Supplementary information for: Reduced accrual of mineral-associated organic matter after two years of enhanced rock weathering in cropland soils, though no net losses of soil organic carbon

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Description: *This supplementary file contains a description of the experimental design of the three field sites and the site characteristics, the output of all linear mixed effect models, the means and standard errors of SOM pools (including stocks in fall 2021 and two-year changes through time between fall 2019 and fall 2021), as well microbial community analysis output of bacterial and fungal sequence data in fall 2021.*
(Figures S1, Tables S1- S12.)

Figure S1. Experimental design of three enhanced rock weathering field trials in California, USA. The three sites include the: (a) Yolo site (n = 3), (b) Merced-1 site (n = 5), and (c) Merced-2 site (n = 5). The Yolo site included several other treatments (compost, biochar, rock + compost, rock + biochar, compost + biochar, rock + compost + biochar); this study only included only the rock and control plots. At Yolo, rock plots were divided in half, to include a meta-basalt amendment and an olivine amendment; this study only used the meta-basalt treatment). Further site details are shown in Table S1.

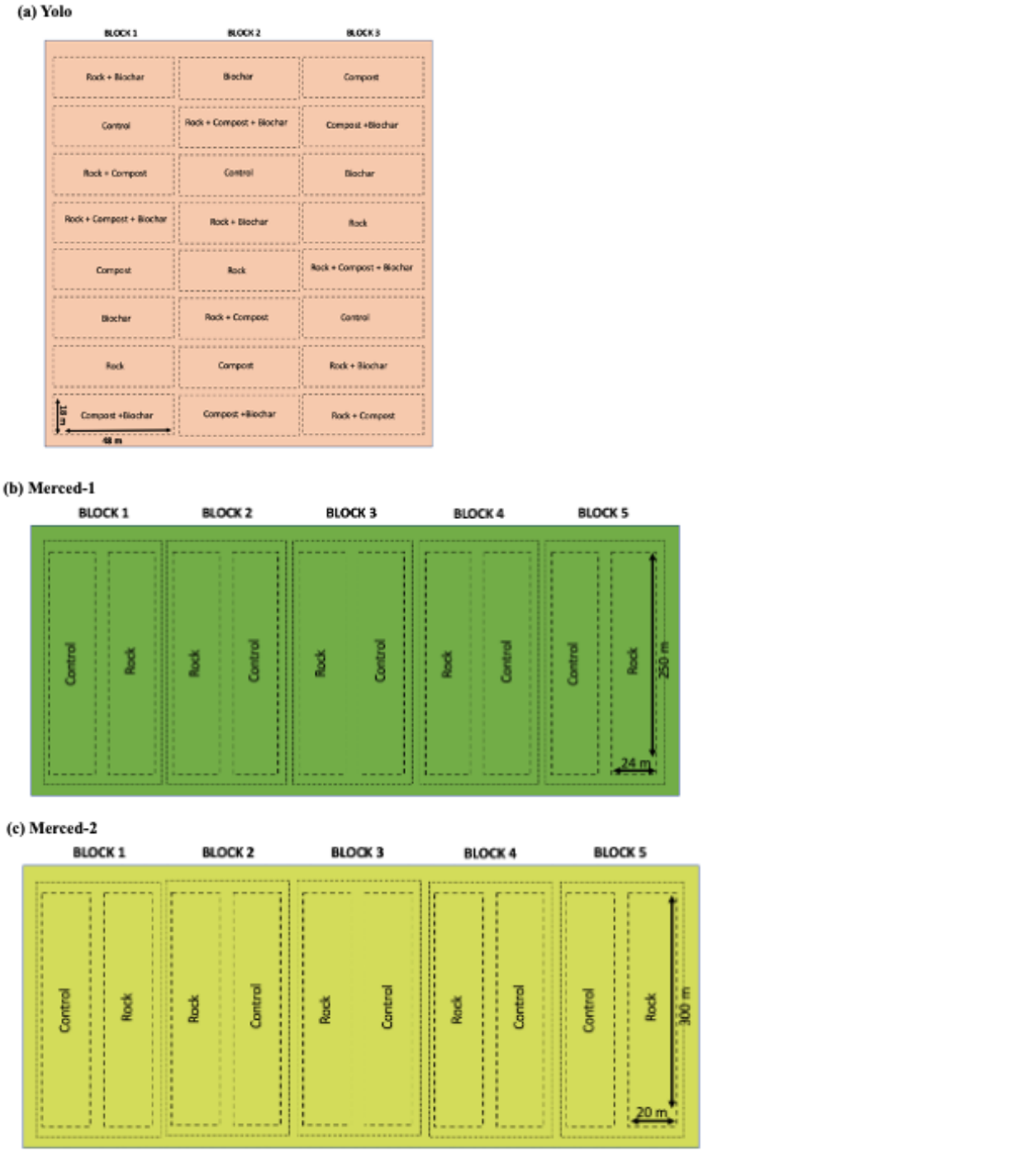

Table S1. Site details for three enhanced rock weathering field trials at the Yolo, Merced-1, and Merced 2 sites.

Site	Yolo	Merced-1	Merced-2
Location	38° 31'53.96"N, 121°46'54.15"W	37° 7'10.099"N, 120°44'38.41"W	
Mean annual precipitation (mm)	449	174	
Mean annual temperature (°C)	15.6	16.7	
Crop	Corn	Alfalfa	*Rotation*: Corn (2019), Tomato (2020), Cilantro (2021)
Management	Conventional	Organic, Conventional	
Irrigation	Drip (subsurface)	Furrow/Flood	
Site size (ha)	5.04	6.1	
Plot size (ha)	0.09 (0.045 for plots with meta-basalt rock plots)	0.6	
Reps/treatment	3	5	5
Soil type	Coarse-loamy, mixed, superactive, nonacid, thermic Mollic Xerofluvents	Fine-loamy, mixed (calcareous), thermic Typic Haplaquolls	Fine-loamy, mixed, montmorillonitic (calcareous), superactive, thermic Typic Epiaqualfs
pH	6.7-7.5	7.9-8.2	7.9-8.2
USDA soil texture class	Silt Loam	Clay Loam*	
Soil texture percentages (%)	4.0 sand; 61.0 silt; 25.1 clay	35.4 Sand, 33.6 Silt, 31 Clay*	
Meta-basalt crushed rock application	40 t ha^{-1} (Fall 2019 and 2020)	40 t ha^{-1} (Fall 2019 only)	40 t ha^{-1} (Fall 2019 and 2020)
Parent Material	Alluvium from mixed sources	Alluvium from granite	
Soil Series/Order	Reiff Series/Entisol	Escano Series/Mollisol	Alros Series/Alfisol

