Vegetation and climate effects on soil production, chemical weathering, and physical erosion rates

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1 Compilation of soil production rates, climate, topographic, vegetation, and other parameters

The formation rate of erodible material can be quantified with in situ-produced cosmogenic nuclide concentrations in regolith material. Depending on the sampled material and the assumptions made, the rate is called a regolith (e.g., Ferrier et al., 2012) or soil production rate (e.g., Heimsath et al., 1997). Even though the terms do not identify exactly the same process, the rates are comparable. Not only do they often describe the same process, but the rates should be equal under steady-state conditions. Regolith or soil production rates, from now on called soil production rates, are determined in different tectonic and lithologic settings. In this study, soil production rates of granitic soil-mantled hillslopes are compiled (Table S6) as well as some in non-granitic lithologies (Table S7). For all the studies at granitic point locations the following parameters were compiled (Table S6) and the linear correlation investigated (Tables S8):

1. Latitude and longitude (Reference study)
2. Altitude (Reference study)
3. Soil depth or sample depth (Reference study)
4. Slope (Reference study)
5. Soil production rates and errors (Reference study)
6. MAP and MAT for point locations based on Karger et al. (2017).
7. MAP and MAT for present-day (PD), pre-industrial (PI), mid Holocene (MD), and Last Glacial Maximum (LGM) extracted from Mutz et al. (2018).
8. Maximum mean vegetation fraction from MODIS (Broxton et al., 2014).
9. Leaf area index from TERRA/MODIS (Knyazikhin et al., 1999).
10. Annual mean solar insolation (1970-2000) from MODIS (Wang, 2017).
11. Evapotranspiration from Zhang et al., 2010.
12. Net primary productivity (NPP) from Running et al., 2015. Data from 1000 m grids are listed.
13. Rooting depth from Schenk et al., 2009.
14. Soil and regolith thicknesses from Pelletier et al., 2016.
15. Local slope from GTOPO30.

16. Frost cracking window for pre-industrial (FCW PI), mid Holocene (FCW MH), and Last Glacial Maximum (FCW LGM) (Sharma, 2018).

In addition, chemical weathering, physical erosion, and total denudation rates from granitic soil-mantled hillslopes are compiled (Table S9) and correlated with some climate and vegetation parameters as listed above (Table S10)

2 Calculation method for soil production rate models discussed in text

Three theoretical considerations of soil production rates were addressed in the main text and described in more detail below. In order to simplify the considerations, only the exponential function for soil production rates with soil depth is addressed. The humped function for soil production rates was not considered.

A) Norton et al. (2014)

Based on mass balance considerations and steady-state, maximum soil production rate SPR_{max} (t/(km^2 yr)) on hillslopes under different climatic conditions is calculated by:

$$SPR_{max} = 0.42\, MAP\, exp\left(\frac{-77}{8.3144598 \times 10^{-3}}\left(\frac{1}{(MAT + 278.15)} + \frac{1}{278.15}\right)\right) \quad \text{(S1)},$$

where MAP (mm/yr) and MAT (°K) are mean annual precipitation and temperatures. For further details see Eqn, 7 in Norton et al. (2014). As the maximum soil production rate SPR_{max} is reduced under soil cover (e.g., Heimsath et al., 1997; Gilbert, 1877), soil production rate SPR can be calculated following:

$$SPR = SPR_{max}\, exp(-\alpha h) \quad \text{(S2)},$$

where h is the soil depth (m) and α a rate constant (/m) considered to be 3 /m in this study (see Table 1 in Norton et al., 2014). In addition to our calculation of SPR under 0.5 and 1.0 m of soil, we assumed a linear increasing soil depth with increasing precipitation. The linear increase of soil depth is based on the correlation of soil depth (mm) with MAP (mm/yr) in our study area (see Table S1). The equation used is: y = 311.7 + 0.292x (R^2 = 0.62).

B) Pelletier and Rasmussen (2009)

Calculation of soil production rate SPR_0 (m/kyr) is suggested to be a function of:

$$SRP_0 = a\, exp^{(b\ EEMT)} \quad \text{(S3)},$$

where EEMT (m^2/(kJ yr)) is the “Effective energy and mass transfer” of Rasmussen and Tabor (2007) and a (m/kyr) and b (m^2/(kJ yr)) are empirical coefficients. The coefficients are calibrated for granitic lithologies to be: a = 0.037 m/kyr and b = 0.00003 m^2/(kJ yr)) (Pelletier and Rassmussen, 2009). EEMT is given by:

$$EMT = 347134\, exp\left\{-0.5\left[\left(\frac{MAT-21.5}{-10.1}\right)^2 + \left(\frac{MAP-4412}{1704}\right)^2\right]\right\} \quad \text{(S4)}$$

where MAT (°C) and MAP (mm/yr) are mean annual temperature and precipitation, respectively (Rassmussen and Tabor, 2007). As EEMT is an empirical function of MAT and MAP, biotic controls on EEMT are included in Eqn. S5. Based on Eqns, S5 and S6, soil production rates can be calculated.

C) Pelak et al. (2016)

Whereas Pelletier and Rassmussen (2009) and Norton et al. (2014) address soil production rate in the light of MAP and MAT, Pelak et al. (2016) approach calculation of soil production rates as influenced by plant biomass density b (kg/m^2) and soil depth h (m). The so called soil production rate $P_{(h.b)}$ of Pelak et al. (2016) is given by:

$$P_{(h,b)} = \left(P_0 + P_v b_{(h)}\right) exp(-k_s h) \quad \text{(S5),}$$

where P_0 (mm/yr) is the abiotic soil production rate in the absence of vegetation and soil, P_v (mm^3/(yr kg)) the sensitivity of soil production to vegetation, and k_s (/m) a rate for the decoupling of soil production from surface weathering processes due to increasing soil depth. Typical suggested model parameters are P_0 = 0.05 mm/yr, P_v = 0.4 mm^3/(yr kg), and k_s = 0.8 /m (see Table I in Pelak et al., 2016); note unit adjustments were needed). The plant biomass density b (kg/m^2) is a function of soil depth h (m) and is calculated with:

$$b_{(h)} = \frac{r}{m}\left[1 - exp\left(-k_g\, h\right)\right] \quad \text{(S6),}$$

where r (/yr) is the vegetation growth rate, m (m^2/(yr kg)) the vegetation turnover rate, and k_g (/m) the vegetation growth response to soil depth. In Pelak et al. (2016) the ratio r/m is given as 4 kg/m^2 and k_g = 0.2 /m. The soil production rates presented in our study reach values up to ~1000 t/(km^2 yr). To reach the full range of soil production rates reported, we show r/m values of 50, 100, and 150 kg/m^2 in Figure 3C. Furthermore, we convert plant biomass density $b_{(h)}$ into LAI based on the relationship shown in Fig. 4 of Gratani and Crescente (2000):

$$LAI = \frac{\left(10 b_{(h)} - 2.217\right)}{71.813} \quad \text{(S7).}$$

Observed LAIs (Table S5) of ~8 m^2/ m^2 then results in plant biomass values of ~60 kg/m^2. This is in agreement with observed values of about 50 kg/m^2 (Brown and Lugo, 1982).

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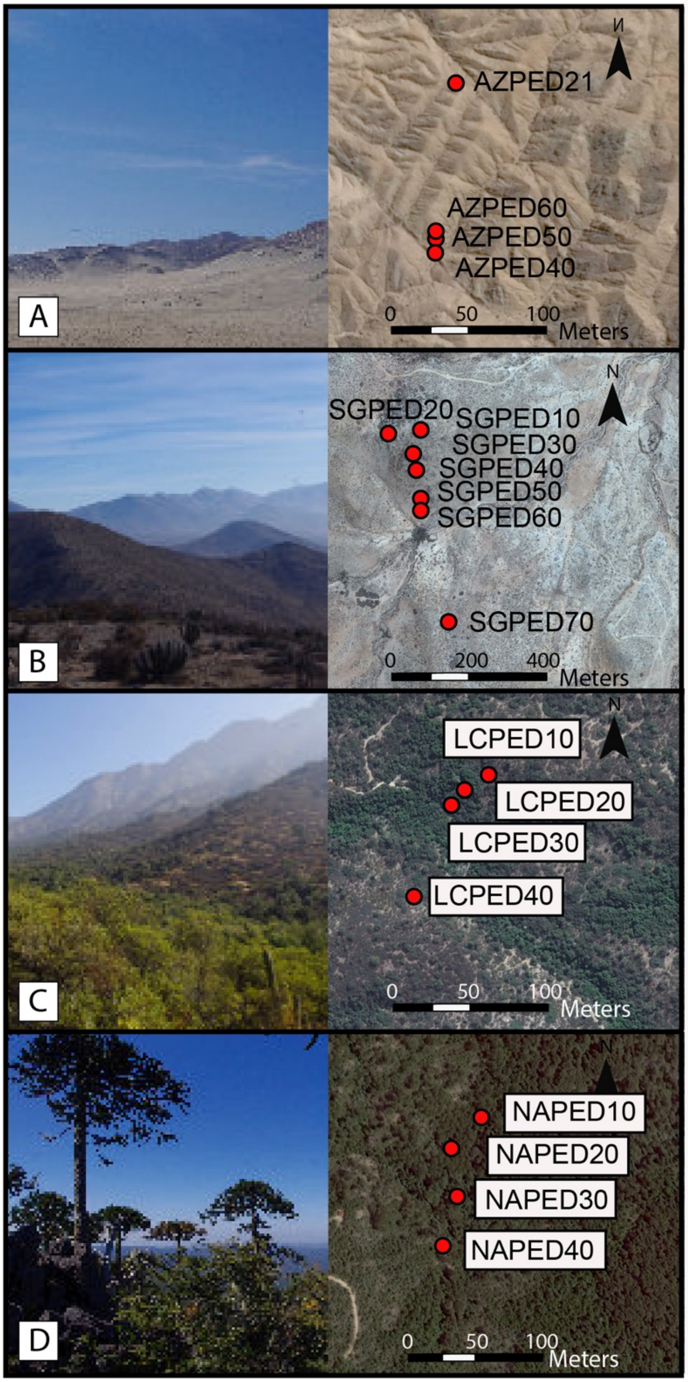

Figure S1: Photographs of study areas and satellite images (Data source: © Google Earth) with sample locations: A) Pan de Azúcar. B) Santa Gracia. C) La Campana. D) Nahuelbuta.

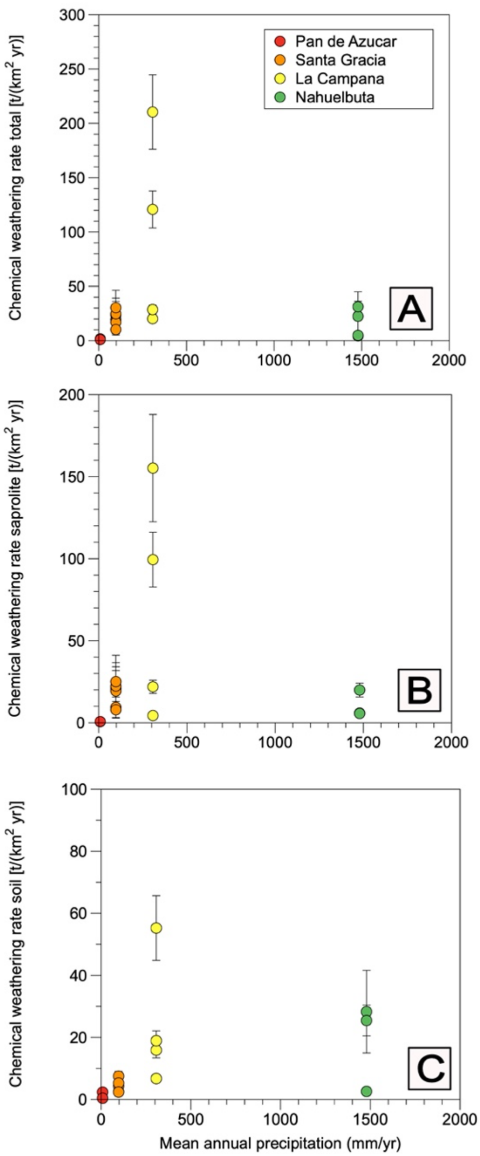

Figure S2: Chemical weathering rate versus mean annual precipitation for the four Chilean study areas: A) Total weathering rate. B) Weathering rate in soil. C) Weathering rate in saprolite.

