

Supplementary Material

Characterisation of organic carbon distribution and turnover by stable carbon isotopes in major types of soils in China

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31 **Table S1.** The surface organic carbon content of nine types of soils in China, 2017–2022

Soil type	Location	SOC (g kg ⁻¹) ^A	Reference	Time
Latosol	Hainan	21.73	(Zeng et al., 2021)	2021
		14.95	(Chen et al., 2022)	2019
		16.02	(Zhao et al., 2021b)	2021
		11.28	(Zhao et al., 2021b)	2021
		12.08	(Zhao et al., 2021b)	2021
		8.56	(Zhao et al., 2021b)	2021
		6.44	(Cao et al., 2021)	2019
		7.31	(Cao et al., 2021)	2019
		8.35	(Cao et al., 2021)	2019
		15.89	(Cao et al., 2021)	2019
		17.6	(Yu et al., 2021)	2021
		18.24	(Zhao et al., 2020c)	2021
		3.27	(Deng et al., 2021)	2020
		27.00	(Kong et al., 2022)	2022
		9.30	(Zhang et al., 2020e)	2020
		18.40	(Zhang et al., 2020e)	2020
		11.70	(Zhang et al., 2020e)	2020
		10.00	(Zhang et al., 2020e)	2020
		0.59	(Zhao et al., 2021a)	2022
		2.07	(Zhao et al., 2021a)	2022
Red soil	Jiangxi	7.69	(Zhong et al., 2022)	2019
		10.63	(Zhong et al., 2022)	2019
		11.15	(Zhong et al., 2022)	2019
		12.65	(Zhong et al., 2022)	2019
		13.25	(Ahmed et al., 2021)	2020
		18.87	(Ahmed et al., 2021)	2020
		21.76	(Ahmed et al., 2021)	2020
		4.97	(Wang et al., 2021b)	2018
		5.50	(Wang et al., 2021b)	2018
		5.99	(Wang et al., 2021b)	2018
		6.29	(Wang et al., 2021c)	2019
		19.00	(Zhang et al., 2021b)	2017
		20.90	(Zhang et al., 2021b)	2017
		8.47	(Li et al., 2020b)	2020
		9.86	(Guo, 2022)	2021
		27.78	(Wang et al., 2022b)	2020
		31.90	(Wang et al., 2022b)	2020
		12.88	(Wang et al., 2022b)	2020
16.30	(Wang et al., 2022b)	2020		

		9.00	(Kong et al., 2022)	2022
		4.00	(Kong et al., 2022)	2022
		10.56	(Lv et al.,2021a)	2021
		13.11	(Lv et al.,2021a)	2021
		11.77	(Lv et al.,2021a)	2021
		11.08	(Lv et al.,2021a)	2021
		24.19	(Han et al., 2021)	2021
		20.71	(Han et al., 2021)	2021
		17.05	(Han et al., 2021)	2021
		13.05	(Han et al., 2021)	2021
		4.52	(He et al., 2020)	2020
		5.01	(Chen et al., 2020)	2020
		17.08	(Zhong et al., 2022)	2019
		20.02	(Zhong et al., 2022)	2019
		20.54	(Zhong et al., 2022)	2019
		22.04	(Zhong et al., 2022)	2019
		34.77	(Zhong et al., 2022)	2019
		36.13	(Zhong et al., 2022)	2019
		37.53	(Zhong et al., 2022)	2019
		39.76	(Zhong et al., 2022)	2019
		6.55	(Liu et al., 2021c)	2021
		8.54	(Ali et al., 2021)	2021
		13.30	(Ali et al., 2021)	2021
		9.76	(Ali et al., 2021)	2021
		14.20	(Ali et al., 2021)	2021
		12.90	(Ali et al., 2021)	2021
		20.80	(Ali et al., 2021)	2021
		12.60	(Ali et al., 2021)	2021
		20.50	(Ali et al., 2021)	2021
		3.65	(Lai et al., 2021)	2020
		24.50	(Fang et al., 2019)	2019
		13.10	(Chu et al., 2020)	2018
		18.10	(Chu et al., 2020)	2018
		11.83	(Lv et al., 2021b)	2018
		8.20	(Zhang et al., 2020e)	2020
		14.90	(Zhang et al., 2020e)	2020
		14.30	(Zhang et al., 2020e)	2020
		10.00	(Zhang et al., 2020e)	2020
		5.10	(Li et al., 2021c)	2020
		11.10	(Pan et al., 2021)	2019
Brown Soil	Shandong	8.58	(Wang et al., 2021d)	2017