**data is from the Soil Web Series. (Reference: Soil Survey Staff, Natural Resources Conservation Service, United States Department of Agriculture. Web Soil Survey. Available online at http://websoilsurvey.nrcs.usda.gov/ accessed [11/16/2023].)*

Table S2. Elemental composition of meta-basalt crushed rock applied each year of the study and reported as oxide weight-percent. The high silica content of the dust results from felsic facies included in the mined and crushed material (Holzer et al, 2023b). Method detection limits are reported parenthetically after each oxide. LOI = loss on ignition.

Oxide (%)	Yolo, 2019	Merced-1 and -2, 2019	Yolo, 2020	Merced-2, 2020	Yolo, 2021
SiO_2 (0.01)	65.92	65.63	61.66	65.51	66.78
Al_2O_3 (0.01)	15.22	15.42	15.05	15.61	15.11
Fe_2O_3 (0.04)	4.9	4.86	6.52	4.85	4.43
MgO (0.01)	1.66	1.7	3.27	1.84	1.52
CaO (0.01)	3.74	3.79	5.19	3.9	3.85
Na_2O (0.01)	4.21	4.2	3.36	3.56	3.85
K_2O (0.01)	1.46	1.43	1.28	1.54	1.5
TiO_2 (0.01)	0.48	0.48	0.54	0.52	0.47
P_2O_5 (0.01)	0.17	0.14	0.15	0.17	0.15
MnO (0.01)	0.14	0.13	0.16	0.12	0.09
Cr_2O_3 (0.002)	0.004	0.008	0.014	0.005	0.01
BaO (0.01)	0.05	0.06	0.06	0.06	0.05
LOI (0.1)	1.9	2	2.6	2.2	2.1
Sum	99.9	99.89	99.91	99.91	99.94

Table S3. Pre-treatment baseline concentrations of upper surface soil SOM pools (0-10 cm depth) measured in early fall 2019 before the experimental period. Plot-specific baseline measurements were taken at two of the three sites (Yolo and Merced-2) before treatments were applied ('Pre-trt. Ctr.' = pre-treatment control plots; 'Pre-trt. Rock'= pre-treatment crushed rock plots). Shown below are means ± standard error (SE) of SOM pool concentrations, including total soil organic C (SOC), total soil organic N (SON), mineral-associated organic matter (MAOM) C and N, and particulate organic matter (POM) C and N. Percent difference (% diff.) is the average difference in the plot-specific concentration of an SOM pool in pre-treatment rock and control plots. At Yolo, baseline data indicated there were significant initial differences between treatment plots for several SOM pools ($p < 0.05$; indicated with an *), which were accounted for by using a correction factor when measuring % differences in fall 2021 SOM stocks (see Table S5). At Merced-2, there was no significant difference (NS) between baseline values of treatment plots ($p > 0.1$). Negative % difference values indicate that SOM concentrations are lower in the experimental plots where rock would be applied versus control plots. $N = 5$ at Merced-2, $n = 3$ at Yolo.

Site	Trt.	SOC ± SE (mg C g soil^{-1})	% Diff. ± SE	SON ± SE (mg N g soil^{-1})	% Diff. ± SE	MAOM-C ± SE (mg C g soil^{-1})	% Diff. ± SE	MAOM-N ± SE (mg N g soil^{-1})	% Diff. ± SE	POM-C ± SE (mg C g soil^{-1})	% Diff. ± SE	POM-N ± SE (mg N g soil^{-1})	% Diff. ± SE
Merced-2	Pre-trt. Ctr.	9.04 ± 0.3	NS	1.07 ± 0.04	NS	6.59 ± 0.16	NS	0.85 ± 0.03	NS	2.45 ± 0.18	NS	0.21 ± 0.02	NS
	Pre-trt. Rock	8.84 ± 0.41		1.02 ± 0.03		6.39 ± 0.19		0.83 ± 0.02		2.45 ± 0.26		0.19 ± 0.02	
Yolo	Pre-trt. Ctr.	6.57 ± 0.32	-14 ± 5*	0.76 ± 0.03	-11 ± 4*	5.4 ± 0.3	-17 ± 4*	0.61 ± 0.03	-13 ± 4*	1.19 ± 0.1	-3 ± 10	0.15 ± 0.001	-6 ± 4
	Pre-trt. Rock	5.66 ± 0.21		0.68 ± 0.02		4.5 ± 0.2		0.53 ± 0.02		1.16 ± 0.04		0.14 ± 0.001	

Table S4. Modeled regression coefficients of the effect of site and crushed rock on soil organic matter and inorganic carbon stocks in three cropland enhanced rock weathering field trials. Shown below are coefficient estimates (± standard error, SE) from linear mixed effect models, which included the effect of crushed rock and site on SOM stocks in Fall 2021. *N = 13* per treatment across all field trials. SOC = total soil organic C; SON = total soil organic N; MAOM = mineral-associated organic matter; POM = particulate organic matter, SIC = soil inorganic C. *($p < 0.1$ is considered marginally significant and indicated by a single asterisks *; $p < 0.05$ is considered significant and indicated by two asterisks **).*

