - % SIC. The units for grind size are in μm . All p-values are < 0.001 .

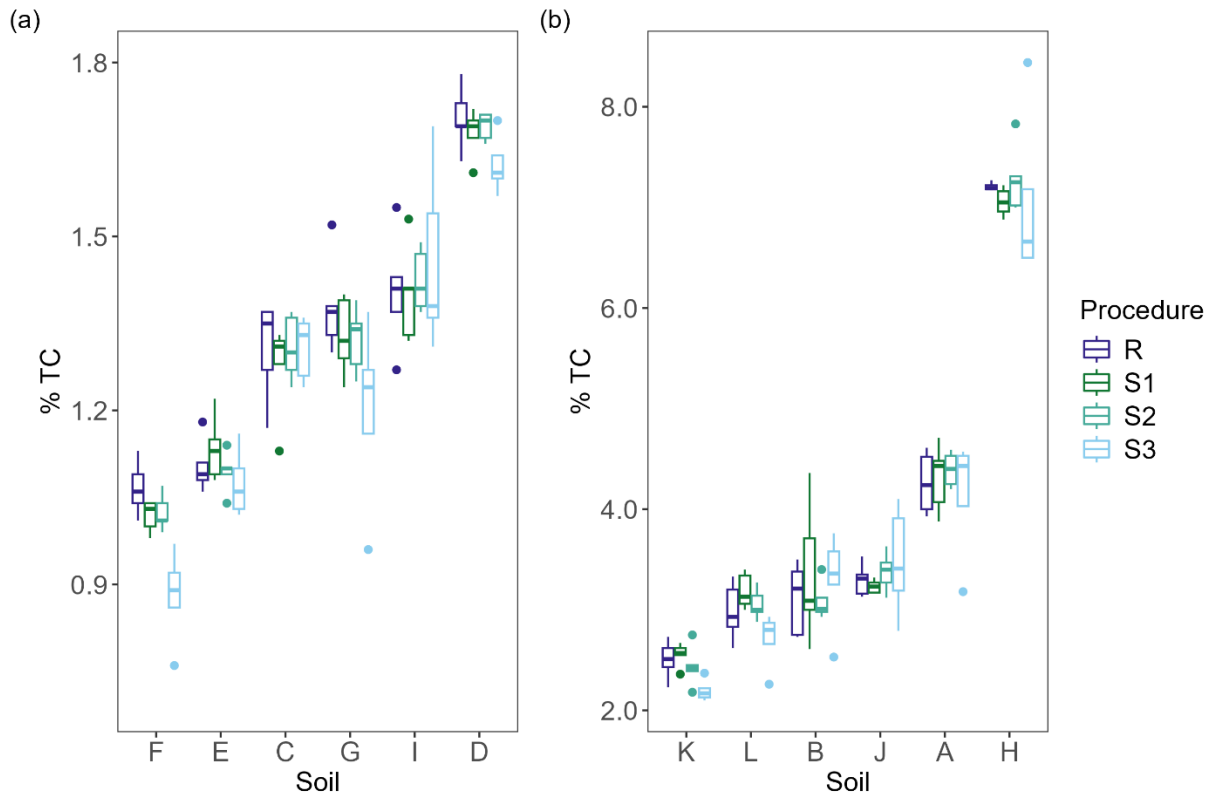


Figure S2: The % total carbon (TC) distribution shown with a boxplot for R (8 + 2 mm), S1 (4 mm), S2 (2 mm with rolling pin), and S3 (mechanical grinder) sieving procedures. Box plots report the median, first and third quartiles. Whiskers extend to the upper and lower data point that are within 1.5 times the interquartile range. Panel a (left) represents the soils with % TC between 0 and 2 %; Panel b (right) represents the soils with % TC between 2 and 8 %.