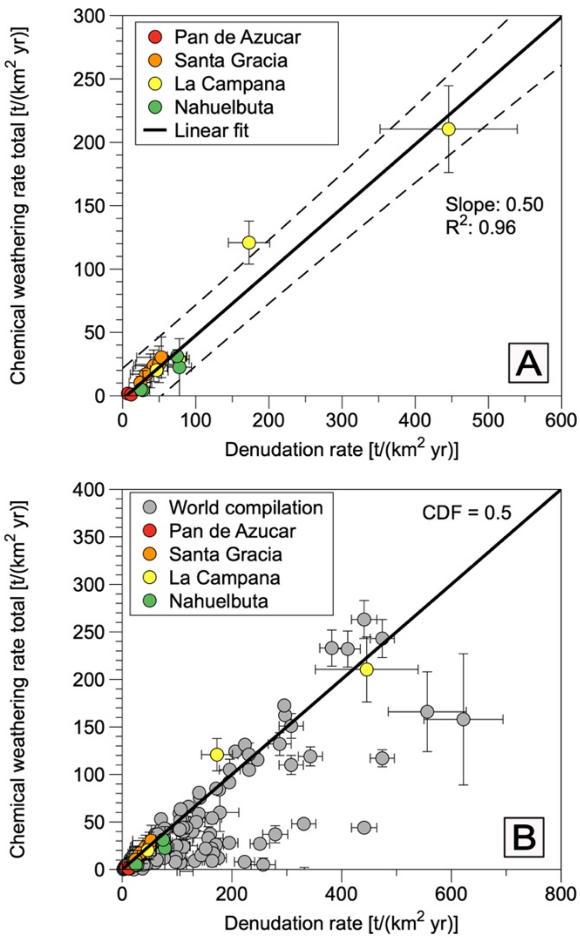

Figure S3: Total weathering rate W_{total} versus denudation rate D_{total}: A) Four study areas investigated in this study. The weathering rate can be approximated by the linear function $W_{total} = 0.5\ D_{total}$ ($r^2 = 0.96$). B) Compilation of published data from hillslopes located in granitic lithologies.

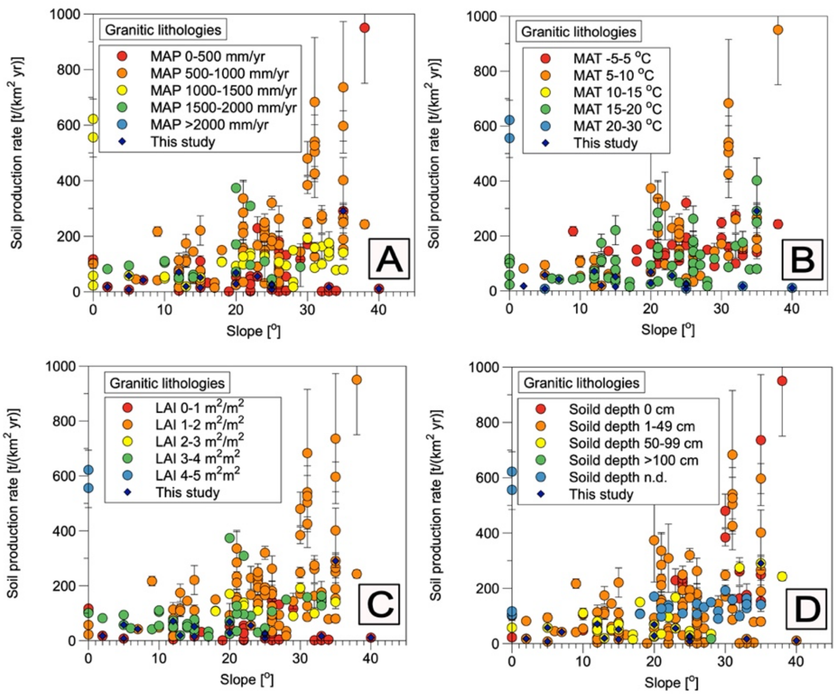

Figure S4: Soil production rates SPRs versus slope: A) SPRs are in mean annual precipitation bins. B) SPRs are in mean annual temperature bins. C) SPRs are in bins for leaf area indices. D) SPRs are in bins of soil depth.

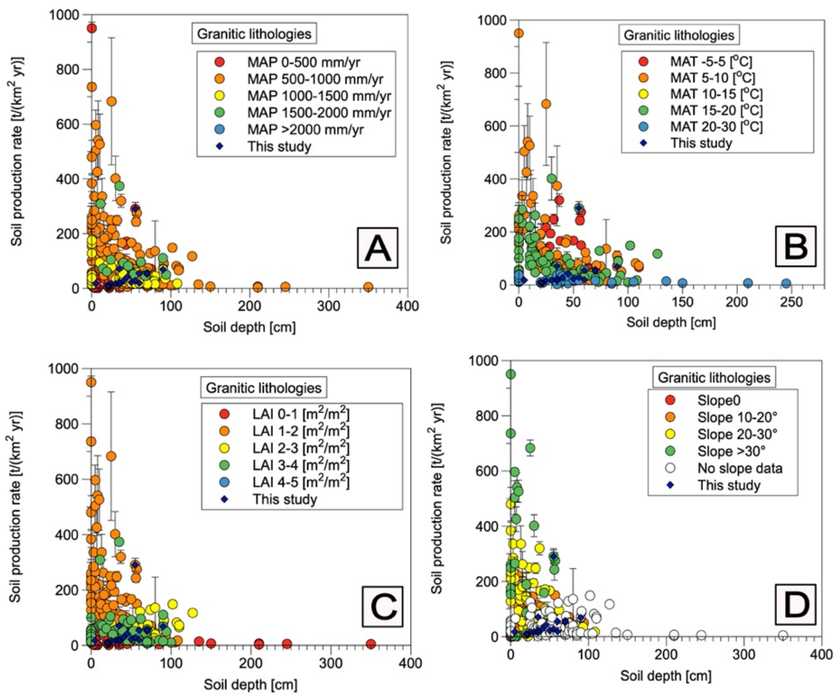

Figure S5: Soil production rates SPRs versus soil depth: A) SPRs are in mean annual precipitation bins. B) SPRs are in mean annual temperature bins. C) SPRs are in bins for leaf area indices. D) SPRs are in slope bins.

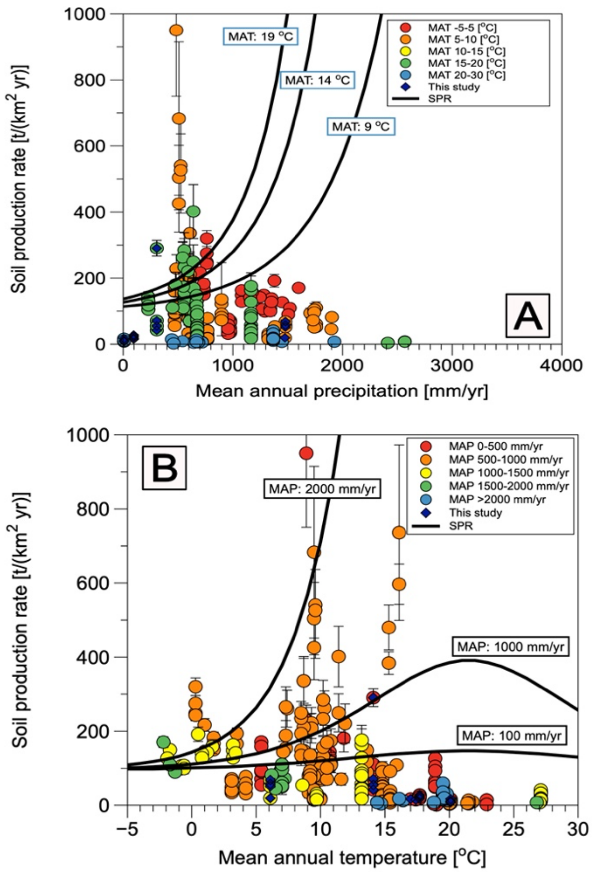

Figure S6: Soil production rates SPRs versus: A) Mean annual precipitation. B) Mean annual temperature. Black lines indicate calculated SPRs for different mean annual temperatures and mean annual precipitations based on Pelletier and Rasmussen (2009).

Table S1:

Table S1: Location for pedons in the investigated four study areas in the Chilean Coastal Cordillera

Soil profile	Location		Altitude	MAP	MAT	Veg. cover	LAI	Aspect	Slope	Soil depth	Ave. regolith density
	°N	°E	m	mm/yr	°C	%	m^2/m^2	°	°	cm	g/cm^3
Pan de Azucar											
AZPED60	-26.11012	-70.5492	343	8	20.1	2	0	60	5	22	1.26
AZPED50	-26.11027	-70.54922	333					0	40	20	1.47
AZPED40	-26.1102	-70.5492	326					0	33	25	1.28
AZPED21	-26.1094	-70.54907	342					180	25	20	1.31
Santa Gracia											
SGPED10	-29.75633	-71.16626	727	97	17.7	31	0.52	300	2	5	
SGPED20	-29.75636	-71.16721	718					240	2	30	1.53
SGPED30	-29.75702	-71.16650	705					0	25	35	
SGPED40	-29.75738	-71.16635	682					0	25	50	1.48
SGPED50	-29.75794	-71.16618	652					0	25	40	
SGPED60	-29.75826	-71.16615	638					0	20	55	1.48
SGPED70	-29.76120	-71.16559	690					180	15	35	1.55
La Campana											
LCPED10	-32.95581	-71.06332	734	307	14.1	84	1.84	60	7	45	1.37
LCPED20	-32.95588	-71.06355	718					0	23	60	1.21
LCPED30	-32.95615	-71.06380	708					60	35	55	1.22
LCPED40	-32.95720	-71.06425	724					120	12	35	1.47
Nahuelbuta											
NAPED10	-37.80735	-73.01285	1248	1479	6.1	95	3.16	60	5	70	0.94
NAPED20	-37.80770	-73.01357	1239					60	15	70	0.91
NAPED30	-37.80838	-73.01345	1228					0	20	90	0.88
NAPED40	-37.80904	-73.01380	1200					180	13	60	1.05

Table S2:

Table S2: Soil production rates and information for calculation

Sample(1)		Sample depth	Density cum.	P_{nuc}	P_{muonS}	P_{muonF}	P_{tot}	$m_{(qtz)}$	$m_{(9Be)}$	$^{10}Be/^{9}Be$	Error	^{10}Be concentration	Soil production	Integration time
		cm	g/cm^3	atoms/($g_{(qtz)}$*yr)	atoms/($g_{(qtz)}$*yr)	atoms/($g_{(qtz)}$*yr)	atoms/($g_{(qtz)}$*yr)	g	mg	(meas.)	%	10^5 atoms/$g_{(qtz)}$	t/(km^2 yr)	kyr
Pan de Azucar														
AZPED60_25-30	GFTE1001G	27.5 ± 10.0	1.48	3.128	0.011	0.035	3.174	44.59	0.3267	1.04E-12	3.2	5.08 ± 0.16	7.7 ± 0.5	207 ± 7
AZPED50_20-25	GFTE10006	22.5 ± 10.0	1.54	3.102	0.011	0.035	3.148	34.67	0.3274	6.14E-13	3.2	3.86 ± 0.12	11.0 ± 0.7	153 ± 5
AZPED40_25-30	GFTE1001H	27.5 ± 10.0	1.48	3.084	0.011	0.035	3.130	47.85	0.3265	5.68E-13	3.2	2.58 ± 0.08	16.8 ± 1.0	107 ± 3
AZPED21_35-40	GFTE10007	37.5 ± 10.0	1.44	3.125	0.011	0.035	3.172	38.12	0.3271	7.86E-13	3.1	4.50 ± 0.14	8.2 ± 0.5	199 ± 6
Santa Gracia														
SGPED10_0-5	GFTE1001J	2.5 ± 2.5	1.50	4.388	0.014	0.044	4.446	3.44	0.3298	6.68E-14	5.0	4.19 ± 0.23	17.8 ± 1.3	96 ± 5
SGPED20_30-35	GFTE1001K	32.5 ± 10.0	1.54	4.357	0.013	0.044	4.414	44.63	0.3272	6.76E-13	3.2	3.30 ± 0.11	17.1 ± 1.0	104 ± 3
SGPED30_36-46	GFTE1001S	41.0 ± 10.0	1.55	4.311	0.013	0.044	4.368	50.31	0.3268	5.46E-13	3.2	2.36 ± 0.08	23.2 ± 1.4	81 ± 3
SGPED40_60-65	GFTE10008	62.5 ± 10.0	1.48	4.231	0.013	0.043	4.287	18.17	0.3049	1.86E-13	4.0	2.07 ± 0.08	22.4 ± 1.4	86 ± 4
SGPED50_45-50	GFTE1001L	47.5 ± 10.0	1.55	4.129	0.013	0.043	4.184	42.53	0.3269	3.64E-13	3.3	1.86 ± 0.06	27.4 ± 1.6	71 ± 2
SGPED60_51-58	GFTE1001M	54.5 ± 10.0	1.48	4.082	0.013	0.042	4.137	43.43	0.3270	3.49E-13	3.4	1.75 ± 0.06	28.0 ± 1.7	70 ± 2
SGPED70_35-40	GFTE10009	37.5 ± 10.0	1.58	4.259	0.013	0.043	4.315	26.43	0.3281	4.25E-13	3.5	3.52 ± 0.12	14.9 ± 0.9	118 ± 4
La Campana														
LCPED10_28-33	GFTE1001N	30.5 ± 10.0	1.36	4.410	0.013	0.044	4.467	39.43	0.3274	2.92E-13	3.5	1.61 ± 0.06	42.1 ± 2.6	46 ± 2
LCPED20_40-45	GFTE1000A	42.5 ± 10.0	1.13	4.352	0.013	0.044	4.409	31.07	0.3304	1.65E-13	3.7	1.20 ± 0.05	55.1 ± 3.5	36 ± 1
LCPED30_50-55	GFTE1001P	52.5 ± 10.0	1.23	4.306	0.013	0.043	4.362	38.76	0.3268	4.13E-14	5.0	0.22 ± 0.01	290.5 ± 24.0	8 ± 1
LCPED40_40-45	GFTE1000B	42.5 ± 10.0	1.47	4.374	0.013	0.044	4.431	31.65	0.3287	1.30E-13	4.1	0.89 ± 0.04	71.0 ± 4.7	29 ± 1
Nahuelbuta														
NAPED10_90-95	GFTE1001Q	92.5 ± 20.0	0.96	6.673	0.017	0.055	6.745	56.33	0.3297	3.74E-13	3.4	1.46 ± 0.05	57.7 ± 3.5	35 ± 1
NAPED20_80-85	GFTE1000C	82.5 ± 20.0	0.89	6.626	0.017	0.055	6.698	25.29	0.3049	2.20E-13	3.8	1.73 ± 0.07	51.5 ± 3.3	38 ± 2
NAPED30_90-95	GFTE1001R	92.5 ± 20.0	0.92	6.569	0.017	0.054	6.640	56.99	0.3265	3.26E-13	3.6	1.24 ± 0.05	68.6 ± 4.2	30 ± 1
NAPED40_80-85	GFTE1000D	82.5 ± 20.0	1.04	6.424	0.016	0.054	6.494	30.38	0.3268	5.34E-13	3.4	3.83 ± 0.13	19.3 ± 1.2	94 ± 3