	Coefficient estimate ± SE	**p value**
(a) *Total SOC (0-10 cm)*		
Intercept	1339 ± 65	<0.0001**
Site (Merced-2)	386 ± 61	<0.0001**
Site (Yolo)	-370 ± 73	<0.0004**
Treatment (crushed rock)	-140 ± 53	0.02**
(b) *Total SOC (10-30 cm)*		
Intercept	1730 ± 71	<0.0001**
Site (Merced-2)	1000 ± 86	<0.0001**
Site (Yolo)	-149 ± 99	0.15
Treatment (crushed rock)	-99 ± 75	0.2
(c) *Total SON (0-10 cm)*		
Intercept	151 ± 8	<0.0001**
Site (Merced-2)	45 ± 7	<0.0001**
Site (Yolo)	-49 ± 9	0.0002**
Treatment (crushed rock)	-19 ± 6	0.007**
(d) *Total SON (10-30 cm)*		
Intercept	188 ± 9	<0.0001**
Site (Merced-2)	120 ± 10	<0.0001**
Site (Yolo)	0.7 ± 12	0.96
Treatment (crushed rock)	-3 ± 9	0.74
(e) *MAOM-C (0-10 cm)*		
Intercept	952 ± 46	<0.0001**
Site (Merced-2)	251 ± 42	<0.0001**
Site (Yolo)	-263 ± 51	0.0004**
Treatment (crushed rock)	-159 ± 37	0.0001**
(f) *MAOM-C (10-30 cm)*		
Intercept	1395 ± 61	<0.0001**
Site (Merced-2)	660 ± 74	<0.0001**
Site (Yolo)	-65 ± 85	0.45
Treatment (crushed rock)	-68 ± 65	0.30
(g) *MAOM-N (0-10 cm)*		
Intercept	116 ± 6	<0.0001**
Site (Merced-2)	34 ± 5	<0.0001**
Site (Yolo)	-39 ± 7	<0.0001**
Treatment (crushed rock)	-17 ± 5	0.001**

(h) *MAOM-N (10-30 cm)*		
Intercept	165 ± 8	<0.0001**
Site (Merced-2)	83 ± 10	<0.0001**
Site (Yolo)	-12 ± 11	0.27
Treatment (crushed rock)	-7 ± 8	0.41
(i) *POM-C (0-10 cm)*		
Intercept	387 ± 32	<0.0001**
Site (Merced-2)	135 ± 36	0.0015**
Site (Yolo)	-107 ± 42	0.02**
Treatment (crushed rock)	19 ± 31	0.6
(j) *POM-C (10-30 cm)*		
Intercept	335 ± 39	<0.0001**
Site (Merced-2)	341 ± 46	<0.0001**
Site (Yolo)	-78 ± 53	0.16
Treatment (crushed rock)	-31 ± 40	0.45
(k) *POM-N (0-10 cm)*		
Intercept	34 ± 3	<0.0001**
Site (Merced-2)	11 ± 3	<0.0001**
Site (Yolo)	-8 ± 3	0.02**
Treatment (crushed rock)	-2 ± 2	0.52
(l) *POM-N (10-30 cm)*		
Intercept	23 ± 2	<0.0001**
Site (Merced-2)	37 ± 3	<0.0001**
Site (Yolo)	13 ± 3	<0.0001**
Treatment (crushed rock))	4 ± 2	0.12
(m) *DOC (0-10 cm)*		
Intercept	14 ± 2	<0.0001**
Site (Merced-2)	14 ± 2	<0.0001**
Site (Yolo)	13 ± 2	<0.0001**
Treatment (crushed rock)	0.07 ± 1	0.96
(n) *DOC (10-30 cm)*		
Intercept	11 ± 1	<0.0001**
Site (Merced-2)	6 ± 1	<0.0001**
Site (Yolo)	-0.01 ± 1	0.992
Treatment (crushed rock)	-0.002 ± 1	0.998
(o) *SIC (0-10 cm)*		
Intercept	59 ± 34	0.096
Site (Merced-2)	124 ± 39	0.006**
Site (Yolo)	-22 ± 45	0.63
Treatment (crushed rock)	13 ± 34	0.70
(p) *SIC (10-30 cm)*		
Intercept	270 ± 64	0.001**
Site (Merced-2)	-5.1 ± 66	0.94
Site (Yolo)	-218 ± 78	0.011**
Treatment (crushed rock)	89 ± 57	0.14

Table S5. Mean stock sizes of SOM pools in upper surface soil (0-10 cm) of plots with crushed rock and unamended control plots in fall 2021 at three enhanced rock weathering field trials. Absolute difference ('Diff') is the difference between the mean of the crushed rock plots minus the mean of the control plots at a given site. Percent difference (% diff.) is calculated as the difference between rock and control plots, divided by the value of the control plots at a given site. At Yolo, pre-treatment baseline data (from 2019, before crushed rock application) indicated there were significant initial differences between treatment plots ($p < 0.05$; see Table S3), though there was no significant difference in baseline concentrations at Merced-2. At Yolo, a correction factor was thus applied to account for baseline differences when estimating the % difference between stock sizes in control versus rock plots (see Methods). Standard errors for absolute differences and percent differences are calculated using gaussian error propagation. Negative % difference values indicate that SOM stocks are lower in rock versus control plots.