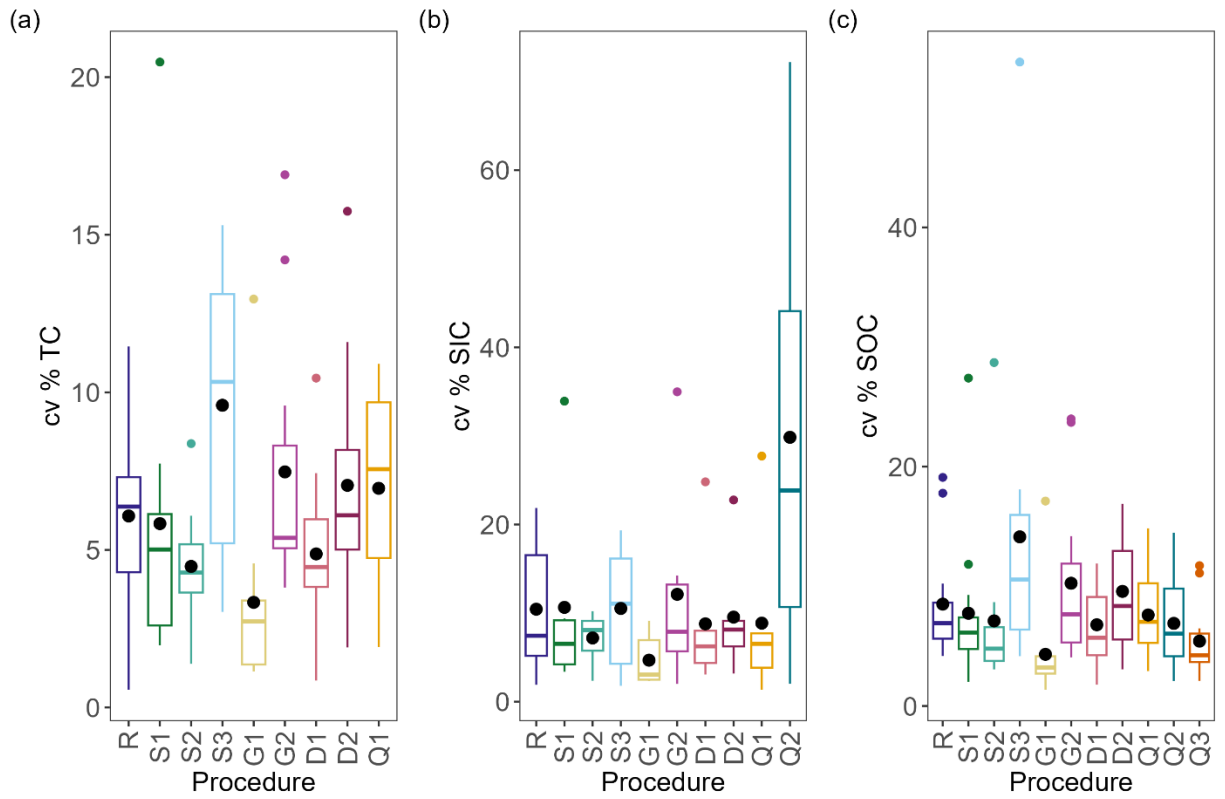


Figure S3: The distribution of the coefficient of variance (CV) across soils for all soil processing and quantification methods for % total carbon (TC; R-Q1; panel a), % soil inorganic carbon (SIC; R-Q2; panel b), and % soil organic carbon (SOC; P0-Q3; panel c) for all procedures described in Figure 1. Box plots report the median, first and third quartiles. Whiskers extend to the upper and lower data point that are within 1.5 times the interquartile range.