(1) Samples in bold are from Schaller et al. (2018) whereas other samples are presented in this study.

Table S3:

Table S3: Elemental concentrations in rock, saprolite, and soil based on Oeser et al. (2018)

Pedon		Number of samples	Ti %	Zr ppm	Si %	Al %	Na %	Ca %	K %	Mg %
Pan de Azucar										
	rock	12	0.29 ± 0.01	206 ± 8	34.52 ± 0.63	7.19 ± 0.41	2.06 ± 0.24	1.03 ± 0.35	3.21 ± 0.13	0.36 ± 0.16
AZPED60	saprolite	5	0.27 ± 0.05	189 ± 31	31.96 ± 2.11	6.73 ± 0.64	2.12 ± 0.32	3.94 ± 3.65	2.80 ± 0.27	0.26 ± 0.16
	soil	3	0.39 ± 0.09	272 ± 75	28.35 ± 3.84	7.25 ± 1.21	1.62 ± 0.25	8.01 ± 8.34	3.04 ± 0.62	0.65 ± 0.18
AZPED50	saprolite	6	0.31 ± 0.02	217 ± 11	32.82 ± 0.41	7.07 ± 0.23	1.66 ± 0.20	2.53 ± 0.86	2.96 ± 0.21	0.21 ± 0.03
	soil	3	0.32 ± 0.07	225 ± 44	31.85 ± 0.98	7.32 ± 0.65	1.78 ± 0.08	3.06 ± 2.19	3.20 ± 0.30	0.30 ± 0.17
AZPED40	saprolite	5	0.31 ± 0.02	214 ± 12	32.38 ± 0.74	7.05 ± 0.28	1.09 ± 1.56	3.79 ± 1.05	2.90 ± 3.37	0.27 ± 0.03
	soil	3	0.28 ± 0.02	201 ± 23	30.98 ± 1.59	6.44 ± 0.50	0.92 ± 0.24	7.20 ± 3.50	2.72 ± 2.87	0.34 ± 0.03
AZPED21	saprolite	4	0.28 ± 0.02	198 ± 15	33.42 ± 1.23	7.00 ± 0.37	0.41 ± 0.14	1.62 ± 1.82	0.20 ± 0.13	0.21 ± 0.09
	soil	3	0.24 ± 0.01	184 ± 14	33.96 ± 0.36	6.25 ± 0.11	0.43 ± 0.12	2.29 ± 0.17	0.19 ± 0.51	0.37 ± 0.08
Santa Gracia										
	rock	8	0.44 ± 0.10	117 ± 74	26.58 ± 2.65	9.43 ± 0.64	3.07 ± 0.57	6.72 ± 2.26	0.64 ± 0.56	2.26 ± 0.98
SGPED10	saprolite									
	soil									
SGPED20	saprolite	5	0.47 ± 0.03	260 ± 19	28.23 ± 0.57	8.88 ± 0.24	3.86 ± 0.18	3.55 ± 0.22	1.58 ± 0.52	1.56 ± 0.16
	soil	3	0.45 ± 0.06	235 ± 33	28.73 ± 0.70	8.91 ± 0.26	3.53 ± 0.25	3.25 ± 0.22	1.89 ± 0.20	1.43 ± 0.19
SGPD30	saprolite	4	0.37 ± 0.03	214 ± 22	29.56 ± 0.50	8.82 ± 0.19	3.49 ± 0.30	3.05 ± 0.08	1.76 ± 0.36	1.21 ± 0.12
	soil	4	0.43 ± 0.02	264 ± 21	29.30 ± 0.12	8.78 ± 0.02	3.24 ± 0.05	2.85 ± 0.02	1.87 ± 0.15	1.19 ± 0.05
SGPED40	saprolite	7	0.36 ± 0.03	166 ± 32	29.55 ± 0.26	8.82 ± 0.20	3.64 ± 0.14	3.15 ± 0.30	1.26 ± 0.15	1.43 ± 0.11
	soil	4	0.41 ± 0.02	250 ± 13	28.95 ± 0.11	8.75 ± 0.07	3.22 ± 0.04	3.14 ± 0.10	1.86 ± 0.08	1.29 ± 0.04
SGPD50	saprolite	7	0.41 ± 0.03	212 ± 25	29.07 ± 0.35	8.92 ± 0.09	3.14 ± 0.18	3.15 ± 0.41	2.02 ± 0.21	1.23 ± 0.08
	soil	4	0.40 ± 0.05	233 ± 28	29.01 ± 0.42	8.79 ± 0.08	3.14 ± 0.11	3.07 ± 0.10	2.12 ± 0.16	1.21 ± 0.14
SGPD60	saprolite	7	0.36 ± 0.04	226 ± 20	29.93 ± 0.69	8.81 ± 0.26	3.06 ± 0.18	2.65 ± 0.25	2.48 ± 0.25	0.90 ± 0.12
	soil	4	0.40 ± 0.03	278 ± 10	29.37 ± 0.21	8.64 ± 0.08	3.11 ± 0.04	2.77 ± 0.08	2.21 ± 0.05	1.06 ± 0.08
SGPED70	saprolite	8	0.39 ± 0.04	181 ± 14	29.77 ± 0.29	8.25 ± 0.23	2.74 ± 0.06	3.03 ± 0.08	2.56 ± 0.24	1.33 ± 0.07
	soil	3	0.37 ± 0.02	219 ± 35	29.57 ± 0.29	8.81 ± 0.13	2.76 ± 0.12	2.93 ± 0.21	2.20 ± 0.03	1.07 ± 0.04
La Campana										
	rock	5	0.16 ± 0.02	169 ± 22	34.77 ± 0.42	7.26 ± 0.15	2.37 ± 0.27	0.98 ± 0.28	3.79 ± 0.70	0.24 ± 0.08
LCPED10	saprolite	2	0.20 ± 0.03	187 ± 23	34.15 ± 0.44	7.47 ± 0.12	1.86 ± 0.11	0.55 ± 0.24	3.77 ± 0.19	0.29 ± 0.09
	soil	4	0.34 ± 0.02	300 ± 24	32.07 ± 0.37	7.82 ± 0.11	1.97 ± 0.04	1.75 ± 0.37	2.98 ± 0.18	0.64 ± 0.07
LCPED20	saprolite	5	0.30 ± 0.05	237 ± 27	31.96 ± 0.78	7.90 ± 0.24	2.15 ± 0.04	1.61 ± 0.21	3.24 ± 0.22	0.59 ± 0.17
	soil	5	0.31 ± 0.02	269 ± 17	32.41 ± 0.36	7.81 ± 0.28	2.02 ± 0.06	1.55 ± 0.20	3.27 ± 0.03	0.51 ± 0.05
LCPED30	saprolite	15	0.43 ± 0.04	260 ± 38	29.95 ± 0.60	8.22 ± 0.18	2.68 ± 0.10	2.72 ± 0.24	2.37 ± 0.22	0.99 ± 0.11
	soil	5	0.47 ± 0.00	321 ± 28	29.68 ± 0.08	8.43 ± 0.03	2.25 ± 0.13	2.65 ± 0.12	2.51 ± 0.05	1.02 ± 0.02
LCPED40	saprolite	5	0.43 ± 0.01	423 ± 26	30.65 ± 0.30	8.57 ± 0.12	1.88 ± 0.10	1.70 ± 0.07	3.14 ± 0.14	0.78 ± 0.05
	soil	4	0.49 ± 0.00	502 ± 50	30.13 ± 0.09	8.51 ± 0.05	1.93 ± 0.04	1.89 ± 0.07	2.99 ± 0.01	0.88 ± 0.02
Nahuelbuta										
	rock	3	0.34 ± 0.01	210 ± 35	31.87 ± 1.29	8.44 ± 0.59	2.25 ± 0.31	2.60 ± 0.27	1.91 ± 0.50	0.84 ± 0.12
NAPED10	saprolite	7	0.41 ± 0.02	283 ± 33	30.34 ± 0.48	9.30 ± 0.51	2.02 ± 0.16	2.46 ± 0.16	1.43 ± 0.16	0.82 ± 0.04
	soil	6	0.47 ± 0.04	297 ± 17	30.09 ± 0.83	10.19 ± 0.49	1.31 ± 0.08	1.70 ± 0.09	1.19 ± 0.06	0.73 ± 0.08
NAPED20	saprolite	8	0.74 ± 0.07	113 ± 32	24.95 ± 1.54	11.7 ± 0.60	0.71 ± 0.18	2.10 ± 1.14	2.23 ± 0.22	2.42 ± 0.33
	soil	7	0.53 ± 0.11	250 ± 93	28.69 ± 3.19	10.6 ± 1.05	0.75 ± 0.14	1.39 ± 0.51	1.94 ± 0.49	1.15 ± 0.86
NAPED30	saprolite	1	0.54 ±	229 ±	28.88 ±	8.70 ±	0.95 ±	3.65 ±	1.80 ±	1.45 ± 0.00
	soil	7	0.65 ± 0.09	363 ± 67	28.95 ± 0.96	9.88 ± 0.36	0.89 ± 0.11	1.95 ± 0.32	1.31 ± 0.25	1.40 ± 0.11
NAPED40	saprolite	6	0.28 ± 0.06	272 ± 47	34.74 ± 1.19	7.17 ± 0.75	0.62 ± 0.10	0.71 ± 0.23	2.29 ± 0.21	0.60 ± 0.18
	soil	6	0.35 ± 0.09	262 ± 46	33.00 ± 1.44	8.26 ± 1.11	0.73 ± 0.17	0.75 ± 0.13	2.11 ± 0.17	0.57 ± 0.13

Table S4:

Table S4: Chemical weathering, physical erosion, and total denudation rates in the Chilean Coastal Cordillera