Site	**Trt.**	**SOC Stock ± SE** (g C m^{-2} to 10 cm)	*Diff. ± SE (g C m^{-2} to 10 cm)*	*% Diff ± SE*	**SON Stock ± SD (g N m^{-2} to 10 cm)**	*Diff. (g N m^{-2} to 10 cm)*	*% Diff. ± SE*	**MAOM C Stock ± SD (g C m^{-2} to 10 cm)**	*Diff ± SE (g C m^{-2} to 10 cm).*	*% Diff ± SE*	**MAOM N Stock ± SD (g N m^{-2} to 10 cm)**	*Diff. ± SE. (g N m^{-2} to 10 cm)*	*% Diff ± SE*	**POM C Stock ± SD (g C m^{-2} to 10 cm)**	*Diff. ± SE. (g C m^{-2} to 10 cm)*	*% Diff ± SE*	**POM N Stock ± SD (g N m^{-2} to 10 cm)**	*Diff. ± SE. (g N m^{-2} to 10 cm)*	*% Diff. ± SE*
Merced-1	Ctr	1326 ± 44	-116 ± 84	-9 ± 4	148 ± 5	-14 ± 8	-10 ± 4	949 ± 49	-152 ± 61	-16 ± 5	116 ± 5	-16 ± 7	-14 ± 4	378 ± 19	37 ± 49	10 ± 8	33 ± 1	-1 ± 4	-3 ± 7
	Rock	1211 ± 71			134 ± 7			796 ± 36			100 ± 4			415 ± 44			34 ± 3		
Merced-2	Ctr	1726 ± 102	-141± 146	-8 ± 6	198 ± 14	-23 ± 19	-11 ± 7	1189 ± 73	-132 ± 96	-11 ± 6	151 ± 11	-17 ± 14	-11 ± 8	536 ± 39	-10 ± 66	-2 ± 9	47 ± 3	6 ± 6	13 ± 8
	Rock	1584 ± 105			175 ± 13			1057 ± 63			134 ± 9			527 ± 54			41 ± 5		
Yolo	Ctr	1001 ± 58	-179 ± 62	-18 ± 5	108 ± 5	-22 ± 6	-20 ± 4	730 ± 47	-217 ± 59	-30 ± 12	82 ± 7	-22 ± 6	-27 ± 4	271 ± 17	38 ± 54	14 ± 12	27 ± 1	-1 ± 2	-4 ± 5
	Rock	822 ± 20			86 ± 3			513 ± 36			60 ± 7			309 ± 51			26 ± 2		
	Baseline % Diff.			*-14 ± 5*			*-11 ± 4*			*-17 ± 4*			*-13 ± 4*			*-3 ± 10*			*-6 ± 4*
	Corrected % Diff.			-4 ± 6			-10 ± 6			-13 ±12			*-13 ± 6*			*17 ± 16*			*3 ± 6*

Table S6. Modeled regression coefficients of the effect of site and crushed rock on plot-specific two-year change in soil organic matter concentrations in enhanced rock weathering field trials. Shown below are coefficient estimates (± standard error, SE) from linear mixed effect models, which included the effect of crushed rock and site on the plot-specific change in soil organic matter pools over the 2-year experimental period (fall 2019 – fall 2021). This dataset includes the two sites where baseline data was available (Yolo and Merced-2). SOC = total soil organic C; SON = total soil organic N; MAOM = mineral-associated organic matter; POM = particulate organic matter. *($p < 0.1$ is considered marginally significant and indicated by a single asterisks *; $p < 0.05$ is considered significant and indicated by two asterisks **).*

	Coefficient estimate ± SE	**p value**
(a) *2-year change in SOC (0-10 cm)*		
Intercept	1.2 ± 0.3	<0.002**
Site (Yolo)	0.2 ± 0.4	0.66
Treatment (crushed rock)	-0.3 ± 0.4	0.51
(b) *2-year change in SOC (10-30 cm)*		
Intercept	2.2 ± 0.4	<0.004**
Site (Yolo)	-1.7 ± 0.3	0.0007**
Treatment (crushed rock)	-0.07 ± 0.3	0.81
(c) *2-year change in SON (0-10 cm)*		
Intercept	0.12 ± 0.05	0.05*
Site (Yolo)	-0.05 ± 0.04	0.3
Treatment (crushed rock)	-0.03 ± 0.04	0.5
(d) *2-year change in SON (10-30 cm)*		
Intercept	0.18 ± 0.03	0.0001**
Site (Yolo)	-0.22 ± 0.04	0.0001**
Treatment (crushed rock)	0.03 ± 0.04	0.46
(e) *2-year change in MAOM-C (0-10 cm)*		
Intercept	0.68 ± 0.2	0.005**
Site (Yolo)	-0.59 ± 0.2	0.017**
Treatment (crushed rock)	-0.67 ± 0.2	0.004**
Treatment (rock)*Site (Yolo)	0.55	0.07*
(f) *2-year change in MAOM-C (10-30 cm)*		
Intercept	1 ± 0.4	0.04**
Site (Yolo)	-0.7 ± 0.3	0.02**
Treatment (crushed rock)	0.2 ± 0.2	0.4
(g) *2-year change in MAOM-N (0-10 cm)*		
Intercept	0.06 ± 0.04	0.2
Site (Yolo)	-0.04 ± 0.03	0.0996*
Treatment (crushed rock)	-0.04 ± 0.02	0.10
(h) *2-year change in MAOM-N (10-30 cm)*		
Intercept	0.08 ± 0.03	0.008**
Site (Yolo)	-0.12 ± 0.03	0.003**
Treatment (crushed rock)	0.03 ± 0.03	0.44

(i) *2-year change in POM-C (0-10 cm)*		
Intercept	0.7 ± 0.2	0.01**
Site (Yolo)	0.5 ± 0.3	0.2
Treatment (crushed rock)	0.2 ± 0.3	0.5
(j) *2-year change in POM-C (10-30 cm)*		
Intercept	1.2 ± 0.2	<0.0001**
Site (Yolo)	-1.1 ± 0.2	0.0006**
Treatment (crushed rock)	-0.3 ± 0.2	0.25
(k) *2-year change in POM-N (0-10 cm)*		
Intercept	0.07 ± 0.02	0.003**
Site (Yolo)	-0.01 ± 0.02	0.9
Treatment (crushed rock)	0.01 ± 0.02	0.6
(l) *2-year change in POM-N (10-30 cm)*		
Intercept	0.1 ± 0.01	<0.0001**
Site (Yolo)	-0.1 ± 0.02	<0.0001**
Treatment (crushed rock)	0.009 ± 0.01	0.55
(m) *2-year change in soil inorganic C (0-10 cm)*		
Intercept	0.4 ± 0.3	0.28
Site (Yolo)	-0.38 ± 0.26	0.17
Treatment (crushed rock)	0.68 ± 0.23	0.017 **
(n) *2-year change in soil inorganic C (10-30 cm)*		
Intercept	0.31 ± 0.22	0.18
Site (Yolo)	-0.42 ± 0.28	0.16
Treatment (crushed rock)	-0.08 ± 0.27	0.76

Table S7. Plot-specific two-year change in SOM pools in the surface soil (0-10 cm) of plots with crushed rock versus control plots. This dataset includes the two sites where pre-treatment baseline data was available (Yolo and Merced-2). The 2-year change is calculated as the plot-specific change in SOM concentration between early fall 2019 (baseline pre-treatment measurements) and fall 2021 (see Methods). Absolute difference ('Diff') is the difference between the mean of the crushed rock plots minus the mean of the control plots at a given site. Standard errors for absolute differences calculated using gaussian error propagation. There were no significant differences at 10-30 cm depth (Table S5).