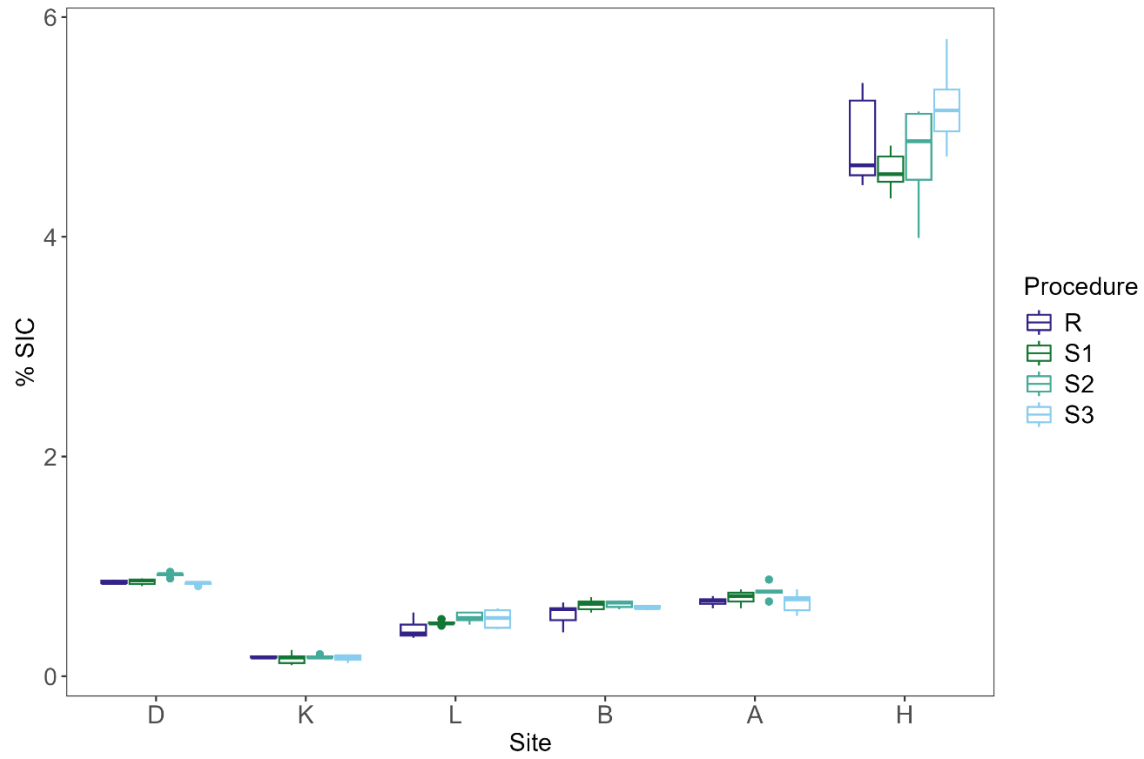


Figure S4: The % soil inorganic carbon (SIC) distribution shown with a boxplot for R (8 + 2 mm), S1 (4 mm), S2 (2 mm with rolling pin), and S3 (mechanical grinder) sieving procedures for each soil with SIC. Box plots report the median, first and third quartiles. Whiskers extend to the upper and lower data point that are within 1.5 times the interquartile range.

