Supplementary Materials

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Do not overlook the biochar-derived dissolved organic matter in real Cr-contaminated environment: leaching dynamics, its impacts on Cr(VI) adsorption and reduction

Hui Liu[a,1], Ying Wang[a,1], Shixu Wang[a], Jing Wu[a], Yulai Wang[a,*]

[a] School of Energy and Environment, Anhui University of Technology, Maanshan City 243002,

China;

*Corresponding Author:

Yulai Wang, E-mail: yulai_wang@163.com, School of Energy and Environment, Anhui University of Technology,

Maanshan City 243002, China

Table S1 The UV-vis spectral indicators of HC-AP and BDOM.

Sample	HC-AP	HC-DOM	PC-DOM	HPC-DOM
$SUVA_{280}(L \cdot mg^{-1} \cdot m^{-1})$	7.84±0.08	7.45±0.15	1.46±0.29	1.21±0.44
$S_{275-295}(nm^{-1})$	0.022±0.0009	0.011±0.0001	0.028±0.0009	0.033±0.002
Ha-L	0.59±0.011	0.51±0.022	0.57±0.012	0.52±0.015
Fa-L	0.082±0.001	0.12±0.007	0.20±0.006	0.22±0.004
SMP	0.22±0.007	0.21±0.007	0.13±0.009	0.13±0.011
Ar-P	0.10±0.005	0.17±0.021	0.11±0.008	0.13±0.019

Table S2 The calculated leaching parameters of BDOM and its fluorescence components based on the first order kinetics model.

Indices	Biochars	$q=ae^{-kt}+q_0$			R^2	P
		a	k	q_0		
BDOC	HC	-288.49	0.030	288.49	0.9746	<0.001
	PC	-9.84	0.016	9.84	0.9637	<0.001
	HPC	-2.29	0.032	2.29	0.9498	<0.001
a_{280}	HC	-26.28	0.017	26.28	0.9858	<0.001
	PC	-2.71	0.036	2.71	0.8743	<0.001
	HPC	-3.20	0.092	3.20	0.9499	<0.001
FBDOM	HC	-7727.40	0.044	7727.40	0.9880	<0.001
	PC	-5748.07	0.050	5748.07	0.9891	<0.001
	HPC	-4807.00	0.200	4807.00	0.9789	<0.001
Ar-P	HC	-1391.39	0.026	1391.39	0.9885	<0.001
	PC	-527.80	0.044	527.80	0.9943	<0.001
	HPC	-780.14	0.045	780.14	0.8557	<0.001
Fa-L	HC	-953.92	0.031	953.92	0.9878	<0.001
	PC	-1100.87	0.083	1100.87	0.9973	<0.001
	HPC	- 943.35	0.140	943.35	0.9981	<0.001
SMP	HC	-1516.59	0.143	1516.59	0.9959	<0.001
	PC	-645.75	0.130	645.75	0.9976	<0.001
	HPC	-594.41	0.088	594.41	0.9833	<0.001
Ha-L	HC	-3810.05	0.115	3810.05	0.9933	<0.001
	PC	-3181.99	0.079	3181.99	0.9962	<0.001
	HPC	-2501.57	0.134	2501.57	0.9664	<0.001

Table S3 The relative contents of Ar-P, Fa-L ,SMP and Ha-L to bulk BDOM derived from HC, PC and HPC.

Biochars	Ar-P	Fa-L	SMP	Ha-L
HC	15.00%-18.02%	11.18%-12.23%	20.43%-21.36%	49.30%-52.49%
	(16.51%±2.11%)	(11.71%±0.74%)	(20.89%±0.65%)	(50.89%±2.22%)
PC	9.95%-11.02%	19.35%-20.14%	12.19%-12.23%	56.09%-57.79%
	(10.5%±0.8%)	(19.75%±0.56%)	(12.83%±0.90%)	(56.94%±1.19%)
HPC	11.42%-14.21%	21.84%-22.45%	12.17%-13.73%	51.01%-53.17%
	(12.8%±1.95%)	(22.15%±0.43%)	(12.95%±1.09%)	(52.01%±1.51%)

Table S4 The kinetic parameters of Cr(VI) based on the pseudo-first-order and pseudo-second-order models.

	Pseudo-first-order model				Pseudo-second-order model			
	K_1 (h^{-1})	Q_e (mg/g)	R^2	P	K_2 (g/(mg·h)	Q_e(mg/g)	R^2	P
HC	0.46	3.93	0.9915	<0.001	0.13	4.48	0.9957	<0.001
PC	0.51	3.89	0.9884	<0.001	0.14	4.41	0.9979	<0.001
HPC	0.49	3.89	0.9922	<0.001	0.14	4.42	0.9969	<0.001
D-HC	0.35	4.03	0.9991	<0.001	0.081	4.75	0.9836	<0.001
D-PC	0.15	3.68	0.9403	<0.001	0.045	4.24	0.9766	<0.001
D-HPC	0.10	3.73	0.9471	<0.001	0.029	4.33	0.9761	<0.001

Table S5 The calculated parameters of BDOM mediated Cr(VI) reduction by Fe(II) based on the single exponential model.