7.87	(Cui et al., 2022)	2017
2.03	(Li et al., 2019b)	2020
13.98	(Liu et al., 2021a)	2021
12.00	(Kong et al., 2022)	2022
8.80	(Liu et al., 2021b)	2022
53.60	(Sun et al., 2019)	2019
10.21	(Zhang et al., 2020a)	2020
7.09	(Zhao et al., 2022)	2021
4.26	(Gao et al., 2020a)	2020
7.34	(Geng et al., 2022)	2022
8.10	(Wu et al., 2021)	2021
16.50	(Liao et al., 2019)	2019
11.89	(Zhang et al., 2021a)	2020
4.81	(Wang et al., 2022a)	2022
6.51	(Wang et al., 2022a)	2022
11.10	(Wang et al., 2022a)	2022
12.36	(Wang et al., 2019a)	2019
11.39	(Wang et al., 2019a)	2019
9.68	(Wang et al., 2019a)	2019
10.81	(Wang et al., 2019a)	2019
8.06	(Cheng et al., 2019)	2019
7.42	(Shen et al., 2020)	2020
14.60	(Zhang et al., 2020e)	2020
23.00	(Zhang et al., 2020e)	2020
17.90	(Zhang et al., 2020e)	2020
16.10	(Zhang et al., 2020e)	2020
6.73	(Li et al., 2021c)	2020
5.88	(Zheng et al., 2020)	2020
10.13	(Yu et al., 2022)	2022
7.05	(Yu et al., 2022)	2022
13.98	(Liu et al., 2021a)	2021
24.77	(Zhang et al., 2019)	2019
24.00	(Zhang et al., 2019)	2019
32.46	(Zhang et al., 2019)	2019
33.00	(Zhang et al., 2019)	2019
7.02	(Zhang et al., 2019)	2020
7.87	(Cui et al., 2022)	2017
3.19	(Fu et al., 2022)	2022
4.23	(Li et al., 2022)	2022
6.91	(Zhang et al., 2020d)	2019
Cinnamon	Hebei	10.02 (Yang et al., 2021a) 2021

soil		6.26	(Zhang et al., 2022)	2017
		8.53	(Liu et al., 2021d)	2018
		7.95	(Liu et al., 2021d)	2018
		9.51	(Liu et al., 2021d)	2018
		10.61	(Liu et al., 2021d)	2018
		6.84	(Liu et al., 2021d)	2018
		10.30	(Cai and Song, 2020)	2018
		8.10	(Wang et al., 2019c)	2019
		5.68	(Zhang et al., 2020b)	2019
		37.18	(Zhang et al., 2020b)	2019
		21.64	(Zhang et al., 2020b)	2019
		7.69	(Wang et al., 2019b)	2017
		9.10	(Zhai et al., 2022)	2019
		9.30	(He et al., 2019)	2019
		21.81	(Sun et al., 2022)	2018
		2.03	(Zhuang et al., 2020)	2020
		18.97	(Zhuang et al., 2020)	2020
		7.02	(Liao et al., 2020)	2019
		5.92	(Liao et al., 2020)	2019
		3.20	(Li et al., 2021a)	2020
		7.80	(Wang et al., 2021a)	2020
		7.23	(Wang et al., 2021a)	2020
		11.21	(Wang et al., 2021a)	2020
		11.21	(Wang et al., 2021a)	2020
		9.34	(Chen et al., 2019)	2019
		37.99	(Gao et al., 2020b)	2019
		15.00	(Mina et al., 2019)	2020
		10.40	(Cai and Song, 2019)	2019
		3.10	(Cai and Song, 2019)	2019
		26.70	(Cai and Song, 2019)	2019
		9.96	(Wang et al., 2020b)	2019
		9.50	(Zhang et al., 2020c)	2017
		12.60	(Zhang et al., 2020c)	2017
	14.80	(Zhang et al., 2020c)	2017	
	20.39	(Yang et al., 2021b)	2018	
Paddy soil	Anhui	10.37	(Liu et al., 2022)	2018
		12.87	(Liu et al., 2022)	2018
		11.83	(He et al., 2020)	2020
		14.90	(Li et al., 2019a)	2019
		1.51	(Lu et al., 2022a)	2022
		15.14	(He et al., 2022)	2022