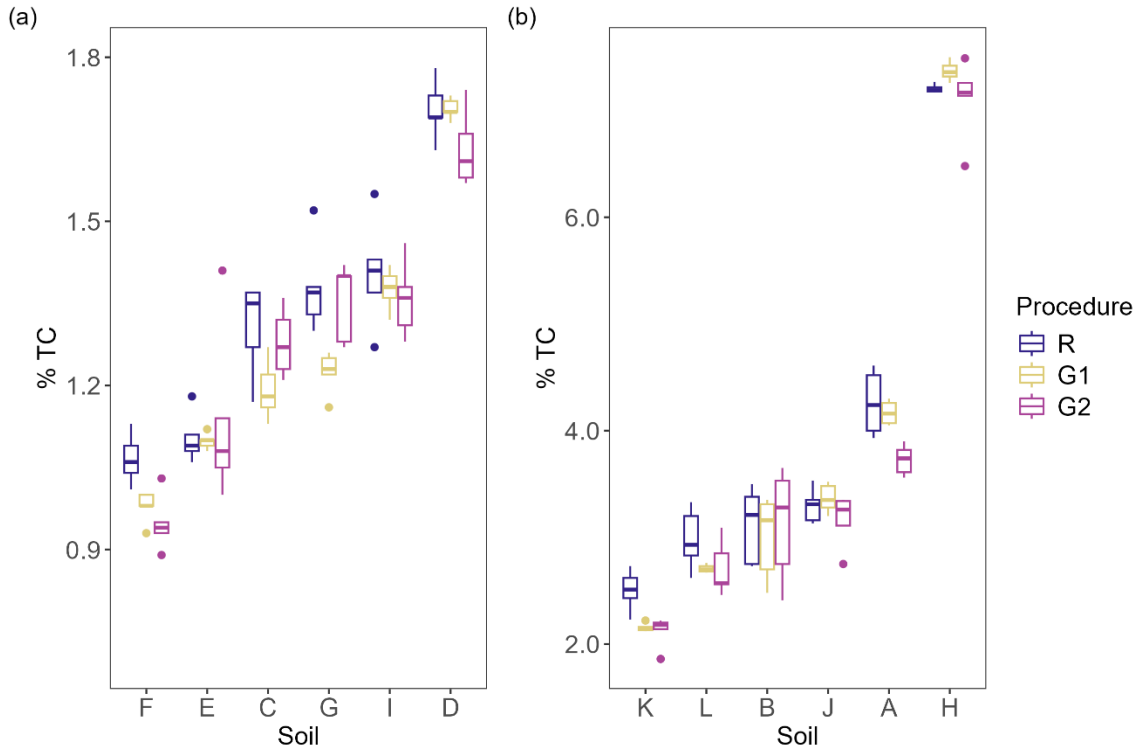


Figure S5: The % total C (TC) distribution shown with a boxplot for R (roller table grind to <math>< 250 \mu\text{m}</math>), G1 (ball mill to <math>< 125 \mu\text{m}</math>), and G2 (no grind; <math>< 2000 \mu\text{m}</math>) grinding procedures. Panel a (left) represents the soils with % TC between 0 and 2 %; Panel b (right) represents the soils with % TC between 2 and 8 %. Box plots report the median, first and third quartiles. Whiskers extend to the upper and lower data point that are within 1.5 times the interquartile range.

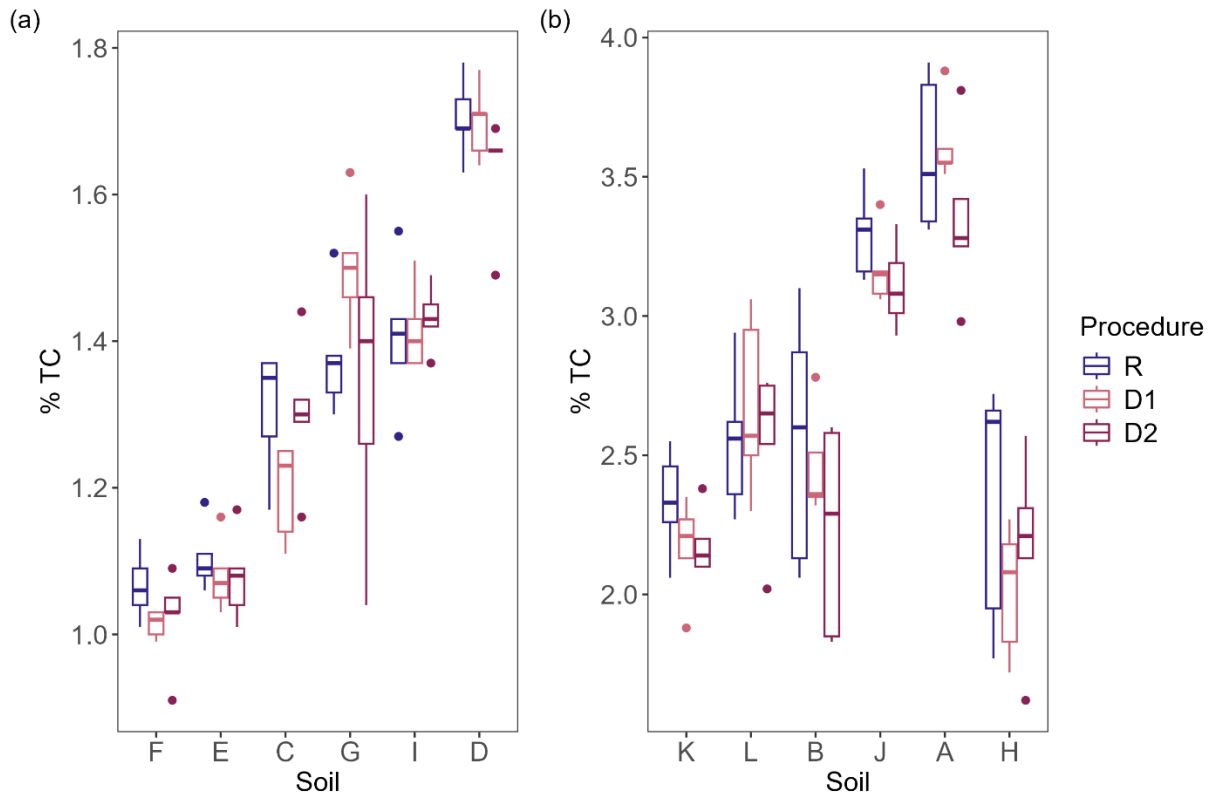


Figure S6: The % total C (TC) distribution shown with a boxplot for r (105 °C), D1 (60 °C), and D2 (air-dried only) drying procedures. Panel a (left) represents the soils with % TC between 0 and 2 %; Panel b (right) represents the soils with % TC between 2 and 8 %. Box plots report the median, first and third quartiles. Whiskers extend to the upper and lower data point that are within 1.5 times the interquartile range.