Pedon	IGSN	Zrsap/Zrrock	Zrsoil/Zrsap	Zrsoil/Zrrock	Fraction of weathering in saprolite	Soil mass g/cm^2	Soil production rate t/(km^2 yr)	Chemical weathering rate Total in oxides t/(km^2 yr)	Physical erosion rate t/(km^2 yr)	Total denudation rate t/(km^2 yr)
Pan de Azucar										
AZPED60	_GFTE1001G_	0.92 ± 0.15	1.44 ± 0.46	1.32 ± 0.37	-0.35 ± 0.11	27.7 ± 12.8	7.7 ± 0.5	1.7 ± 0.8	5.4 ± 0.9	7.1 ± 1.3
AZPED50	_GFTE10006_	1.06 ± 0.07	1.04 ± 0.21	1.09 ± 0.22	0.61 ± 0.13	29.4 ± 15.1	11.0 ± 0.7	1.0 ± 0.1	10.6 ± 0.7	11.6 ± 1.0
AZPED40	_GFTE1001H_	1.04 ± 0.07	0.94 ± 0.12	0.98 ± 0.12	-1.60 ± 0.22	31.5 ± 13.1	16.8 ± 1.0	-0.4 ± 0.2	17.9 ± 1.0	17.5 ± 1.6
AZPED21	_GFTE10007_	0.96 ± 0.08	0.93 ± 0.10	0.89 ± 0.08	0.33 ± 0.04	26.2 ± 13.2	8.2 ± 0.5	-0.9 ± 0.1	8.8 ± 0.5	7.9 ± 0.8
Site average	Mean ± SEM	1.00 ± 0.03	1.08 ± 0.12	1.07 ± 0.09	-0.25 ± 0.49	28.7 ± 1.1	10.9 ± 2.1	0.3 ± 0.6	10.7 ± 2.6	11.0 ± 2.4
Santa Gracia										
SGPED10	_GFTE1001J_						17.8 ± 1.3			
SGPED20	_GFTE1001K_	2.22 ± 1.41	0.93 ± 0.14	2.07 ± 1.33	1.06 ± 0.96	45.9 ± 15.3	17.1 ± 1.0	19.6 ± 13.3	18.3 ± 1.0	37.9 ± 24.3
SGPED30	GFTE1001S	1.83 ± 1.17	1.23 ± 0.16	2.26 ± 1.44	0.82 ± 0.74	63.6 ± 15.6	23.2 ± 1.4	23.7 ± 12.4	18.8 ± 1.5	42.5 ± 27.3
SGPED40	_GFTE10008_	1.42 ± 0.94	1.50 ± 0.30	2.14 ± 1.35	0.56 ± 0.51	74.0 ± 14.9	22.4 ± 1.5	16.9 ± 6.4	14.9 ± 2.1	31.8 ± 21.1
SGPED50	_GFTE1001L_	1.81 ± 1.16	1.10 ± 0.19	1.99 ± 1.28	0.90 ± 0.82	84.5 ± 15.7	27.4 ± 1.6	24.8 ± 14.4	24.9 ± 1.7	49.7 ± 32.1
SGPED60	_GFTE1001M_	1.90 ± 1.21	1.23 ± 0.12	2.34 ± 1.48	0.83 ± 0.74	81.4 ± 15.1	28.0 ± 1.7	30.4 ± 16.0	22.7 ± 1.8	53.1 ± 33.9
SGPED70	_GFTE10009_	1.53 ± 0.97	1.19 ± 0.19	1.82 ± 1.18	0.77 ± 0.70	54.3 ± 15.6	15.9 ± 0.9	11.0 ± 5.4	13.3 ± 1.0	24.3 ± 15.5
Site average	Mean ± SEM	1.79 ± 0.12	1.20 ± 0.08	2.10 ± 0.08	0.82 ± 0.07	67.3 ± 6.3	21.7 ± 1.9	21.0 ± 2.8	18.8 ± 1.8	39.9 ± 4.4
La Campana										
LCPED10	_GFTE1001N_	1.10 ± 0.19	1.60 ± 0.23	1.77 ± 0,27,	0.22 ± 0.05	54.8 ± 14.1	42.1 ± 2.6	20.2 ± 2.6	26.2 ± 3.6	46.5 ± 8.7
LCPED20	_GFTE1000A_	1.40 ± 0.24	1.14 ± 0.15	1.59 ± 0.23	0.77 ± 0.17	78.7 ± 20.3	43.8 ± 3.4	28.6 ± 4.1	48.4 ± 3.6	77.0 ± 14.1
LCPED30	_GFTE1001P_	1.53 ± 0.30	1.23 ± 0.21	1.89 ± 0.29	0.74 ± 0.18	61.0 ± 12.6	290.5 ± 24.0	210.5 ± 34.3	235.2 ± 26.1	445.7 ± 93.7
LCPED40	_GFTE1000B_	2.44 ± 0.36	1.36 ± 0.24	3.32 ± 0.62	0.90 ± 0.19	51.5 ± 15.4	71.0 ± 4.7	120.8 ± 17.0	52.1 ± 5.7	172.8 ± 28.3
Site average (n=4)	Mean ± SEM	1.62 ± 0.29	1.33 ± 0.10	2.14 ± 0.40	0.66 ± 0.15	61.5 ± 6.1	111.8 ± 59.9	95.0 ± 44.7	90.5 ± 48.6	185.5 ± 90.8
minus LCPED30 (n=3)	Mean ± SEM	1.65 ± 0.41	1.37 ± 0.13	2.23 ± 0.55	0.63 ± 0.21	61.6 ± 8.6	52.3 ± 9.4	56.6 ± 32.2	42.2 ± 8.1	98.8 ± 38.1
Nahuelbuta										
NAPED10	_GFTE1001Q_	1.35 ± 0.27	1.05 ± 0.14	1.41 ± 0.25	0.89 ± 0.24	65.8 ± 16.3	57.7 ± 3.5	22.5 ± 4.2	55.1 ± 3.5	77.6 ± 16.5
NAPED20	_GFTE1000C_	0.54 ± 0.17	2.22 ± 1.03	1.19 ± 0.49	-5.49 ± 2.87	86.5 ± 20.2	51.5 ± 3.3	4.4 ± 15.5	23.2 ± 13.7	27.6 ± 9.2
NAPED30	_GFTE1001R_	1.09 ± 0.18	1.59 ± 0.29	1.73 ± 0.43	0.19 ± 0.06	79.2 ± 25.8	68.6 ± 4.2	31.3 ± 5.1	43.2 ± 6.5	74.5 ± 13.3
NAPED40	_GFTE1000D_	1.29 ± 0.31	0.96 ± 0.24	1.25 ± 0.30	1.15 ± 0.39	73.5 ± 16.4	19.3 ± 1.2	4.9 ± 1.4	20.0 ± 1.2	25.0 ± 6.2
Site average (n=4)	Mean ± SEM	1.06 ± 0.19	1.45 ± 0.29	1.39 ± 0.12	-0.82 ± 1.57	76.2 ± 4.4	49.3 ± 10.6	15.8 ± 6.7	35.4 ± 8.3	51.2 ± 14.4
minus NAPED20 (n=3)	Mean ± SEM	1.24 ± 0.08	1.20 ± 0.20	1.46 ± 0.14	0.74 ± 0.29	72.8 ± 3.9	48.5 ± 14.9	19.6 ± 7.8	39.4 ± 10.3	59.0 ± 17.0

SEM = Standard error of the mean

Table S5:

Table S5: Chemical weathering rates and chemical depletion fraction in Chilean soil and saprolite

Pedon	IGSN	Chemical weathering rate	Wsap	Wsoil	Total	CDFtotal	CDFsap	CDFsoil
		Total in oxides			denudation rate			
		t/(km^2 yr)	t/(km^2 yr)	t/(km2 yr)	t/(km^2 yr)			
Pan de Azucar								
AZPED60	*GFTE1001G*	1.74 ± 0.77	-0.61 ± 0.11	2.35 ± 0.76	7.10 ± 1.26	0.24 ± 0.12	-0.09 ± 0.02	0.33 ± 0.12
AZPED50	*GFTE10006*	1.00 ± 0.10	0.61 ± 0.05	0.38 ± 0.08	11.6 ± 1.0	0.09 ± 0.01	0.05 ± 0.01	0.03 ± 0.01
AZPED40	*GFTE1001H*	-0.44 ± 0.17	0.7 ± 0.1	-1.14 ± 0.16	17.5 ± 1.6	-0.03 ± 0.01	0.04 ± 0.01	-0.07 ± 0.01
AZPED21	*GFTE10007*	-0.93 ± 0.08	-0.30 ± 0.03	-0.63 ± 0.08	7.86 ± 0.83	-0.12 ± 0.02	-0.04 ± 0.01	-0.08 ± 0.01
Site average	Mean ± SEM	0.34 ± 0.62	0.10 ± 0.33	0.24 ± 0.77	11.01 ± 2.37	0.05 ± 0.08	-0.01 ± 0.03	0.05 ± 0.10
Santa Gracia								
SGPED10	*GFTE1001J*							
SGPED20	*GFTE1001K*	19.60 ± 13.32	20.82 ± 13.32	-1.22 ± 0.20	37.92 ± 24.27	0.52 ± 0.48	0.55 ± 0.50	-0.03 ± 0.02
SGPED30	GFTE1001S	23.68 ± 12.44	19.34 ± 12.42	4.34 ± 0.61	42.51 ± 27.30	0.56 ± 0.46	0.45 ± 0.41	0.10 ± 0.07
SGPED40	*GFTE10008*	16.93 ± 6.44	9.43 ± 6.25	7.50 ± 1.56	31.83 ± 21.10	0.53 ± 0.41	0.30 ± 0.28	0.24 ± 0.16
SGPED50	*GFTE1001L*	24.76 ± 14.38	22.29 ± 14.38	2.48 ± 0.44	49.68 ± 32.05	0.50 ± 0.43	0.45 ± 0.41	0.05 ± 0.03
SGPED60	*GFTE1001M*	30.35 ± 16.04	25.07 ± 16.03	5.28 ± 0.60	53.06 ± 33.93	0.57 ± 0.47	0.47 ± 0.43	0.10 ± 0.06
SGPED70	*GFTE10009*	10.28 ± 5.07	7.90 ± 5.05	2.38 ± 0.41	22.78 ± 14.56	0.45 ± 0.36	0.35 ± 0.31	0.10 ± 0.07
Site average	Mean ± SEM	20.93 ± 2.84	17.47 ± 2.90	3.46 ± 1.22	39.63 ± 4.61	0.52 ± 0.02	0.43 ± 0.04	0.09 ± 0.04
La Campana								
LCPED10	*GFTE1001N*	20.23 ± 2.63	4.36 ± 0.81	15.88 ± 2.50	46.47 ± 8.66	0.44 ± 0.10	0.09 ± 0.02	0.34 ± 0.08
LCPED20	*GFTE1000A*	28.62 ± 4.14	21.90 ± 4.02	6.72 ± 0.96	77.02 ± 14.13	0.37 ± 0.09	0.28 ± 0.07	0.09 ± 0.02
LCPED30	*GFTE1001P*	210.45 ± 34.25	155.19 ± 32.63	55.26 ± 10.41	445.66 ± 93.69	0.47 ± 0.13	0.35 ± 0.10	0.12 ± 0.04
LCPED40	*GFTE1000B*	120.83 ± 16.99	99.41 ± 16.68	18.91 ± 3.21	172.88 ± 28.30	0.70 ± 0.15	0.58 ± 0.13	0.11 ± 0.03
Site average (n=4)	Mean ± SEM	95.03 ± 44.71	70.22 ± 35.05	24.19 ± 10.68	185.51 ± 90.80	0.49 ± 0.07	0.33 ± 0.10	0.17 ± 0.06
minus LCPED30 (n=3)	Mean ± SEM	56.56 ± 32.22	41.89 ± 29.20	13.83 ± 3.66	98.79 ± 38.08	0.50 ± 0.10	0.32 ± 0.14	0.18 ± 0.08
Nahuelbuta								
NAPED10	*GFTE1001Q*	22.50 ± 22.50	19.92 ± 4.22	2.58 ± 0.37	77.57 ± 16.45	0.29 ± 0.30	0.26 ± 0.08	0.03 ± 0.01
NAPED20	*GFTE1000C*	4.36 ± 15.52	-23.94 ± 7.95	28.29 ± 13.32	27.60 ± 9.17	0.16 ± 0.56	-0.87 ± 0.41	1.03 ± 0.59
NAPED30	*GFTE1001R*	31.30 ± 5.08	5.85 ± 1.04	25.44 ± 4.97	74.45 ± 13.27	0.42 ± 0.10	0.08 ± 0.02	0.34 ± 0.09
NAPED40	*GFTE1000D*	4.93 ± 1.42	5.65 ± 1.41	-0.72 ± 0.18	24.96 ± 6.22	0.20 ± 0.08	0.23 ± 0.08	-0.03 ± 0.01
Site average (n=4)	Mean ± SEM	15.77 ± 6.67	1.87 ± 9.23	13.90 ± 7.54	51.15 ± 14.38	0.27 ± 0.06	-0.08 ± 0.27	0.34 ± 0.24
minus NAPED20 (n=3)	Mean ± SEM	19.57 ± 7.75	10.47 ± 4.72	9.10 ± 8.23	59.00 ± 17.04	0.30 ± 0.06	0.19 ± 0.05	0.12 ± 0.11

SEM = Standard error of the mean

Table S6:

Table S6: Compilation of published soil production rates from granitic soil-mantled hillslopes and topographic, climate, and vegetation parameters