	17.30	(Duan et al., 2018)	2018
	15.79	(Jin et al., 2020)	2017
	8.52	(Jin et al., 2020)	2017
	9.83	(Yuan et al., 2021)	2021
	5.39	(Chen et al., 2021)	2019
	19.37	(Cai et al., 2020)	2018
	17.92	(Cai et al., 2020)	2018
	21.11	(Cai et al., 2020)	2018
	17.40	(Cai et al., 2020)	2018
	21.40	(Cai et al., 2020)	2018
	18.74	(Cai et al., 2020)	2018
	20.13	(Cai et al., 2020)	2018
	18.10	(Cai et al., 2020)	2018
	17.69	(Cai et al., 2020)	2018
	20.48	(Cai et al., 2020)	2018
	21.11	(Cai et al., 2020)	2018
	40.44	(Wang et al., 2020a)	2020
	25.55	(Yan et al., 2022)	2022
	16.12	(Zhao et al., 2020a)	2018
	8.90	(Zhao et al., 2020a)	2018
	1.51	(Lu et al., 2022b)	2022
	21.98	(Youfeng et al., 2020)	2020
	20.01	(Youfeng et al., 2020)	2020
	19.78	(Youfeng et al., 2020)	2020
	19.08	(Gao et al., 2022)	2022
	6.05	(Yao et al., 2021)	2019
	7.61	(Zhou and Zhu, 2020)	2020
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	20.06	(Xu et al., 2020)	2017
	16.53	(Ji et al., 2021)	2019
	17.16	(Ji et al., 2021)	2019
	17.98	(Ji et al., 2021)	2019
	15.62	(Ji et al., 2021)	2019
	13.53	(Ji et al., 2021)	2019
	16.28	(Ji et al., 2021)	2019
	32.10	(Zhang et al., 2021d)	2018
	31.50	(Zhang et al., 2021d)	2018
	11.40	(Fu et al., 2021)	2017
	14.60	(Fu et al., 2021)	2017
	16.70	(Fu et al., 2021)	2017
	24.10	(Fu et al., 2021)	2017
	25.20	(Fu et al., 2021)	2017
Dark brown forest soil			Jilin

		52.80	(Yuanhong et al., 2020)	2020
		20.73	(Fang, 2021)	2020
		26.80	(Li et al., 2021b)	2017
		25.60	(Zheng et al., 2021)	2019
		24.50	(Zheng et al., 2021)	2019
		25.40	(Zheng et al., 2021)	2019
		26.00	(Qiu et al., 2021)	2017
		15.13	(Liang et al., 2021)	2021
		13.98	(Cai et al., 2021)	2020
		14.53	(Cai et al., 2021)	2020
		16.84	(Cai et al., 2021)	2020
		17.12	(Cai et al., 2021)	2020
		21.75	(Song et al., 2020)	2020
		31.20	(Jiang et al., 2020)	2020
		27.78	(Li et al., 2020b)	2020
		26.91	(Li et al., 2019b)	2020
		28.84	(Huang et al., 2019)	2019
		31.32	(Wang et al., 2020c)	2019
		15.49	(Wang et al., 2020c)	2019
Black soil	Heilongjiang	13.52	(Wang et al., 2020c)	2019
		36.14	(Zhang et al., 2020f)	2020
		22.60	(Hong et al., 2021)	2017
		21.79	(Hong et al., 2021)	2017
		26.51	(Liu et al., 2021a)	2021
		20.01	(Liu et al., 2021a)	2021
		31.50	(Yang et al., 2021c)	2021
		26.50	(Yang et al., 2021c)	2021
		21.30	(Yang et al., 2021c)	2021
		22.00	(Yang et al., 2021c)	2021
		17.53	(Du et al., 2022)	2019
		18.83	(Du et al., 2022)	2019
		23.32	(Li et al., 2020a)	2020
		35.00	(Kong et al., 2022)	2021
		11.95	(He et al., 2020)	2019
		11.40	(Zhang et al., 2020e)	2020
		24.50	(Zhang et al., 2020e)	2020
		19.70	(Zhang et al., 2020e)	2020
		15.80	(Zhang et al., 2020e)	2020
		26.84	(Zhu et al., 2021)	2019
Boggy soil	Heilongjiang	17.86	(Zhu et al., 2021)	2019
		33.06	(Lin et al., 2021)	2022

