Table S1: PPDI (Pedogenic Phosphorus Depletion Index) from Chronosequence studies or soil profile measurements

Soil Order	Source	Temperature	Precipitation	TP_0 (kg P ha^{-1})	TP (kg P ha^{-1})	Soil strain	Depth	PPDI	Reference
Entisol	Hawaii Chronosequence	16C	2500mm				Top 50cm	10%*	Chadwick et al., 1999
	Northern Arizona Chronosequence	11C	~330mm	600^	325	0.6§	0-15cm mineral soil	13%#	Selmants and Hart, 2009
Inceptisol	Hawaii Chronosequence	16C	2500mm				Top 50cm	20%*	Chadwick et al., 1999
	Haast chronosequence	11.3	3455mm				50cm	3.6%*	Eger et al., 2011
Aridsol	Jornada chronosequence		160-200mm	700^	502^	0.1£	0-20cm	28%#	Lajtha and Schlesinger, 1988
Mollisol	Northern Arizona Chronosequence	11C	~330mm	600^	180	0.1£	0-15cm mineral soil	67%#	Selmants and Hart, 2009
	Soil profile measurement						9-22cm	23%*	St. Arnaud et al., 1988
	Soil profile measurement						50cm	30%*	Bern and Townsend, 2008
	Northern Arizona Chronosequence	11C	~330mm	600^	140	0†	0-15cm mineral soil	77%#	Selmants and Hart, 2009
	Soil profile						0-	65%*	St. Arnaud et

	measurement						29cm		al., 1988
Alfisol	Soil profile measurement						0-25cm	68%*	St. Arnaud et al., 1988
	Soil profile measurement (upper slope)	Low temperature	400-450mm	1213.8^	389.2^	0†	Ae 5-17cm	68%#	Schoenau et al., 1989
	Soil profile measurement (middle slope)	Low temperature	400-450mm	1156.6^	384.5^	0†	Ae 5-13cm	67%#	Schoenau et al., 1989
	Soil profile measurement						12-23cm	54%*	St. Arnaud et al., 1988
	Soil profile measurement						50cm	55%*	Sheldon, 2012
	Soil profile measurement			6292^	4224^	-0.41	50cm	60%#	Schroeder and West, 2005
	Soil profile measurement			6500^	3620^	0.3	50cm	30%#	Schroeder and West, 2005
	Soil profile measurement						Ae 5-21cm	70%*	Letkeman et al., 1996
	Franz Josef Soil Chronosequence	-	3600-6000mm	1360^	120^	-0.21¶	Upper 10cm of mineral soil	93%#	Richardson et al., 2004
	Lake Michigan Sand Dune	6.2	77.2cm per year				Upper 15cm	55%*	Lichter, 1998

	Chronosequence						of minera l soil		
Spodosol	Volcanic chronosequence , New Zealand	10-13C	1600-2400mm	427^$	240^$	-0.21¶	Upper 10cm	56%#	Parfitt et al., 2005
	Haast chronosequence	11.3	3455mm				50cm	41%*	Eger et al., 2011
	Haast chronosequence	11.3	3455mm				50cm	63%*	Eger et al., 2011
	Haast chronosequence	11.3	3455mm				50cm	75%*	Eger et al., 2011
	waitutu	10 C	1800mm	890^$	132^$	-0.21¶	Upper 10cm	88%#	Parfitt et al., 2005
Ultisol	Hawaii Chronosequence	16C	2500mm				Top 50cm	70%*	Chadwick et al., 1999
	Soil profile measurement			5940^	668^	-0.02	50cm	89%#	Schroeder and West, 2005
	Soil profile measurement						50cm	50%*	Bern and Townsend, 2008
Oxisol	Hawaii Chronosequence	16C	2500mm				Top 50cm	90%*	Chadwick et al., 1999

* PPDI was provided in reference
# PPDI was calculated using Eq.1.
^ P content (kg P ha^{-1}) was converted from concentration (ppm) given in original reference using soil bulk density and sample soil depth
$ Soil organic carbon content was used to estimate bulk density using the Adams(1973) equation
§ Based on Eger et al. (2011)
£ Based on Tsai et al. (2007)
† Based on Sheldon (2003)

¶ Based on the mean strain value for top 15cm soils from Eger et al. (2011)

Table S2: Percentage of P (mean ± sd) in different forms based on Hedley P database

Soil Order	Labile Pi	Secondary Pi	Apatite P	Occluded P	Organic P
Entisol	11±8	5±4	47±20	22±10	15±8
Inceptisol	12±7	7±3	17±13	23±13	41±22
Aridsol	8±2	6±3	64±15	17±7	5±2
Vertisol	6±3	6±3	29±12	47±8	12±3
Mollisol	5±3	4±2	28±9	44±7	19±9
Alfisol	7±3	11±5	19±11	38±13	25±12
Spodosol	7±3	12±7	9±8	28±15	44±9
Ultisol	7±5	14±5	3±4	50±15	26±7
Oxisol	6±3	14±5	1±0	59±12	20±8

Table S3: Soil strain (50cm depth) in different weathering categories

Slightly weathered soils				**Parent material**	**Reference**
Entisols	**Inceptisols**				
	0.7			Granite	Yousefifard et al., 2012
	0.7			Granodiorite	Yousefifard et al., 2012
	0.5			Dacite	Yousefifard et al., 2012
	0.9			Monzodiorite	Yousefifard et al., 2012
	0.7			andesite	Yousefifard et al., 2015
	0.5			andesite	Yousefifard et al., 2016
	0.5			syenite	Yousefifard et al., 2017
	0.8			andesite	Yousefifard et al., 2018
	0.7			Granite	Yousefifard et al., 2012
	0.7			Granodiorite	Yousefifard et al., 2012
	-0.7			Limestone debris	Merkli et al., 2009
	-0.55			Dolomite debris	Merkli et al., 2009
	-0.8			limestone/dolomite debris	Merkli et al., 2009
	-0.5			Limestone debris	Merkli et al., 2009
	-0.6			Limestone debris	Merkli et al., 2009
-0.7				Dolomite debris	Merkli et al., 2009
-0.7				Dolomite debris	Merkli et al., 2009
	-0.7			Limestone debris	Merkli et al., 2009
Intermediately weathered soils					
aridsols	***mollisols***	***vertisols***	***afisols***		
			0.05	basalt	Schroeder and west, 2005
			0.3	Schist	Schroeder and west, 2005
			-0.41	meta-gabbro	Tsai et al.,2007
		0.25		sandstone	Tsai et al.,2007

	0.1		sandstone	Sheldon, 2003
Highly weathered soils				
Spodosols	***Ultisols***	***Oxisols***		
0.07			Sandstone	Eger et al., 2011
-0.09			Sandstone	Eger et al., 2011
-0.37			Sandstone	Eger et al., 2011
	-0.125± 0.12	-0.125± 0.12	gneiss/schist	Colin et al., 1992

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