Reference	Sample ID	Sample type	Latitude	Longitude	Altitude	Soil depth	Slope	Soil production rate				MAP	MAT	PD MAP	PD MAT	PI MAP	PI MAT	MH MAP	MH MAT	LGM MAP	LGM MAT	Veg. cover	Leaf area index	Solar irradiation	Evapotranspiration	Net primary productivity	Rooting depth		Soil thickness	Regolith thickness	Local slope	Frost cracking window		
						Literature	Literature	Literature		Literature/calculated		Karger et al., 2017						Mutz et al., 2018				Broxton et al., 2014	NEO	Kato et al., 2018	Zhang et al., 2010	Running and Zhao, 2015	Schenk and Jackson, 2009		Pelletier et al., 2016		DEM GTOPO30	Sharma, 2018		
																											D50	D95				FCW PI	FCW MH	FCW LGM
			N	E	m	cm	°	m/Myr	m/Myr	t/(km² yr)	t/(km² yr)	mm/yr	°C	mm/yr	°C	mm/yr	°C	mm/yr	°C	mm/yr	°C	%	m²/m²	(kJ/m²)/day	kg/m²/day	gC/m²/day	m	m	cm	m	°	day/yr	day/yr	day/yr
This study	AZPED60	saprolite	-26.1101	-70.5492	343	22	5			7.7	0.5	8	20.1	50	19.9	53	18.9	68	19.3	289	16.4	2	0.00	134	185.71	0	0.20	1.20	34	38	3.5	0.0	0.0	0.0
	AZPED50	saprolite	-26.1103	-70.5492	333	20	40			11.0	0.7	8	20.1	50	19.9	53	18.9	68	19.3	289	16.4	2	0.00	134	185.71	0	0.20	1.20	34	38	3.5	0.0	0.0	0.0
	AZPED40	saprolite	-26.1102	-70.5492	326	25	33			16.8	1.0	8	20.1	50	19.9	53	18.9	68	19.3	289	16.4	2	0.00	134	185.71	0	0.20	1.20	34	38	3.5	0.0	0.0	0.0
	AZPED21	saprolite	-26.1094	-70.5491	342	20	25			8.2	0.5	8	20.1	50	19.9	53	18.9	68	19.3	289	16.4	2	0.00	134	185.71	0	0.20	1.20	34	38	3.5	0.0	0.0	0.0
	SGPED10	saprolite	-29.7563	-71.1663	727	5	2			17.8	1.3	97	17.7	564	15.3	574	14.6	610	14.8	1119	13.0	31	0.52	129	520.40	2623	0.20	1.40	49	44	2.3	0.0	0.0	0.0
	SGPED20	saprolite	-29.7564	-71.1672	718	30	2			17.1	1.0	97	17.0	564	15.3	574	14.6	610	14.8	1119	13.0	31	0.52	129	520.40	2626	0.20	1.40	39	50	7.3	0.0	0.0	0.0
	SGPED30	saprolite	-29.7570	-71.1665	705	35	25			23.2	1.4	97	17.7	564	15.3	574	14.6	610	14.8	1119	13.0	31	0.52	129	520.40	2623	0.20	1.40	49	44	2.3	0.0	0.0	0.0
	SGPED40	saprolite	-29.7574	-71.1664	682	50	25			22.4	1.4	97	17.7	564	15.3	574	14.6	610	14.8	1119	13.0	31	0.52	129	520.40	2623	0.20	1.40	49	44	2.3	0.0	0.0	0.0
	SGPED50	saprolite	-29.7579	-71.1662	652	40	25			27.4	1.6	97	17.7	564	15.3	574	14.6	610	14.8	1119	13.0	31	0.52	129	520.40	2623	0.20	1.40	49	44	2.3	0.0	0.0	0.0
	SGPED60	saprolite	-29.7583	-71.1662	638	55	20			28.0	1.7	97	17.7	564	15.3	574	14.6	610	14.8	1119	13.0	31	0.52	129	520.40	2623	0.20	1.40	49	44	2.3	0.0	0.0	0.0
	SGPED70	saprolite	-29.7612	-71.1656	690	35	15			14.9	0.9	97	17.4	564	15.3	574	14.6	610	14.8	1119	13.0	31	0.52	129	520.40	2669	0.20	1.40	43	50	4.2	0.0	0.0	0.0
	LCPED10	saprolite	-32.9558	-71.0633	734	45	7			42.1	2.6	307	14.1	1199	14.3	1238	13.7	1346	13.8	1587	12.9	84	1.84	133	810.10	10850	0.20	1.40	81	14	5.2	0.0	0.0	0.0
	LCPED20	saprolite	-32.9559	-71.0636	718	60	23			55.1	3.5	307	14.1	1199	14.3	1238	13.7	1346	13.8	1587	12.9	84	1.84	133	810.10	10850	0.20	1.40	81	14	5.2	0.0	0.0	0.0
	LCPED30	saprolite	-32.9562	-71.0638	708	55	35			290.5	24.0	307	14.1	1199	14.3	1238	13.7	1346	13.8	1587	12.9	84	1.84	133	810.10	10850	0.20	1.40	81	14	5.2	0.0	0.0	0.0
	LCPED40	saprolite	-32.9572	-71.0643	724	35	12			71.0	4.7	307	14.1	1199	14.3	1238	13.7	1346	13.8	1587	12.9	84	1.84	133	810.10	10850	0.20	1.40	81	14	5.2	0.0	0.0	0.0
	NAPED10	saprolite	-37.8074	-73.0129	1248	5	5			57.7	3.5	1479	6.1	2170	12.8	2168	12.2	2491	12.4	2985	12.5	95	3.16	133	678.40	25538	0.30	2.40	62	12	2.5	0.0	0.0	0.0
	NAPED20	saprolite	-37.8077	-73.0136	1239	70	15			51.5	3.3	1479	6.1	2170	12.8	2168	12.2	2491	12.4	2985	12.5	95	3.16	133	678.40	26147	0.30	2.40	62	12	2.5	0.0	0.0	0.0
	NAPED30	saprolite	-37.8084	-73.0135	1228	90	20			68.6	4.2	1479	6.1	2170	12.8	2168	12.2	2491	12.4	2985	12.5	95	3.16	133	678.40	26147	0.30	2.40	70	15	1.7	0.0	0.0	0.0
	NAPED40	saprolite	-37.8090	-73.0138	1200	60	13			19.3	1.2	1475	6.1	2170	12.8	2168	12.2	2491	12.4	2985	12.5	95	3.16	133	678.40	26147	0.30	2.40	70	15	1.7	0.0	0.0	0.0
Owen et al., 2011		saprolite	-24.1300	-69.9900	1170	4	22	1.0	0.1	1.5	0.1	7	19.0	9	17.3	8	16.2	5	16.5	79	15.7	2	0.00	138	160.30	65533	0.20	1.50	21	50	4.8	0.0	0.0	0.0
		saprolite	-24.1300	-69.9900	1170	5	19	0.8	0.0	1.3	0.0	7	19.0	9	17.3	8	16.2	5	16.5	79	15.7	2	0.00	138	160.30	0	0.20	1.50	21	50	4.8	0.0	0.0	0.0
		saprolite	-24.1300	-69.9900	1170	22	26	0.9	0.0	1.5	0.1	7	19.0	9	17.3	8	16.2	5	16.5	79	15.7	2	0.00	138	160.30	0	0.20	1.50	21	50	4.8	0.0	0.0	0.0
		saprolite	-24.1300	-69.9900	1170	8	32	0.9	0.1	1.5	0.1	7	19.0	9	17.3	8	16.2	5	16.5	79	15.7	2	0.00	138	160.30	0	0.20	1.50	21	50	4.8	0.0	0.0	0.0
		saprolite	-24.1300	-69.9900	1170	6	33	1.2	0.1	1.9	0.2	7	19.0	9	17.3	8	16.2	5	16.5	79	15.7	2	0.00	138	160.30	0	0.20	1.50	21	50	4.8	0.0	0.0	0.0
		saprolite	-26.2800	-70.4900	687	2	12	2.9	0.2	4.6	0.3	11	18.8	50	19.9	53	18.9	68	19.3	289	16.4	2	0.00	134	185.77	0	0.20	1.20	62	50	3.4	0.0	0.0	0.0
		saprolite	-26.2800	-70.4900	687	2	22	3.0	0.2	4.8	0.3	11	18.8	50	19.9	53	18.9	68	19.3	289	16.4	2	0.00	134	185.77	0	0.20	1.20	62	50	3.4	0.0	0.0	0.0
		saprolite	-26.2800	-70.4900	687	2	27	3.0	0.2	4.8	0.3	11	18.8	50	19.9	53	18.9	68	19.3	289	16.4	2	0.00	134	185.77	0	0.20	1.20	62	50	3.4	0.0	0.0	0.0
		saprolite	-26.2800	-70.4900	687	4	27	2.5	0.1	4.0	0.2	11	18.8	50	19.9	53	18.9	68	19.3	289	16.4	2	0.00	134	185.77	0	0.20	1.20	62	50	3.4	0.0	0.0	0.0
		saprolite	-26.2800	-70.4900	687	2	34	2.4	0.2	3.8	0.3	11	18.8	50	19.9	53	18.9	68	19.3	289	16.4	2	0.00	134	185.77	0	0.20	1.20	62	50	3.4	0.0	0.0	0.0
		saprolite	-29.7700	-71.0800	377	7	16	20.0	1.7	32.0	2.7	69	19.5	564	15.3	574	14.6	610	14.8	1119	13.0	24	0.52	129	534.47	2521	0.20	1.40	46	11	2.9	0.0	0.0	0.0
		saprolite	-29.7700	-71.0800	377	9	20	33.0	2.3	52.8	3.7	69	19.5	564	15.3	574	14.6	610	14.8	1119	13.0	24	0.52	129	534.47	2521	0.20	1.40	46	11	2.9	0.0	0.0	0.0

Table S7:

Table S7: Published soil production rates from non-granitic soil-mantled hillslopes and parameters													
Reference	Sample ID	Sample type	Latitude	Longitude	Altitude	Soil depth	Slope	Soil production rate		MAP	MAT	Veg. cover	Leaf area index
										Karger et al., 2017		Broxton et al., 2014	NEO
			N	E	m	cm	°	t/(km^2 yr)	t/(km^2 yr)	mm/yr	°C	%	m^2/m^2
Larsen et al., 2014	Karangarua 1	saprolite	-43.64850	169.84660	1030	40	24	830	70	4557	7.4	96	2.14
highly fractured schist	Karangarua 2	saprolite	-43.64930	169.84990	1082	21	28	430	30	4851	6.3	96	2.14
	Karangarua 3	saprolite	-43.64860	169.85210	1112	15	37	310	20	3605	0.5	0	2.14
	Karangarua 4	saprolite	-43.64800	169.84580	959	21	29	1030	80	4557	7.4	96	2.14
	Karangarua 5	saprolite	-43.64790	169.84580	961	10	44	830	60	4557	7.4	96	2.14
	Fox 1	saprolite	-43.49430	169.99840	932	32	25	610	40	5381	7.4	97	2.14
	Fox 2	saprolite	-43.49440	169.99880	942	20	27	310	20	5381	7.4	97	2.14
	Alex Knob 2	saprolite	-43.41680	170.15740	846	41	36	430	30	4772	8.3	98	2.48
	Alex Knob 3	saprolite	-43.41990	170.15340	947	15	35	500	40	4829	6.9	98	2.48
	Alex Knob 4	saprolite	-43.41690	170.15770	836	31	29	410	30	4829	6.9	98	2.48
	Alex Knob 4	saprolite	-43.41690	170.15770	836	31	29	380	30	4829	6.9	98	2.48
	Alex Knob 4	saprolite	-43.41690	170.15770	836	31	29	50.0	20	4829	6.9	98	2.48
	Gunn 1	saprolite	-43.40400	170.40460	866	254	25	1410	110	2322	8.0	93	1.96
	Gunn 2	saprolite	-43.40470	170.40500	832	25	32	980	80	2322	8.0	93	1.96
	Gunn 3	saprolite	-43.40440	170.40480	856	29	40	1000	80	2322	8.0	93	1.96
	Gunn 4	saprolite	-43.40270	170.40270	953	39	26	520	40	2322	8.0	93	1.96
	Gunn 5	saprolite	-43.40340	170.40370	910	30	25	690	60	2322	8.0	93	1.96
	Gunn 6	saprolite	-43.40460	170.40480	838	27	31	1000	80	2322	8.0	93	1.96
	Gunn 7	saprolite	-43.40500	170.41020	555	34	31	700	50	2204	9.9	93	1.96
	Rappid Creek 1	saprolite	-43.02940	171.01750	966	40	35	1020	80	2903	7.8	97	3.52
	Rappid Creek 2	saprolite	-43.02820	171.01730	897	30	44	1930	160	2903	7.8	97	3.52
	Rappid Creek 3	saprolite	-43.02670	171.01700	856	16	0	2600	200	2903	7.8	97	3.52
	Rappid Creek 4	saprolite	-43.02890	171.01750	946	12	50	6390	1110	2903	7.8	97	3.52
	Rappid Creek 5	saprolite	-43.02730	171.01730	832	15	28	2910	240	2903	7.8	97	3.52
Bestland et al., 2016			-35.0833	138.7	405		1	19.8	1.7	943	13.8	88	2.50
Australia, Lofty Ranges			-35.0833	138.6833	396		1	32.8	2.6	835	14.3	90	2.50
Meta-shales, sandstone-quartzite			-35.0833	138.7	381		9	6.6	0.6	943	13.8	88	2.50
			-35.0833	138.6833	300		0	6.8	0.6	835	14.3	90	2.50
			-35.0833	138.6833	331		0	15.8	1.3	835	14.3	90	2.50
Heimsath et al., 1997			37.9000	-122.6000	135	0	8	62.4	12.8	934	12.9	97	1.26
California, Tennesse Valley			37.9000	-122.6000	120	15	10	75.2	24.0	934	12.9	97	1.26
Greenstone, greywacke sandstone, chert			37.9000	-122.6000	275	0	15	32.0	8.0	934	12.9	97	1.26
			37.9000	-122.6000	275	0	0	24.0	6.4	934	12.9	97	1.26
			37.9000	-122.6000	105	35	15	41.6	4.8	934	12.9	97	1.26
			37.9000	-122.6000	100	58	20	33.6	4.8	934	12.9	97	1.26
			37.9000	-122.6000	115	51	17	38.4	6.4	934	12.9	97	1.26
			37.9000	-122.6000	120	0	21	171.2	36.8	934	12.9	97	1.26
			37.9000	-122.6000	116	30	15	96.0	25.6	934	12.9	97	1.26
			37.9000	-122.6000	140	49	18	41.6	8.0	934	12.9	97	1.26
			37.9000	-122.6000	135	20	15	76.8	12.8	934	12.9	97	1.26
			37.9000	-122.6000	133	35	20	52.8	8.0	934	12.9	97	1.26
			37.9000	-122.6000	133	60	25	43.2	8.0	934	12.9	97	1.26
			37.9000	-122.6000	137	0	15	145.6	38.4	934	12.9	97	1.26