Site	Trt.	2-year change in total SOC ± SE (mg C g soil^{-1})	Diff. ± SE (mg C g soil^{-1})	2-year change in total SON ± SE (mg N g soil^{-1})	Diff. ± SE (mg N g soil^{-1})	2-year change in MAOM-C ± SE (mg C g soil^{-1})	Diff. ± SE (mg C g soil^{-1})	2-year change in MAOM-N ± SE (mg C g soil^{-1})	Diff. ± SE (mg N g soil^{-1})	2-year change in POM-C ± SE (mg C g soil^{-1})	Diff. ± SE (mg C g soil^{-1})	2-year change in POM-N ± SE (mg N g soil^{-1})	Diff. ± SE mg N g soil^{-1})	2-year change in total soil inorganic C (mg C g soil^{-1})	Diff. ± SE (mg C g soil^{-1})
Merced-2	Ctr.	1.51 ± 0.7	−0.8 ± 0.41	0.14 ± 0.12	−0.06 ± 0.08	0.68 ± 0.05	-0.67 ± 0.26	0.07 ± 0.09	-0.06 ± 0.06	0.84 ± 0.17	-0.13 ± 0.3	0.074 ± 0.8	-0.01 ± 0.03	0.22 ± 0.4	0.96 ± 0.02
	Rock	1.08 ± 1.9		0.08 ± 0.13		0.26 ± 0.01		0.009 ± 0.09		0.71 ± 0.2		0.068 ± 0.7		1.18 ± 0.2	
Yolo	Ctr.	0.98 ± 0.6	0.63 ± 0.51	0.05 ± 0.05	0.03 ± 0.03	0.12 ± 0.3	-0.12 ± 0.17	0.00015 ± 0.04	-0.01 ± 0.02	0.86 ± 0.2	0.74 ± 0.6	0.05 ± 0.9	0.04 ± 0.03	0.11 ± 0.2	0.21 ± 0.16
	Rock	1.61 ± 0.98		0.08 ± 0.03		0.004 ± 0.03		-0.005 ± 0.02		1.6 ± 0.6		0.09 ± 1.6		0.32 ± 0.15	

Table S8. $\delta^{13}C$ and $\delta^{15}N$ values of soil organic matter pools in three cropland enhanced rock weathering field trials. Shown below are means (± standard error, SE) of $\delta^{13}C$ and $\delta^{15}N$ values of mineral-associated organic matter (MAOM), particulate organic matter (POM), and dissolved organic carbon (DOC) pools at 0-10 cm and 10-30 cm in plots with crushed rock and control plots. $N = 5$ Merced-1 and Merced-2; $n = 3$ at Yolo.

Site	Depth (cm)	Treatment	MAOM $\delta^{13}C$ ± SE	MAOM $\delta^{15}N$ ± SE	POM $\delta^{13}C$ ± SE	POM $\delta^{15}N$ ± SE	DOC $\delta^{13}C$ ± SE
Merced-1	0-10	Control	-23.92 ± 0.97	7.24 ± 0.1	-26.56 ± 0.58	4.99 ± 0.17	-24.93 ± 0.65
		Rock	-25.40 ± 0.08	7.21 ± 0.1	-26.48 ± 0.62	4.87 ± 0.17	-24.33 ±1.36
	10-30	Control	-24.71 ± 0.6	6.93 ± 0.1	-20.59 ± 1.78	5.47 ± 0.11	-25.54 ± 0.2
		Rock	-24.85 ± 0.3	6.84 ± 0.14	-25.37 ±1.31	5.34 ± 0.18	-23.57 ± 0.7
Merced-2	0-10	Control	-23.90 ± 0.34	7.98 ± 0.11	-22.18 ± 0.64	5.96 ± 0.04	-23.34 ±0.21
		Rock	-24.26 ± 0.17	7.76 ± 0.1	-21.94 ±1.08	5.79 ± 0.12	-22.77 ± 0.26
	10-30	Control	-24.03 ± 0.73	7.17 ± 0.07	-21.78 ±1.32	5.40 ± 0.12	-23.82 ±0.16
		Rock	-24.21 ± 0.46	7.29 ± 0.05	-22.93 ± 1.24	5.80 ± 0.07	-23.88 ±0.15
Yolo	0-10	Control	-25.07 ± 0.13	5.55 ± 0.24	-23.71 ± 0.26	2.31 ± 0.21	-24.24 ± 0.2
		Rock	-24.65 ± 0.14	5.17 ± 0.29	-23.76 ± 0.6	2.04 ± 0.16	-23.08 ± 0.68
	10-30	Control	-25.43 ± 0.02	5.11 ± 0.17	-25.09 ± 0.18	2.25 ± 0.18	-24.5 ± 0.82
		Rock	-24.93 ± 0.13	5.23 ± 0.2	-23.81 ± 0.26	1.82 ± 0.08	-21.27 ±0.26