		21.17	(Zhang et al., 2021c)	2020
		23.66	(Zhang et al., 2021c)	2020
		20.45	(Zhang et al., 2021c)	2020
		21.32	(Zhang et al., 2021c)	2020
		10.09	(Dai et al., 2019)	2017, 2018
		5.10	(Dai et al., 2019)	2017, 2018
		17.29	(Dai et al., 2019)	2017, 2018
		54.79	(Hu et al., 2020)	2018
		19.12	(Hu et al., 2020)	2018
		9.77	(Hu et al., 2020)	2018
		11.02	(Hu et al., 2020)	2018
Chestnut soil	Qinghai	2.42	(Zhao et al., 2020b)	2020
		4.35	(Zuo and He, 2021)	2019
		27.67	(Zuo and He, 2021)	2019
		15.26	(Zuo and He, 2021)	2019
		6.26	(Zuo and He, 2021)	2019
		26.51	(Zuo and He, 2021)	2019
		15.95	(Zuo and He, 2021)	2019
		9.74	(Cui et al., 2018)	2018

32 ^A SOC means organic carbon content.

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53 **Table S2.** Descriptive statistical analysis of the surface organic carbon content of nine types of soils in China, 2017-2022

Soil type	Soil organic carbon(g/kg)				
	N	Mean	Lower limits ^A	Upper limits ^B	SD ^C
Boggy soil	7	23.48	18.80	28.16	5.06
Black soil	37	22.43	20.30	24.56	6.40
Dark brown forest soil	15	21.70	15.84	27.56	10.58
Chestnut soil	15	15.69	8.39	22.99	13.18
Cinnamon soil	31	11.86	8.62	15.09	8.82
Brown soil	42	12.48	9.49	15.48	9.61
Paddy soil	38	15.56	13.19	17.93	7.22
Red soil	58	15.18	12.89	17.47	8.70
latosol	20	12.04	8.88	15.20	6.75

54 ^A Lower limits indicate the lower limit of the 95% confidence interval of the mean.

55 ^B Upper limits indicate the Upper limit of the 95% confidence interval of the mean.

56 ^C SD standard deviation.

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58 **Table S3.** Components and stability indexes of water-stable aggregates

Soil type	Land use type	Soil aggregate size class (mm)						MWD ^A	PAD ^B
		> 2	2-1	1-0.25	0.25-0.053	0.053-0.02	< 0.02		
Boggy soil	cultivated land	29.25	6.55	17.35	21.89	8.10	16.86	0.83	36.49
	wasteland	5.44	9.29	35.34	32.28	5.85	11.8	0.52	42.04
Black soil	cultivated land	4.51	2.51	23.81	43.41	11.37	14.39	0.35	61.53
	wasteland	7.31	5.27	22.16	45.08	8.73	11.44	0.44	55.58
Dark brown forest soil	cultivated land	20.79	9.27	28.90	18.78	6.46	15.81	0.77	18.04
	wasteland	3.41	10.40	47.86	21.05	4.14	13.13	0.56	24.45
Chestnut soil	cultivated land	11.50	3.16	20.56	34.27	10.75	19.77	0.47	46.42
	wasteland	3.38	1.43	13.15	47.96	11.58	22.51	0.25	68.41
Cinnamon soil	cultivated land	10.67	5.64	29.62	40.84	4.96	8.28	0.55	30.39
	wasteland	0.66	0.75	19.92	55.76	9.19	13.72	0.24	68.19
Brown soil	cultivated land	16.76	7.45	24.05	31.12	8.89	11.73	0.65	41.21
	wasteland	16.74	6.60	25.04	38.44	5.68	7.50	0.65	38.21
Red soil	cultivated land	30.74	7.95	24.94	22.01	2.94	11.43	0.93	12.78
	wasteland	9.89	7.32	34.70	34.28	3.29	10.52	0.58	22.18
Paddy soil	cultivated land	18.28	8.10	28.73	19.19	7.96	17.74	0.70	32.02
	wasteland	17.93	11.34	43.24	20.95	1.98	4.56	0.83	32.36
Latosol	cultivated land	13.79	12.07	38.54	26.01	2.73	6.86	0.74	-8.12
	wasteland	9.19	7.70	37.39	35.78	3.89	6.06	0.59	-15.49

59 ^A MWD is the mean weight diameter.