Table S8:

Table S8: Correlation R of soil production rate with selected location parameterrs

		Unit	SPR	Altitude	CMAP	CMAT	VegCov	LAI	Solar	ET	NPP	D50	D95	LocSlope	FCWPI	FCWLG
Soil prduction rate	SPR	t/(km2 yr)	1.00	0.34	-0.16	-0.33	0.00	-0.03	-0.27	-0.07	-0.12	-0.15	-0.19	0.37	0.15	0.10
Altitude	Altitude	m	0.34	1.00	0.11	-0.72	-0.15	0.14	-0.22	0.00	-0.16	0.05	-0.05	0.60	0.39	0.41
Mean annual precipitation	CMAP	mm/yr	-0.16	0.11	1.00	-0.06	0.53	0.64	0.40	0.63	-0.02	0.37	0.44	0.11	0.18	0.06
Mean annual temperature	CMAT	°C	-0.33	-0.72	-0.06	1.00	-0.11	-0.28	0.69	0.21	0.22	0.31	0.43	-0.57	-0.61	-0.68
Vegetation cover	VegCov	%	0.00	-0.15	0.53	-0.11	1.00	0.62	-0.03	0.51	-0.30	0.07	0.07	0.01	0.05	0.14
Leaf area index	LAI	m^2/m^2	-0.03	0.14	0.64	-0.28	0.62	1.00	0.01	0.53	-0.09	0.07	0.04	0.12	0.27	0.26
Solar irraditaion	Solar	$(kJ/m^2)/day$	-0.27	-0.22	0.40	0.69	-0.03	0.01	1.00	0.59	0.27	0.66	0.76	-0.36	-0.50	-0.50
Evapotranspiration	ET	$kg/m^2/day$	-0.07	0.00	0.63	0.21	0.51	0.53	0.59	1.00	-0.05	0.28	0.41	-0.12	-0.39	-0.32
Net primary productivity	NPP	$gC/m^2/day$	-0.12	-0.16	-0.02	0.22	-0.30	-0.09	0.27	-0.05	1.00	0.03	0.15	-0.07	-0.31	-0.28
50% rooting depth	D50	m	-0.15	0.05	0.37	0.31	0.07	0.07	0.66	0.28	0.03	1.00	0.93	-0.09	-0.17	-0.05
95% rooting depth	D95	m	-0.19	-0.05	0.44	0.43	0.07	0.04	0.76	0.41	0.15	0.93	1.00	-0.13	-0.36	-0.23
Local slope	LocSlope	°	0.37	0.60	0.11	-0.57	0.01	0.12	-0.36	-0.12	-0.07	-0.09	-0.13	1.00	0.47	0.37
Frost-crackoing window (pre-industrial)	FCWPI	days/yr	0.15	0.39	0.18	-0.61	0.05	0.27	-0.50	-0.39	-0.31	-0.17	-0.36	0.47	1.00	0.75
Frost-crackoing window (LGM)	FCWLGM	days/yr	0.10	0.41	0.06	-0.68	0.14	0.26	-0.50	-0.32	-0.28	-0.05	-0.23	0.37	0.75	1.00

$p > 0.05$

R^2 0 to 0.3, $p < 0.05$

R^2 0.3 to 0.5, $p < 0.05$

R^2 0.5 to 0.7, $p < 0.05$

R^2 0.7 to 1.0, $p < 0.05$

Table S9:

Table S9: Compilation of published chemical weathering, physical eroaion, and denudation rates from granitic soil-mantled hillslopes and some climate and vegetation parameters