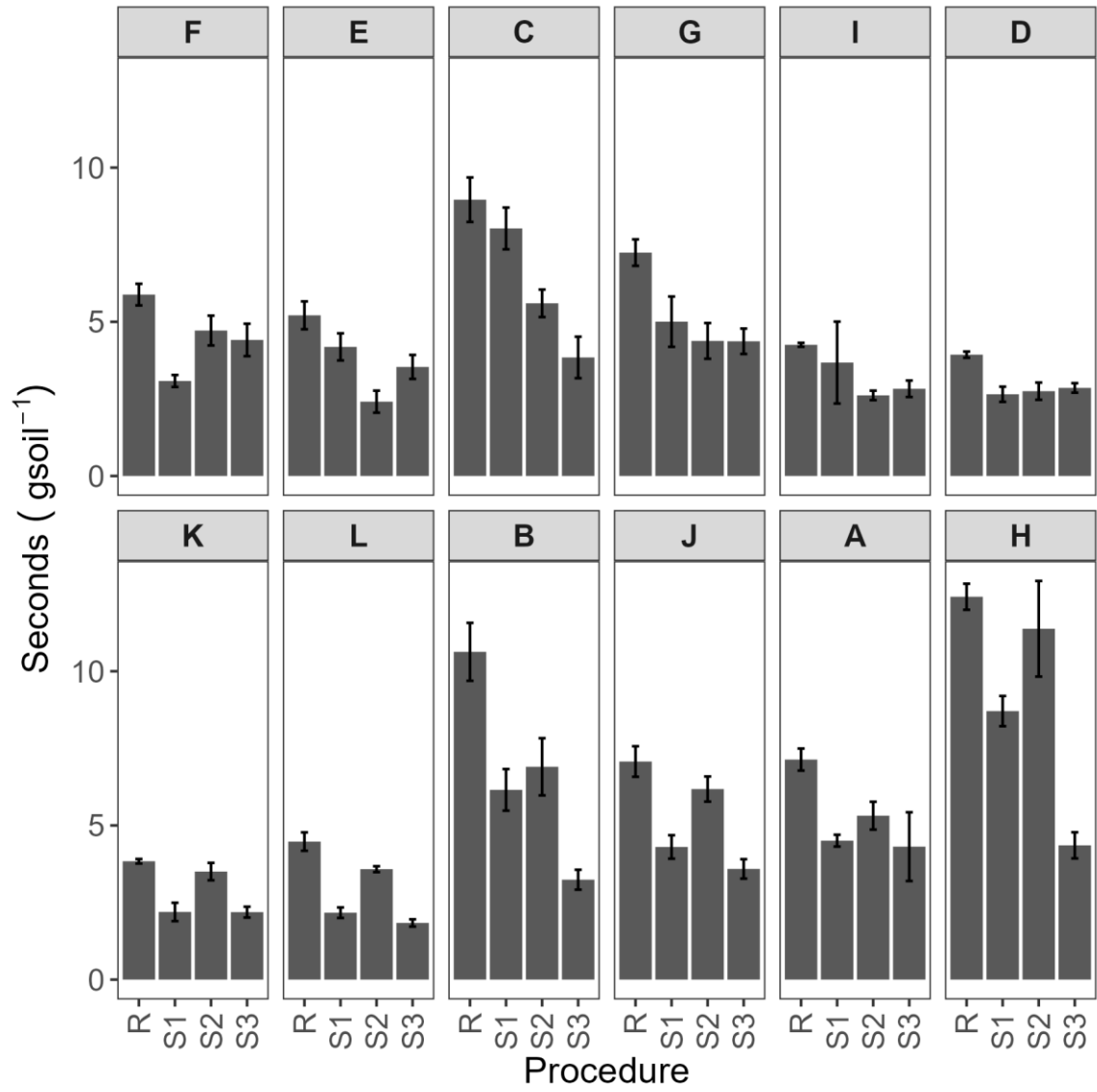


Figure S7: The time taken to process soils in seconds per gram of soil using for the R (8 + 2 mm), S1(4 mm), S2 (2 mm with rolling pin), and S3 (mechanical grinder) sieving procedures. Lettered panels represent the soil in ascending order of % total carbon.