Table S9. Modeled regression coefficients of the effect of site and crushed rock on $\delta^{13}C$ and $\delta^{15}N$ of soil organic matter pools in three cropland enhanced rock weathering field trials. Shown below are coefficient estimates (± standard error, SE) from linear mixed effect models, which included the effect of crushed rock and site on C and N stable isotope ratios of soil organic matter pools. *N = 13* per treatment across all field trials. MAOM = mineral-associated organic matter; POM = particulate organic matter; DOC = dissolved organic carbon. *($p < 0.1$ is considered marginally significant and indicated by a single asterisks *; $p < 0.05$ is considered significant and indicated by two asterisks **).*

	Coefficient estimate ± SE	**p value**
(a) *$\delta^{13}C$ MAOM-C (0-10 cm)*		
Intercept	-24.3 ± 0.4	<0.0001**
Site (Merced-2)	-0.58 ± 0.5	0.24
Site (Yolo)	-0.20 ± 0.6	0.72
Treatment (crushed rock)	-0.61 ± 0.5	0.16
(b) *$\delta^{13}C$ MAOM-C (10-30 cm)*		
Intercept	-24.8 ± 0.4	<0.0001**
Site (Merced-2)	0.66 ± 0.5	0.2
Site (Yolo)	-0.38 ± 0.5	0.5
Treatment (crushed rock)	-0.007 ± 0.4	0.96
(c) *$\delta^{15}N$ MAOM-N (0-10 cm)*		
Intercept	7.3 ± 0.1	<0.0001**
Site (Merced-2)	0.6 ± 0.1	<0.0001**
Site (Yolo)	-1.9 ± 0.2	<0.0001**
Treatment (crushed rock)	-0.2 ± 0.1	0.1
(d) *$\delta^{15}N$ MAOM-N (10-30 cm)*		
Intercept	6.8 ± 0.1	<0.0001**
Site (Merced-2)	0.3 ± 0.1	0.004
Site (Yolo)	-1.7 ± 0.1	<0.0001**
Treatment (crushed rock)	0.04 ± 0.1	0.67
(e) *$\delta^{13}C$ POM-C (0-10 cm)*		
Intercept	27 ± 0.6	<0.0001**
Site (Merced-2)	4.5 ± 0.5	<0.0001**
Site (Yolo)	3.2 ± 0.6	<0.0001**
Treatment (crushed rock)	0.1 ± 0.5	0.81
(f) *$\delta^{13}C$ POM-C (10-30 cm)*		
Intercept	-22.0 ± 1	<0.0001**
Site (Merced-2)	0.6 ± 1	0.6
Site (Yolo)	-1.5 ± 2	0.4
Treatment (crushed rock)	-2.0 ± 1	0.1
(g) *$\delta^{15}N$ POM-N (0-10 cm)*		
Intercept	5.0 ± 0.1	<0.0001**
Site (Merced-2)	0.9 ± 0.1	<0.0001**
Site (Yolo)	-2.7 ± 0.2	<0.0001**
Treatment (crushed rock)	-0.1 ± 0.1	0.1

(h) *$\delta^{15}N$ POM-N (10-30 cm)*		
Intercept	5.4 ± 0.1	<0.0001**
Site (Merced-2)	0.2 ± 0.1	0.18
Site (Yolo)	-3.3 ± 0.2	<0.0001**
Treatment (crushed rock)	0.007 ± 0.1	0.96
(i) *$\delta^{13}C$ -DOC (0-10 cm)*		
Intercept	-25.0 ± 0.6	<0.0001**
Site (Merced-2)	1.6 ± 0.6	0.02**
Site (Yolo)	0.8 ± 0.7	0.2
Treatment (crushed rock)	0.7 ± 0.5	0.2

Table S10. Modeled regression coefficients of the effect of site and crushed rock on edaphic properties and microbial variables in three enhanced rock weathering field trials. Shown below are coefficient estimates (± standard error, SE) from linear mixed effect models, which included the effect of crushed rock and site on different soil and microbial variables. *N = 13* per treatment across all field trials. *($p < 0.1$ is considered marginally significant and indicated by a single asterisks *; $p < 0.05$ is considered significant and indicated by two asterisks **).*

	Coefficient estimate ± SE	**p value**
(a) *Soil pH (10-30 cm)*		
Intercept	8.1 ± 0.05	<0.0001**
Site (Merced-2)	-0.5 ± 0.05	<0.0001**
Site (Yolo)	-0.6 ± 0.07	<0.0001**
Treatment (crushed rock)	0.1 ± 0.05	0.2
(b) *Electrical Conductivity (0-10 cm)*		
Intercept	378 ± 36	<0.0001**
Site (Merced-2)	266 ± 38	<0.0001**
Site (Yolo)	330 ± 44	<0.0001**
Treatment (crushed rock)	-39 ± 33	0.25
(c) *Electrical Conductivity (10-30 cm)*		
Intercept	308 ± 46	<0.0001**
Site (Merced-2)	840 ± 50	<0.0001**
Site (Yolo)	-133 ± 59	0.06*
Treatment (crushed rock)	-22 ± 44	0.62
(d) *Gravimetric Soil Water Content (10-30 cm)*		
Intercept	0.2 ± 0.01	<0.0001**
Site (Merced-2)	0.05 ± 0.01	<0.0007**
Site (Yolo)	-0.05 ± 0.01	<0.0009**
Treatment (crushed rock)	-0.005 ± 0.01	0.65
(e) *Water Holding Capacity (0-10 cm)*		
Intercept	29.3 ± 0.6	<0.0001**
Site (Merced-2)	-1.3 ± 0.75	0.05*
Site (Yolo)	-0.4 ± 0.9	0.55
Treatment (crushed rock)	-0.8 ± 0.7	0.2
(f) *Active microbial biomass (0-10 cm)*		
Intercept	21 ± 0.8	<0.0001**
Site (Merced-2)	5 ± 0.97	0.0001**
Site (Yolo)	-9.16 ± 1.1	<0.0001**
Treatment (crushed rock)	-2.7 ± 0.9	0.004**
(g) *Active microbial biomass (10-30 cm)*		
Intercept	10.4 ± 0.7	<0.0001**
Site (Merced-2)	2.9 ± 0.9	0.003**
Site (Yolo)	-6.8 ± 1.0	<0.0001**
Treatment (crushed rock)	1.5 ± 0.8	0.06*
(h) *Cumulative respiration – 60 days (0-10 cm)*		
Intercept	151 ± 64	0.03**