Reference	Sample	Sample type	Latitude	Longitude	Altitude	Soil depth	Slope	Chemical weathering		Physical erosion		Total denudation		Chemical weathering		Physical erosion		Total denudation		CDFtotal		CDF CEF corrected		MAP	MAT	Veg. cover	LAI	ET	FCI PI
																								Karger et al., 2017		Broxton et al., 2014	MODIS	MODIS	Sharma, 2018
			N	E	m	cm		m/Myr	m/Myr	m/Myr	m/Myr	m/Myr	m/Myr	t km-2 yr-1	t km-2 yr-1	t km-2 yr-1	t km-2 yr-1	t km-2 yr-1	t km-2 yr-1					mm/yr	C	%	m^2/m^2	kg/m2/day	day/yr
This study	AZPED60	saprolite	-26.11012	-70.54922	343	22	5							1.7	0.8	5.4	0.9	7.1	1.3	0.24	0.12			8	20.1	2	0.00	186	0
	AZPED50	saprolite	-26.11027	-70.54922	333	20	40							1.0	0.1	10.6	0.7	11.6	1.0	0.09	0.01			8	20.1	2	0.00	186	0
	AZPED40	saprolite	-26.11024	-70.54921	326	25	33							-0.4	0.2	17.9	1.0	17.5	1.6	-0.03	0.01			8	20.1	2	0.00	186	0
	AZPED21	saprolite	-26.10936	-70.54907	342	20	25							-0.9	0.1	8.8	0.5	7.9	0.8	-0.12	0.02			8	20.1	2	0.00	186	0
	SGPED20	saprolite	-29.75636	-71.16721	718	30	2							19.6	13.3	18.3	1.0	37.9	24.3	0.52	0.48			97	17.7	31	0.52	520	0
	SGPED30	saprolite	-29.75702	-71.16650	705	35	25							23.7	12.4	18.8	1.5	42.5	27.3	0.56	0.46			97	17.7	31	0.52	520	0
	SGPED40	saprolite	-29.75738	-71.16635	682	50	25							16.9	6.4	14.9	2.1	31.8	21.1	0.53	0.41			97	17.7	31	0.52	520	0
	SGPED50	saprolite	-29.75794	-71.16618	652	40	25							24.8	14.4	24.9	1.7	49.7	32.1	0.50	0.43			97	17.7	31	0.52	520	0
	SGPED60	saprolite	-29.75826	-71.16615	638	55	20							30.4	16.0	22.7	1.8	53.1	33.9	0.57	0.47			97	17.7	31	0.52	520	0
	SGPED70	saprolite	-29.76120	-71.16559	690	35	15							11.0	5.4	13.3	1.0	24.3	15.5	0.45	0.36			97	17.7	31	0.52	520	0
	LCPED10	saprolite	-32.95581	-71.06332	734	45	7							20.2	2.6	26.2	3.6	46.5	8.7	0.44	0.10			307	14.1	84	1.84	810	0
	LCPED20	saprolite	-32.95588	-71.06355	718	60	23							28.6	4.1	48.4	3.6	77.0	14.1	0.37	0.09			307	14.1	84	1.84	810	0
	LCPED30	saprolite	-32.95615	-71.06380	708	55	35							210.5	34.3	235.2	26.1	445.7	93.7	0.47	0.13			307	14.1	84	1.84	810	0
	LCPED40	saprolite	-32.95720	-71.06425	724	35	12							120.8	17.0	52.1	5.7	172.8	28.3	0.70	0.15			307	14.1	84	1.84	810	0
	NAPED10	saprolite	-37.80735	-73.01285	1248	70	5							22.5	4.2	55.1	3.5	77.6	16.5	0.29	0.30			1479	6.1	95	3.16	678	0
	NAPED20	saprolite	-37.80770	-73.01357	1239	70	15							4.4	15.5	23.2	13.7	27.6	9.2	0.16	0.56			1479	6.1	95	3.16	678	0
	NAPED30	saprolite	-37.80838	-73.01345	1228	90	20							31.3	5.1	43.2	6.5	74.5	13.3	0.42	0.10			1479	6.1	95	3.16	678	0
	NAPED40	saprolite	-37.80904	-73.01380	1200	60	13							4.9	1.4	20.0	±	25.0	6.2	0.20	0.08			1479	6.1	95	3.16	678	0
Riebe et al. 2004	ST-1	bedrock	20.3500	-105.5000	750		0							166	42	390	62.0	556.0	71.0	0.30	0.08	0.45	0.09	1028	24.7	98	4.11	1023	0
	ST-4	bedrock	20.3500	-105.5000	750		0							158	69	464	86.0	622.0	72.0	0.25	0.11	0.42	0.11	1028	24.7	98	4.11	1023	0
	SR-1	saprolite	41.3333	-117.6333	2377		0							7	3	99	11.0	106.0	11.0	0.07	0.03			230	10.7	40	0.70	293	352
	SR-3	saprolite	41.3333	-117.6333	2580		27							9	3	132	14.0	132.0	14.0	0.07	0.02			230	10.7	40	0.70	293	352
	SR-4	saprolite	41.3333	-117.6333	2350		26							15	4	129	14.0	144.0	15.0	0.10	0.03			230	10.7	40	0.70	293	352
	SR-6	saprolite	41.3333	-117.6333	2180		0							16	4	87	10.0	104.0	11.0	0.15	0.04			230	10.7	40	0.70	293	352
	SR-7	saprolite	41.3333	-117.6333	2086		0							24	7	83	12.0	112.0	12.0	0.21	0.07			230	10.7	40	0.70	293	352
	SR-10	saprolite	41.3333	-117.6333	2749		29							-2	6	119	13.0	117.0	12.0	-0.02	-0.05			230	10.7	40	0.70	293	352
Burke et al., 2007	6	saprolite	38.0800	-122.8800		15		35		24		59		42		28.8		70.8		0.59				1167	13.2	97	1.26	728	0
	20	saprolite	38.0800	-122.8800		15		44		15		59		53		18		70.8		0.75				1167	13.2	97	1.26	728	0
	9	saprolite	38.0800	-122.8800		29		13		45		58		16		54		69.6		0.22				1167	13.2	97	1.26	728	0
	7	saprolite	38.0800	-122.8800		40		31		19		50		37		22.8		60.0		0.62				1167	13.2	97	1.26	728	0
	17	saprolite	38.0800	-122.8800		40		6		44		50		7		52.8		60.0		0.12				1167	13.2	97	1.26	728	0
	19	saprolite	38.0800	-122.8800		40		17		33		50		20		39.6		60.0		0.34				1167	13.2	97	1.26	728	0
	5	saprolite	38.0800	-122.8800		48		27		23		50		32		27.6		60.0		0.54				1167	13.2	97	1.26	728	0
	16	saprolite	38.0800	-122.8800		55		5		31		36		6		37.2		43.2		0.14				1167	13.2	97	1.26	728	0
	8	saprolite	38.0800	-122.8800		60		4		32		36		5		38.4		43.2		0.11				1167	13.2	97	1.26	728	0
	15	saprolite	38.0800	-122.8800		70		2		16		18		2		19.2		21.6		0.11				1167	13.2	97	1.26	728	0
	25	saprolite	38.0800	-122.8800		70		4		14		18		5		16.8		21.6		0.22				1167	13.2	97	1.26	728	0
	26	saprolite	38.0800	-122.8800		70		4		14		18		5		16.8		21.6		0.22				1167	13.2	97	1.26	728	0
	14	saprolite	38.0800	-122.8800		75		1		17		18		1		20.4		21.6		0.06				1167	13.2	97	1.26	728	0
	10	saprolite	38.0800	-122.8800		80		7		21		28		8		25.2		33.6		0.25				1167	13.2	97	1.26	728	0
	1	bedrock	38.0800	-122.8800		90		1		13		14		1		15.6		16.8		0.07				1167	13.2	97	1.26	728	0
	24	saprolite	38.0800	-122.8800		100		1		10		11		1		12		13.2		0.09				1167	13.2	97	1.26	728	0
	12	saprolite	38.0800	-122.8800		120		1		10		11		1		12		13.2		0.09				1167	13.2	97	1.26	728	0
	21	saprolite	38.0800	-122.8800		120		1		10		11		1		12		13.2		0.09				1167	13.2	97	1.26	728	0
Burke et al., 2009	FH1	saprolite	-36.0000	149.0000		52	2	3.9	1.2	14.8	1.6	18.7	1.0	5	1.44	17.76	1.9	22.4	1.2	0.21	0.07			769	9.5	94	1.03	963	0
	FH2	saprolite	-36.0000	149.0000		50	14	11.7	0.6	7.8	1.2	19.5	1.0	14	0.72	9.36	1.4	23.4	1.2	0.60	0.04			769	9.5	94	1.03	963	0
	FH3	saprolite	-36.0000	149.0000		55	15	8.5	0.7	9.1	1.2	17.6	1.0	10	0.84	10.92	1.5	21.1	1.2	0.48	0.05			769	9.5	94	1.03	963	0
	FH4	saprolite	-36.0000	149.0000		65	18	7.3	0.5	7.1	1.1	14.4	1.0	9	0.6	8.52	1.3	17.3	1.2	0.51	0.05			769	9.5	94	1.03	963	0
	FH5	saprolite	-36.0000	149.0000		40	16	15.2	0.7	8.6	2.3	23.8	2.2	18	0.84	10.32	2.8	28.6	2.6	0.64	0.07			769	9.5	94	1.03	963	0
	FH6	saprolite	-36.0000	149.0000		104	12	3.5	0.2	3.1	1.0	6.6	1.0	4	0.24	3.72	1.2	7.9	1.2	0.53	0.09			769	9.5	94	1.03	963	0
	FH7	saprolite	-36.0000	149.0000		58	4	8.6	0.6	8	1.2	16.6	1.0	10	0.72	9.6	1.4	19.9	1.2	0.52	0.05			769	9.5	94	1.03	963	0
	FH8	saprolite	-36.0000	149.0000		65	8	6.9	0.6	7.5	1.2	14.4	1.0	8	0.72	9	1.4	17.3	1.2	0.48	0.05			769	9.5	94	1.03	963	0
	FH9	saprolite	-36.0000	149.0000		48	12	9.5	0.7	10.8	1.4	20.3	1.2	11	0.84	12.96	1.7	24.4	1.4	0.47	0.04			769	9.5	94	1.03	963	0
	FH10	saprolite	-36.0000	149.0000		55	17	0	0	17.6	1.0	17.6	1.0	0	0	21.12	1.2	21.1	1.2	0.00	0.00			769	9.5	94	1.03	963	0
	FH-B1	saprolite	-36.0000	149.0000		50	5	5	1.1	12.6	1.5	17.6	1.0	6	1.32	15.12	1.8	21.1	1.2	0.28	0.06			769	9.5	94	1.03	963	0
	FH-B2	saprolite	-36.0000	149.0000		30	12	11	1.41	11.4	4.7	22.4	4.5	13	1.692	13.68	5.7	26.9	5.4	0.49	0.12			769	9.5	94	1.03	963	0
	FH-B3	saprolite	-36.0000	149.0000		70	6	5	0.5	6.4	1.1	11.4	1.0	6	0.6	7.68	1.3	13.7	1.2	0.44	0.06			769	9.5	94	1.03	963	0
	FH-B4	saprolite	-36.0000	149.0000		70	8	7	0.4	4.4	1.1	11.4	1.0	8	0.48	5.28	1.3	13.7	1.2	0.61	0.06			769	9.5	94	1.03	963	0
	FH-B5	saprolite	-36.0000	149.0000		25	9	1	1.74	29.6	4.8	30.6	4.5	1	2.088	35.52	5.8	36.7	5.4	0.03	0.06			769	9.5	94	1.03	963	0
	FH-2MP	saprolite	-36.0000	149.0000		35	8	7.8	1.5	16.7	5.2	24.5	5.0	9	1.8	20.04	6.3	29.4	6.0	0.32	0.09			769	9.5	94	1.03	963	0
	NR0	saprolite	-36.6200	149.5000		65	9	7.6	0.5	6.8	3.0	14.4	3.0	9	0.6	8.16	3.6	17.3	3.6	0.53	0.12			676	14.8	100	3.19	897	0
	NR1	saprolite	-36.6200	149.5000		75	11	6.9	0.4	4.9	2.0	11.8	2.0	8	0.48	5.88	2.4	14.2	2.4	0.58	0.10			676	14.8	100	3.19	897	0
	NR2	saprolite	-36.6200	149.5000		72	16	7.2	0.2	5.4	2.0	12.6	2.0	9	0.24	6.48	2.4	15.1	2.4	0.57	0.09			676	14.8	100	3.19	897	0
	NR3	saprolite	-36.6200	149.5000		72	19	9.5	0.6	3.1	2.1	12.6	2.0	11	0.72	3.72	2.5	15.1	2.4	0.75	0.13			676	14.8	100	3.19	897	0
	NR4	saprolite	-36.6200	149.5000		49	11	12	1	7.9	4.1	19.9	4.0	14	1.2	9.48	4.9	23.9	4.8	0.60	0.13			676	14.8	100	3.19	897	0
	NR5	saprolite	-36.6200	149.5000		30	13	15.6	0.5	13.5	5.0	29.1	5.0	19	0.6	16.2	6.0	34.9	6.0	0.54	0.09			676	14.8	100	3.19	897	0
	NR6	saprolite	-36.6200	149.5000		58	16	9.7	0.4	6.9	2.0	16.6	2.0	12	0.48	8.28	2.4	19.9	2.4	0.58	0.07			676	14.8	100	3.19	897	0
	NR7	saprolite	-36.6200	149.5000		75	18	6.7	0.6	5.1	1.2	11.8	1.0	8	0.72	6.12	1.4	14.2	1.2	0.57	0.07			676	14.8	100	3.19	897	0
	NRA1	saprolite	-36.6200	149.5000		60	19	7.2	0.5	7	1.1	14.2	1.0	9	0.6	8.4	1.3	17.0	1.2	0.51	0.05			676	14.8	100	3.19	897	0
	NR2MP	saprolite	-36.6200	149.5000		50	11	11.2	0.6	6.4	2.1	17.6	2.0	13	0.72	7.68	2.5	21.1	2.4	0.64	0.08			847	15.4	100	3.79	852	0
	SN-B1	saprolite	-36.7800	149.7200		50	16	11.1	0.6	8.4	2.1	19.5	2.0	13	0.72	10.08	2.5	23.4	2.4	0.57	0.07			847	15.4	100	3.79	852	0
	SN-B1B	saprolite	-36.7800	149.7200		65	22	6.6	0.9	7.5	1.3	14.1	1.0	8	1.08	9	1.6	16.9	1.2	0.47	0.07			847	15.4	100	3.79	852	0
	SN-B3	saprolite	-36.7800	149.7200		40	29	12.2	0	11.6	2.0	23.8	2.0	15	0	13.92	2.4	28.6	2.4	0.51	0.04			847	15.4	100	3.79	852	0
	SN-B4	saprolite	-36.7800	149.7200		40	28	8.8	0.7	15	2.1	23.8	2.0	11	0.84	18	2.5	28.6	2.4	0.37	0.04			847	15.4	100	3.79	852	0
	SN-B5	saprolite	-36.7800	149.7200		55	33	8.8	0.3	8.8	1.0	17.6	1.0	11	0.36	10.56	1.3	21.1	1.2	0.50	0.03			847	15.4	100	3.79	852	0
	SN-B6	saprolite	-36.7800	149.7200		60	24	11.8	0.4	4.2	1.1	16.0	1.0	14	0.48	5.04	1.3	19.2	1.2	0.74	0.05			847	15.4	100	3.79	852	0
	H2B1	saprolite	-36.7800	149.7200		70	26	3.5	0.4	3.7	1.1	7.2	1.0	4	0.48	4.44	1.3	8.6	1.2	0.49	0.09			847	15.4	100	3.79	852	0
	H2B2	saprolite	-36.7800	149.7200		60	21	6.5	0.6	9.5	1.2	16.0	1.0	8	0.72	11.4	1.4	19.2	1.2	0.41	0.05			847	15.4	100	3.79	852	0
Dixon et al., 2009	LD0	saprolite	36.9535	-119.6308	216	6								75.4		66.2		141.5		0.53				417	18.9	97	0.86	433	0
	LD1	saprolite	36.9535	-119.6308	216	25								104.8		126.4		231.2		0.45				417	18.9	97	0.86	433	0
	LD2	saprolite	36.9535	-119.6308	216	27								58.7		80.5		139.3		0.42				417	18.9	97	0.86	433	0
	LD3	saprolite	36.9535	-119.6308	216	40								38.6		34.3		73.0		0.53				417	18.9	97	0.86	433	0
	LD4	saprolite	36.9535	-119.6308	216	45								66.1		64.8		120.8		0.55				417	18.9	97	0.86	433	0
	LD5	saprolite	36.9535	-119.6308	216	53								42.4		37.1		79.5		0.53				417	18.9	97	0.86	433	0
	LD6	saprolite	36.9535	-119.6308	216	75								58.9		45.7		104.6		0.56				417	18.9	97	0.86	433	0
	WB0	saprolite	37.2823	-119.0875	2991	53								52.5		57.5		110.0		0.48				975	3.1	65	2.04	750	0
	WB1	saprolite	37.2823	-119.0875	2991	64								51.7		54.2		105.8		0.49				975	3.1	65	2.04	750	0
	WB2	saprolite	37.2823	-119.0875	2991	70								43.1		34.2		77.4		0.56				975	3.1	65	2.04	750	0
	WB3	saprolite	37.2823	-119.0875	2991	110								31.3		34.8		66.1		0.47				975	3.1	65	2.04	750	0
	WB4	saprolite	37.2823	-119.0875	2991	75								30.6		35.1		65.6		0.47				975	3.1	65	2.04	750	0
	WB5	saprolite	37.2823	-119.0875	2991	75								37.1		27.5		64.6		0.57				975	3.1	65	2.04	750	0
	WB6	saprolite	37.2823	-119.0875	2991	60								17.8		23.6		61.4		0.29				975	3.1	65	2.04	750	0
	WB7	saprolite	37.2823	-119.0875	2991	90								63.4		43.2		106.5		0.60				975	3.1	65	2.04	750	0
	WB8	saprolite	37.2823	-119.0875	2991	80								23.7		34.3		57.9		0.41				975	3.1	65	2.04	750	0
	BM1	saprolite	37.0390	-119.2548	1186	91								84		89.5		176.5		0.48				671	13.6	90	2.10	757	0
	BM2	saprolite	37.0390	-119.2548	1186	74								91.7		103.3		195.1		0.47				671	13.6	90	2.10	757	0
	BM3	saprolite	37.0390	-119.2548	1186	102								115.5		131.1		246.6		0.47				671	13.6	90	2.10	757	0
	BM4	saprolite	37.0390	-119.2548	1186	127								85.1		86.2		171.3		0.50				671	13.6	90	2.10	757	0
	PC1	saprolite	37.0652	-119.2055	1952	80								162.2		131		297.0		0.55				897	9.2	92	2.41	648	0
	PC2	saprolite	37.0652	-119.2055	1952	71								80.8		59.4		140.2		0.58				897	9.2	92	2.41	648	0
	PC20061	saprolite	37.0652	-119.2055	1952	61								124.1		82		206.1		0.60				897	9.2	92	2.41	648	0
	PC20062	saprolite	37.0652	-119.2055	1952	91								131.3		92.3		223.6		0.59				897	9.2	92	2.41	648	0
	PC20063	saprolite	37.0652	-119.2055	1952	107								172.6		122.7		295.4		0.58				897	9.2	92	2.41	648	0
	PC20064	saprolite	37.0652	-119.2055	1952	110								37.3		63.2		160.4		0.23				897	9.2	92	2.41	648	0
	KR20061	saprolite	37.2833	-119.1068	2681	25								22.1		52.1		79.4		0.28				957	4.2	76	2.04	750	0
Norton and von Blanckenburg, 2	WR	soil	46.4590	8.1590	2659		21							25	14	74	19.0	99.0	23.6	0.25	0.15			1450	-1.9	67	3.77	459	880
	HR	soil	46.4660	8.1760	2573		21							16	8	38	12.0	54.0	14.4	0.30	0.17			1293	-0.9	100	3.77	557	880
	BR	soil	46.4790	8.2070	2415		26							25	5	42	7.0	67.0	8.6	0.37	0.09			1269	-0.8	100	3.77	557	880
	MR	soil	46.5150	8.2530	2519		18							20	5	41	7.0	61.0	8.6	0.33	0.09			1342	-0.6	100	2.78	459	880
	OR	soil	46.5220	8.2870	2659		22							41	11	65	16.0	106.0	19.4	0.39	0.13			1352	0.8	100	2.78	459	880
	Org	soil	46.5280	8.2780	2623		29							5	8	34	11.0	39.0	13.6	0.13	0.21			1505	-1.3	92	2.78	459	880
	WV	soil	46.4710	8.1770	2403		28							40	15	88	21.0	128.0	25.8	0.31	0.13			1283	-1.7	54	3.77	557	880
	BV	soil	46.4690	8.2090	1967		31							50	9	85	13.0	135.0	15.8	0.37	0.08			1176	1.6	100	3.77	557	880
	MV	soil	46.5010	8.2570	1910		33							40	6	72	8.0	112.0	10.0	0.36	0.06			1247	1.2	100	2.78	459	880
	NV	soil	46.5220	8.2810	2164		30							60	20	118	28.0	178.0	34.4	0.34	0.13			1379	0.5	100	2.78	459	880
	NVg	soil	46.5290	8.2680	2637		24							19	10	54	14.0	73.0	17.2	0.26	0.15			1521	-1.7	46	2.78	459	880
	Ovg	soil	46.5340	8.2790	2631		20							33	12	124	24.0	157.0	26.8	0.21	0.08			1600	-2.2	22	2.78	459	880
	HI	soil	46.4530	8.1950	1867		33							44	12	73	16.0	117.0	20.0	0.38	0.12			1081	3.2	99	3.77	557	880
	OI	soil	46.5150	8.2950	2029		35							44	12	67	17.0	111.0	20.8	0.40	0.13			1159	3.4	100	2.78	459	880
Ferrier et al., 2012	P	soil	45.1711	-115.3000	2283	50	23							26	4	145	13.0	171.0	13.6	0.15	0.03			736	1.7	85	1.94	474	625
	P	soil	45.1710	-115.3000	2281	16	25							28	5	167	15.0	195.0	15.8	0.14	0.03			736	1.7	85	1.94	474	625
	P	soil	45.1690	-115.3000	2090	57	18							22	5	141	13.0	163.0	13.9	0.13	0.03			736	1.7	85	1.94	474	625
	P	soil	45.1650	-115.3000	1850	29	25							-9	8	210	19.0	201.0	20.6	-0.04	-0.04			590	3.5	81	1.94	474	625
	P	soil	45.1610	-115.3000	1706	38	25							12	5	163	14.0	175.0	14.9	0.07	0.03			590	3.5	81	1.94	474	625
	P	soil	45.1570	-115.3000	1485	31	23							13	2	85	7.0	98.0	7.3	0.13	0.02			470	5.4	77	1.94	476	625
	P	soil	45.1570	-115.3000	1471	32	26							8	2	89	7.0	97.0	7.3	0.08	0.02			470	5.4	77	1.94	476	625
	P	soil	45.1540	-115.3000	1277	44	30							17	6	149	12.0	166.0	13.4	0.10	0.04			470	5.4	77	1.94	476	625
	P	soil	45.1550	-115.3000	1264	43	33							9	6	155	13.0	164.0	14.3	0.05	0.04			470	5.4	77	1.94	476	625
	P	soil	45.1540	-115.3000	1062	75	15							12	2	64	5.0	76.0	5.4	0.16	0.03			470	5.4	77	1.94	476	625
	P	soil	45.1540	-115.3000	1062	33	27							10	1	53	4.0	63.0	4.1	0.16	0.02			470	5.4	77	1.94	476	625
	T	soil	45.0810	-115.3000	2364	28	14							22	5	130	14.0	152.0	14.9	0.14	0.04			700	1.0	74	1.94	476	625
	T	soil	45.0750	-115.3000	2073	25	9							8	4	215	18.0	223.0	18.4	0.04	0.02			700	1.0	74	1.94	465	625
	T	soil	45.0620	-115.3000	1755	37	25							-6	8	338	27.0	332.0	28.2	-0.02	-0.02			763	0.3	62	1.94	465	625
	T	soil	45.0610	-115.3000	1508	32	30							5	7	252	21.0	257.0	22.1	0.02	0.03			763	0.3	62	1.94	465	625
	T	soil	45.0610	-115.3000	1294	57	32							37	9	242	21.0	279.0	22.8	0.13	0.03			763	0.3	62	1.94	465	625
	T	soil	45.0610	-115.3000	1084	56	38							27	5	224	17.0	251.0	17.7	0.11	0.02			763	0.3	62	1.94	465	625
Dixon et al., 2012	W-U1-1	saprolite	34.3470	-118.0030	1813									16	3	22	4.0	38.0	7.0	0.42	0.11			616	10.0	70	1.43	737	0
	W-U1-2	saprolite	34.3470	-118.0030	1813									54	6	110	12.0	164.0	17.0	0.33	0.05			616	10.0	70	1.43	737	0
	W-U1-3a	saprolite	34.3470	-118.0030	1813									42	1	63	2.0	105.0	13.0	0.40	0.05			616	10.0	70	1.43	737	0
	W-U1-3b	saprolite	34.3470	-118.0030	1813									18	3	32	5.0	50.0	8.0	0.36	0.08			616	10.0	70	1.43	737	0
	W-U1-4	saprolite	34.3470	-118.0030	1813									105	11	91	9.0	196.0	19.0	0.54	0.08			616	10.0	70	1.43	737	0
	W-M1-1	saprolite	34.3520	-118.0290	1596									243	20	231	19.0	474.0	22.0	0.51	0.05			525	11.7	71	1.69	820	0
	W-M1-2	saprolite	34.3520	-118.0290	1596									232	19	173	14.0	411.0	23.0	0.56	0.06			525	11.7	71	1.69	820	0
	W-M1-3	saprolite	34.3520	-118.0290	1596									132	12	155	14.0	287.0	21.0	0.46	0.05			525	11.7	71	1.69	820	0
	W-M1-4	saprolite	34.3520	-118.0290	1596									119	10	224	19.0	343.0	22.0	0.35	0.04			525	11.7	71	1.69	820	0
	W-M1-5	saprolite	34.3520	-118.0290	1596									110	10	197	17.0	308.0	22.0	0.36	0.04			525	11.7	71	1.69	820	0
	W-M1-6	saprolite	34.3520	-118.0290	1596									151	13	157	14.0	308.0	22.0	0.49	0.05			525	11.7	71	1.69	820	0
	W-M2-1	saprolite	34.3690	-117.9980	1694									121	12	109	10.0	231.0	20.0	0.52	0.07			513	10.9	56	1.69	737	0
	W-M2-2	saprolite	34.3690	-117.9980	1694									263	20	179	14.0	441.0	23.0	0.60	0.05			513	10.9	56	1.69	737	0
	W-M2-3	saprolite	34.3690	-117.9980	1694									233	19	149	12.0	382.0	22.0	0.61	0.06			513	10.9	56	1.69	737	0
	W-M2-4	saprolite	34.3690	-117.9980	1694									48	4	283	24.0	331.0	22.0	0.15	0.02			513	10.9	56	1.69	737	0
	W-M2-5	saprolite	34.3690	-117.9980	1694									117	9	357	29.0	474.0	22.0	0.25	0.02			513	10.9	56	1.69	737	0
	W-M2-6	saprolite	34.3690	-117.9980	1694									44	4	397	32.0	441.0	23.0	0.10	0.01			513	10.9	56	1.69	737	0
Heimsath et al., 2020	KR-14	saprolite	-23.0290	31.2690	326	35		0.13	0.07	1.39	0.75			0.2	0.1	2.0	1.2	2.2	1.2	0.09				470	23.1	80	0.46	510	0
	KR-115	saprolite	-23.0290	31.2690	319	51		0.92	0.28	9.2	2.37			1.5	0.4	13.2	3.8	14.7	3.8	0.10				470	23.1	80	0.46	510	0
	KR-3	saprolite	-25.0170	31.4920	367	45		2.11	0.42	3.52	0.53			3.4	0.7	2.3	1.1	5.6	0.8	0.60				550	21.9	88	0.48	619	0
	KR-12	saprolite	-25.0310	31.4960	342	38		2.94	0.54	5.16	0.69			4.7	0.9	3.6	1.4	8.3	1.1	0.57				645	21.5	89	0.48	619	0
	KR-13	saprolite	-25.0330	31.4980	336	85		0.47	0.41	2.61	2.12			0.8	0.7	3.4	3.5	4.2	3.4	0.18				645	21.5	89	0.48	619	0
	KR-109	saprolite	-25.0200	31.5000	359	105		3.19	0.94	7.09	1.74			5.1	1.5	6.2	3.2	11.3	2.8	0.45				670	21.5	88	0.33	619	0
	KR-110	saprolite	-25.0200	31.5010	354	135		1.92	0.73	8.73	2.87			3.1	1.2	10.9	4.7	14.0	4.6	0.22				670	21.5	88	0.33	619	0
	KR112	saprolite	-25.0200	31.5010	355	150		2.3	0.81	4.26	1.29			3.7	1.3	3.1	2.4	6.8	2.1	0.54				670	21.5	88	0.33	619	0
	KR-103	saprolite	-25.2040	31.2830	576	210		0.93	0.57	2.01	1.13			1.5	0.9	1.7	2.0	3.2	1.8	0.46				730	21.6	88	0.48	671	0
	KR-105	saprolite	-25.2020	31.2810	582	350		1.84	3.51	3.01	5.61			2.9	5.6	1.9	10.6	4.8	9.0	0.61				752	20	88	0.48	671	0
	KR-120	saprolite	-25.2090	31.2850	553	210		2.21	1.27	4.33	2.28			3.5	2.0	3.4	4.2	6.9	3.6	0.51				719	20.1	87	0.48	671	0
	KR-121	saprolite	-25.2110	31.2860	528	245		0.55	0.11	3.45	0.5			0.9	0.2	4.6	0.8	5.5	0.8	0.16				719	20.1	87	0.48	671	0