60 ^B PAD is the rate of aggregate destruction.

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67 **Table S4.** Organic carbon content and $\delta^{13}\text{C}$ value in water-stable aggregates

	Soil types	Land use types	Water-stable aggregates size (mm)					Bulk soil	
			> 2	2–1	1–0.25	0.25–0.053	0.053–0.02		< 0.02
SOC ^A (g kg ⁻¹)	Boggy soil	cultivated land	44.15	46.99	47.36	5.70	34.99	41.53	46.31
		wasteland	30.34	25.42	26.89	22.79	21.05	23.69	24.1
	Black soil	cultivated land	21.73	24.03	25.17	21.42	14.25	22.27	22.8
		wasteland	29.09	26.66	39.45	26.41	10.46	34.22	29.3
	Dark brown forest soil	cultivated land	24.94	23.88	31.44	31.74	15.53	21.19	27.35
		wasteland	31.04	21.72	29.81	28.15	16.23	22.6	28.92
	Chestnut soil	cultivated land	11.12	14.45	12.52	8.78	8.22	10.89	11.57
		wasteland	10.81	16.36	24.91	8.81	5.98	9.63	10.89
	Cinnamon soil	cultivated land	14.00	13.57	18.84	12.75	10.70	15.94	12.22
		wasteland	6.67	10.13	7.36	4.38	4.55	7.28	4.77
	Brown soil	cultivated land	3.53	6.15	8.27	6.54	6.65	10.97	7.20
		wasteland	2.56	2.75	5.12	8.70	6.99	11.63	6.41
	Red soil	cultivated land	20.61	17.41	18.21	17.07	18.93	19.72	21.83
		wasteland	17.84	2.25	4.67	3.62	5.18	7.78	5.53
	Paddy soil	cultivated land	11.99	17.8	14.24	13.36	7.11	11.56	12.88
		wasteland	11.85	18.28	18.87	14.96	6.89	9.99	14.26
	Latosols	cultivated land	9.61	8.83	8.87	11.09	13.30	17.09	11.68
		wasteland	20.86	17.36	19.6	21.41	21.30	21.23	20.36
$\delta^{13}\text{C}$ (‰)	Boggy soil	cultivated land	-26.59	-26.68	-26.41	-26.55	-26.35	–	-26.55
		wasteland	-25.27	-25.10	-25.23	-24.93	-23.8	–	-24.58
	Black soil	cultivated land	-21.70	-22.10	-22.80	-21.92	-21.57	–	-21.33
		wasteland	-25.16	-24.99	-24.44	-23.95	-23.64	–	-23.84
	Dark brown forest soil	cultivated land	-26.31	-25.12	-24.41	-24.86	-24.64	–	-24.08
		wasteland	-26.22	-26.75	-25.97	-26.25	-25.67	–	-25.30
	Chestnut soil	cultivated land	-24.69	-24.35	-24.22	-24.67	-23.21	–	-25.08
		wasteland	-25.14	-25.02	-25.77	-25.27	-24.51	–	-24.5
	Cinnamon soil	cultivated land	-23.4	-23.22	-23.08	-22.51	-19.49	–	-22.82
		wasteland	-24.36	-24.18	-23.27	-21.37	-21.07	–	-24.21
	Brown soil	cultivated land	-23.42	-23.28	-24.14	-24.27	-22.22	–	-23.92
		wasteland	-25.82	-25.61	-25.17	-24.01	-24.65	–	-24.74
	Red soil	cultivated land	-27.00	-26.77	-26.91	-26.51	-26.75	–	-26.33
		wasteland	-23.79	-26.39	-22.57	-24.28	-21.72	–	-24.52
	Paddy soil	cultivated land	-27.68	-27.44	-26.94	-27.08	-26.79	–	-26.02
		wasteland	-26.94	-26.94	-27.18	-27.07	-26.76	–	-26.15
	Latosol	cultivated land	-23.04	-22.36	-22.40	-22.84	-22.19	–	-22.81
		wasteland	-20.10	-18.83	-18.42	-18.00	-17.41	–	-20.62

68 ^A SOC means organic carbon content.

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