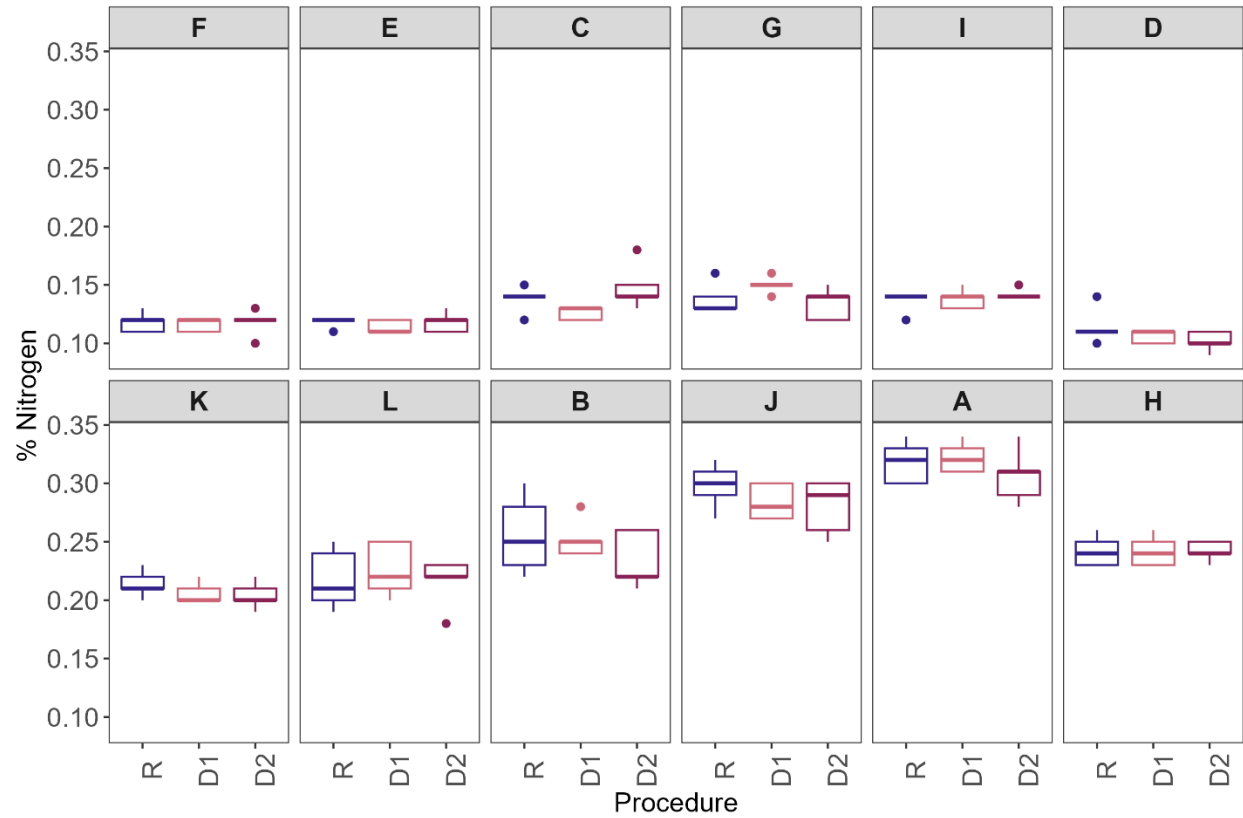


Figure S8: The % nitrogen distribution shown with a boxplot for R (105 °C), D1 (60 °C), and D2 (air-dried only) drying procedures. Lettered panels represent the soil in ascending order of % total carbon. All soils were sieved and finely ground using the same method. Box plots report the median, first and third quartiles. Whiskers extend to the upper and lower data point that are within 1.5 times the interquartile range.