Table S10:

Table S10: Correlation R of chemical weathering, physical erosion, and total denudation rates with location parameters

		W	E	D	CDF	MAP	MAT	VC	LAI	ET	FCI
Chem. weathering rate	W	1.00	0.54	0.89	0.35	-0.10	0.03	-0.04	0.14	0.14	-0.14
Physical erosion rate	E	0.54	1.00	0.78	-0.29	-0.10	-0.21	-0.19	0.16	-0.12	0.27
Denudation rate	D	0.89	0.78	1.00	0.10	-0.12	0.03	-0.11	0.15	0.10	-0.09
Chemical depletion	CDF	0.35	-0.29	0.10	1.00	-0.02	0.24	0.27	0.18	0.46	-0.40
Annual precipitation	MAP	-0.10	-0.10	-0.12	-0.02	1.00	-0.48	0.54	0.52	0.27	0.26
Annual temperature	MAT	0.03	-0.21	0.03	0.24	-0.48	1.00	0.03	-0.38	0.14	-0.70
Vegetation cover	VC	-0.04	-0.19	-0.11	0.27	0.54	0.03	1.00	0.40	0.55	-0.09
Leaf area index	LAI	0.14	0.16	0.15	0.18	0.52	-0.38	0.40	1.00	0.29	0.32
Evapotranspiration	ET	0.14	-0.12	0.10	0.46	0.27	0.14	0.55	0.29	1.00	-0.53
Frost cracking index	FCI	-0.14	0.27	-0.09	-0.40	0.26	-0.70	-0.09	0.32	-0.53	1.00

Legend (cell shading):

- (white) $p > 0.05$
- (lightest) R^2 0 to 0.3, $p < 0.05$
- (light) R^2 0.3 to 0.5, $p < 0.05$
- (medium) R^2 0.5 to 0.7, $p < 0.05$
- (dark) R^2 0.7 to 1.0, $p < 0.05$