Site (Merced-2)	197 ± 76	0.01**
Site (Yolo)	169 ± 88	0.07*
Treatment (crushed rock)	28 ± 67	0.68
(i) *Cumulative respiration – 60 days (10-30 cm)*		
Intercept	132 ± 11	<0.0001**
Site (Merced-2)	-23 ± 9	0.02**
Site (Yolo)	-56 ± 14	<0.0001**
Treatment (crushed rock)	-0.9 ± 8	0.9
(j) *Mg (0-10 cm)*		
Intercept	4.4 ± 1.4	0.006**
Site (Merced-2)	2.9 ± 1.7	0.11
Site (Yolo)	19 ± 2.0	<0.0001**
Treatment (crushed rock)	-1 ± 1.5	0.5
(k) *Mg (10-30 cm)*		
Intercept	3.0 ± 0.6	0.0001**
Site (Merced-2)	9.7 ± 0.8	<0.0001**
Site (Yolo)	3.6 ± 0.9	<0.0001**
Treatment (crushed rock)	-0.7 ± 0.7	0.3
(l) *Ca (0-10 cm)*		
Intercept	12.4 ± 3	0.0002**
Site (Merced-2)	11.2 ± 3	0.003**
Site (Yolo)	7.7 ± 4	0.06*
Treatment (crushed rock)	-1.0 ± 3	0.74
(m) *Ca (10-30 cm)*		
Intercept	9.7 ± 2	0.0001**
Site (Merced-2)	34.3 ± 2	<0.0001**
Site (Yolo)	-4.8 ± 3	0.11
Treatment (crushed rock)	-2.1 ± 2	0.34
(n) *Na (0-10 cm)*		
Intercept	27.1 ± 4	<0.0001**
Site (Merced-2)	19.2 ± 5	0.0008**
Site (Yolo)	-19.6 ± 6	0.003**
Treatment (crushed rock)	0.7 ± 4	0.9
(o) *Na (10-30 cm)*		
Intercept	21.8 ± 1	<0.0001**
Site (Merced-2)	31.6 ± 2	<0.0001**
Site (Yolo)	-18.1 ± 2	<0.0001**
Treatment (crushed rock)	-0.8 ± 1	0.5
(p) *Si (0-10 cm)*		
Intercept	9.2 ± 1	<0.0001**
Site (Merced-2)	2.0 ± 1	0.1
Site (Yolo)	-1.9 ± 1	0..2
Treatment (crushed rock)	-0.7 ± 1	0.5
(q) *Si (10-30 cm)*		

Intercept	9.0 ± 10.8	<0.0001**
Site (Merced-2)	-0.6 ± 0.95	0.5
Site (Yolo)	-0.95 ± 1	0.4
Treatment (crushed rock)	-0.51 ± 0.8	0.5
(r) *K (0-10 cm)*		
Intercept	2.7 ± 0.9	0.03**
Site (Merced-2)	5.7 ± 0.9	<0.0001**
Site (Yolo)	21.8 ± 1.2	<0.0001**
Treatment (crushed rock)	-0.1 ± 0.9	0.9
(s) *K (10-30 cm)*		
Intercept	1.3 ± 0.4	0.002**
Site (Merced-2)	3.0 ± 0.5	<0.0001**
Site (Yolo)	5.0 ± 0.5	<0.0001**
Treatment (crushed rock)	0.02 ± 0.43	0.97
(t) *Fe (0-10 cm)*		
Intercept	0.3 ± 0.1	0.03**
Site (Merced-2)	-0.3 ± 0.1	0.05*
Site (Yolo)	-0.3 ± 0.2	0.1
Treatment (crushed rock)	0.06 ± 0.1	0.6
(u) *Fe (10-30 cm)*		
Intercept	0.3 ± 0.4	0.3
Site (Merced-2)	-0.2 ± 0.4	0.6
Site (Yolo)	1.4 ± 0.5	0.01*
Treatment (crushed rock)	-0.21 ± 0.4	0.6
(v) *Al (0-10 cm)*		
Intercept	0.3 ± 0.1	0.03*
Site (Merced-2)	-0.3 ± 0.1	0.05*
Site (Yolo)	-0.3 ± 0.2	0.06*
Treatment (crushed rock)	0.06 ± 0.1	0.6
(w) *Al (10-30 cm)*		
Intercept	0.3 ± 0.3	0.3
Site (Merced-2)	-0.3 ± 0.4	0.5
Site (Yolo)	1 ± 0.5	0.01**
Treatment (crushed rock)	-0.14 ± 0.3	0.6
(x) *P (0-10 cm)*		
Intercept	2.5 ± 2	0.2
Site (Merced-2)	4.8 ± 2	0.06*
Site (Yolo)	-0.6 ± 3	0.8
Treatment (crushed rock)	-2.5 ± 2	0.3
(y) *P (10-30 cm)*		
Intercept	0.3 ± 0.08	0.002**
Site (Merced-2)	0.3 ± 0.1	0.006**
Site (Yolo)	-0.2 ± 0.1	0.1
Treatment (crushed rock)	0.1 ± 0.09	0.2

Table S11. Permutational analysis of variance (PERMANOVA) for bacteria and fungi at 0-10 and 10-30 cm depths respectively. This dataset includes the three sites where sequencing data was available (Yolo, Merced-1 and Merced-2). *($p < 0.1$ is considered marginally significant and indicated by a single asterisk *; $p < 0.05$ is considered significant and indicated by two asterisks **).*

	Bray-Curtis			**Euclidean**		
Bacteria	**F value**	**DF**	**p value**	**F value**	**DF**	**p value**
0-10 cm						
Treatment	1.3446	1	0.2392	0.9354	1	0.4172
Site	20.7055	2	0.0001**	10.3609	2	0.0001**
Treatment*Site	2.2127	2	0.0263**	0.98	2	0.4389
10-30 cm						
Treatment	0.6423	1	0.7057	0.9354	1	0.4157
Site	11.8923	2	0.0001**	10.3609	2	0.0001**
Treatment*Site	0.7438	2	0.7039	0.98	2	0.4392
Fungi						
0-10 cm						
Treatment	1.6607	1	0.0965*	1.128	1	0.2742
Site	9.8799	2	0.0001**	8.2797	2	0.0001**
Treatment*Site	1.2437	2	0.2219	1.1724	2	0.2303

10-30 cm						
Treatment	0.9151	1	0.4738	0.9403	1	0.4342
Site	9.6585	2	0.0001**	6.5875	2	0.0001**
Treatment*Site	1.0965	2	0.3251	1.0486	2	0.3392

Table S12. Differential abundance analysis of unfiltered sequence data at the ASV level for bacteria and fungi at 0-10 and 10-30 cm depths respectively. This dataset includes the three sites where sequencing data was available (Yolo, Merced-1 and Merced-2). Taxa showing significant differences between treatment and control ($p < 0.05$) across all three sites shown.

Data	Depth (cm)	ASV	Kingdom	Phylum	Class	Order	Family	Genus	Species	log2 Fold Change	p-value (adjusted)
16S	0_10	ASV_69	Bacteria	Chloroflexi	KD4-96	<NA>	<NA>	<NA>	<NA>	20.1	0.0103
16S	0_10	ASV_186	Bacteria	Actinobacteriota	Rubrobacteria	Rubrobacterales	Rubrobacteriaceae	Rubrobacter	<NA>	-4.8	0.0056
16S	0_10	ASV_645	Bacteria	Planctomycetota	Planctomycetes	Planctomycetales	<NA>	<NA>	<NA>	4.0	0.0386
16S	0_10	ASV_731	Bacteria	Proteobacteria	Alphaproteobacteria	Sphingomonadales	Sphingomonadaceae	Ellin6055	<NA>	2.2	0.0616
16S	10_30	ASV_161	Bacteria	Proteobacteria	Alphaproteobacteria	Sphingomonadales	Sphingomonadaceae	Sphingomonas	S. jaspsi	4.2	0.0002
16S	10_30	ASV_299	Bacteria	Proteobacteria	Alphaproteobacteria	Sphingomonadales	Sphingomonadaceae	Sphingomonas	S. flava	4.9	0.0070

16S	10_30	ASV_711	Bacteria	Verrucomicrobiota	Verrucomicrobiae	Chthoniobacterales	Chthoniobacteraceae	Candidatus	C. udaeobacter	3.9	0.0561
16S	10_30	ASV_723	Archaea	Crenarchaeota	Nitrososphaeria	Nitrososphaerales	Nitrososphaeraceae	<NA>	<NA>	4.1	0.0443
16S	10_30	ASV_849	Bacteria	Proteobacteria	Alphaproteobacteria	Sphingomonadales	Sphingomonadaceae	Ellin6055	<NA>	4.4	0.0628
16S	10_30	ASV_906	Bacteria	Actinobacteriota	Thermoleophilia	Solirubrobacterales	67-14	<NA>	<NA>	4.4	0.0628
ITS	0_10	ASV_32	Fungi	Ascomycota	Dothideomycetes	Pleosporales	Sporormiaceae	<NA>	<NA>	-18.2	0.0003
ITS	0_10	ASV_52	Fungi	Ascomycota	Sordariomycetes	Sordariales	Lasiosphaeriaceae	Schizothecium	S. inaequale	-18.5	0.0003
ITS	0_10	ASV_68	Fungi	Ascomycota	Sordariomycetes	Microascales	Microascaceae	Pithoascus	P. nidicola	-20.9	0.0005

ITS	0_10	ASV_84	Fungi	Ascomycota	Sordariomycetes	Microascales	Microascaceae	<NA>	<NA>	22.5	0.0003
ITS	0_10	ASV_230	Fungi	Ascomycota	Dothideomycetes	Pleosporales	Didymellaceae	<NA>	<NA>	-18.4	0.0003
ITS	0_10	ASV_429	Fungi	Ascomycota	Pezizomycetes	Pezizales	Pezizaceae	Iodophanus	<NA>	22.6	0.0004
ITS	10_30	ASV_9	Fungi	Ascomycota	Eurotiomycetes	Eurotiales	Aspergillaceae	Aspergillus	<NA>	-7.6	0.0137
ITS	10_30	ASV_33	Fungi	Ascomycota	Sordariomycetes	Microascales	Microascaceae	Pithoascus	P. nidicola	22.2	0.0007
ITS	10_30	ASV_52	Fungi	Ascomycota	Sordariomycetes	Sordariales	Lasiosphaeriaceae	Schizothecium	S. inaequale	-18.6	0.0021
ITS	10_30	ASV_93	Fungi	Mortierellomycota	Mortierellomycetes	Mortierellales	Mortierellaceae	Mortierella	M. elongata	-18.4	0.0000

ITS	10_30	ASV_159	Fungi	Ascomycota	Eurotiomycetes	Onygenales	Onygenales_fam_Incertae_sedis	Chrysosporium	C. lobatum	-19.1	0.0004
ITS	10_30	ASV_239	Fungi	Basidiomycota	Agaricomycetes	Cantharellales	Ceratobasidiaceae	Thanatephorus	T. cucumeris	-22.2	0.0007
ITS	10_30	ASV_277	Fungi	Ascomycota	Sordariomycetes	Hypocreales	Nectriaceae	Gibberella	G. tricincta	20.5	0.0026
ITS	10_30	ASV_365	Fungi	Ascomycota	Pezizomycetes	Pezizales	Pezizaceae	Iodophanus	<NA>	-23.1	0.0004
ITS	10_30	ASV_545	Fungi	Basidiomycota	Agaricomycetes	Agaricales	Entolomataceae	Entoloma	E. undatum	17.3	0.0356