| Experiment systems	BDOM contents	$C_t/C_0 = F_1 + F_2 e^{-kt}$			R^2
		F_1	F_2	k (h^{-1})	
Control (Fe(II))	0 mg C/L	35.90%	64.10%	0.42	0.9999
HC-AP + Fe(II)	1 mg C/L	37.44%	62.56%	0.58	0.9978
	5 mg C/L	32.14%	67.86%	0.62	0.9924
	10 mg C/L	19.10%	80.90%	0.55	0.9968
HC-BDOM + Fe(II)	1 mg C/L	42.77%	57.23%	1.23	0.9917
	5 mg C/L	30.71%	69.29%	0.81	0.9962
	10 mg C/L	18.78%	81.23%	1.06	0.9923
PC-BDOM + Fe(II)	1 mg C/L	35.70%	64.30%	7.62	0.9999
	5 mg C/L	39.29%	60.71%	25.18	0.9999
	10 mg C/L	53.70%	46.30%	308.67	0.9999
HPC-BDOM + Fe(II)	1 mg C/L	34.41%	65.59%	9.28	0.9999
	5 mg C/L	37.30%	62.70%	19.32	0.9999
	10 mg C/L	41.40%	58.60%	353.67	0.9999

Figures:
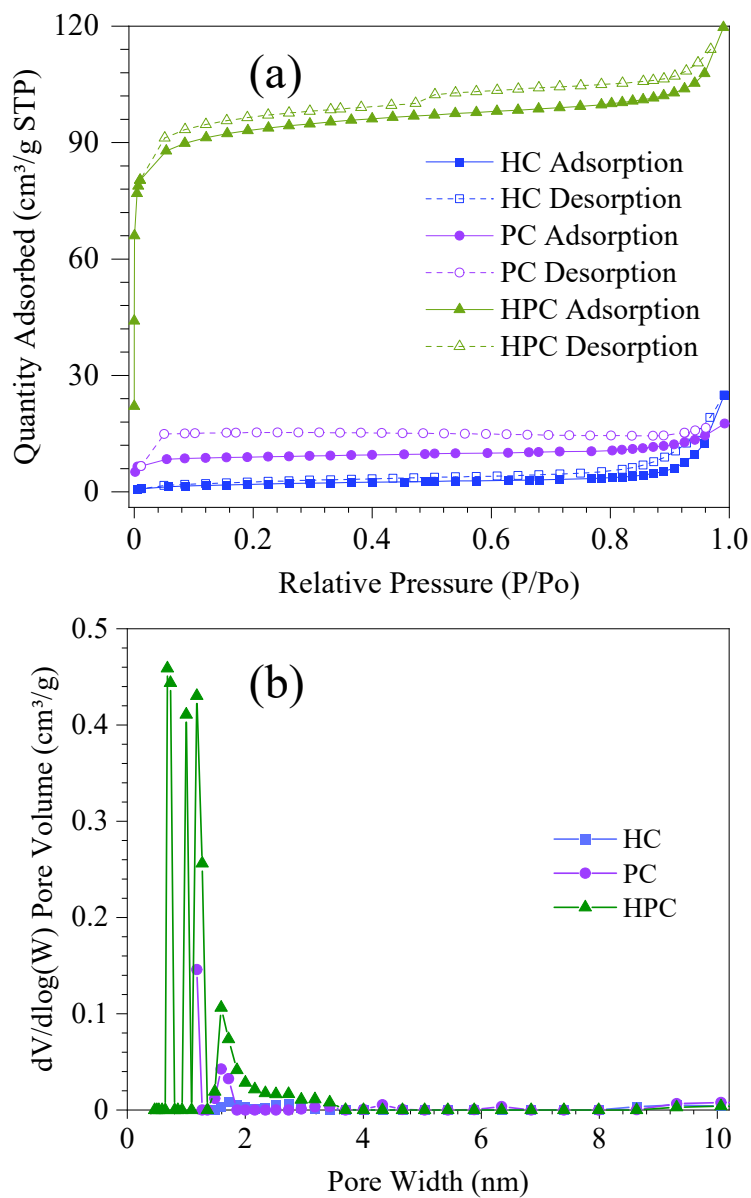
Fig. S1 (a) N_2 sorption–desorption isotherms and (b) pore size distributions curves of biochars.
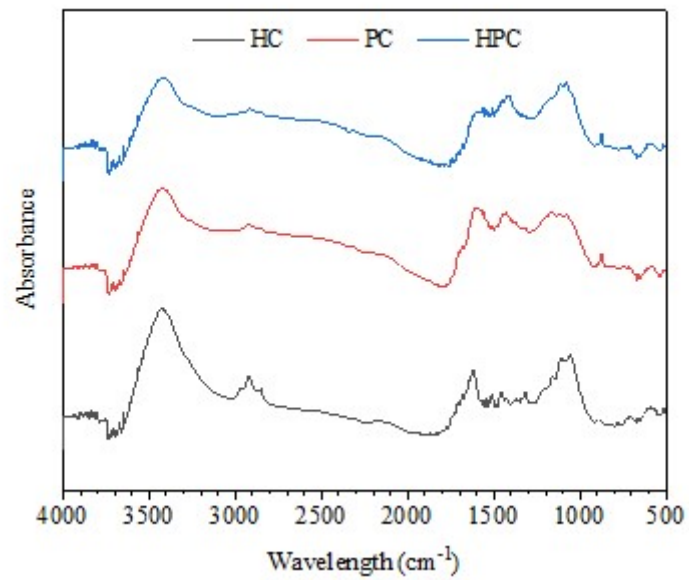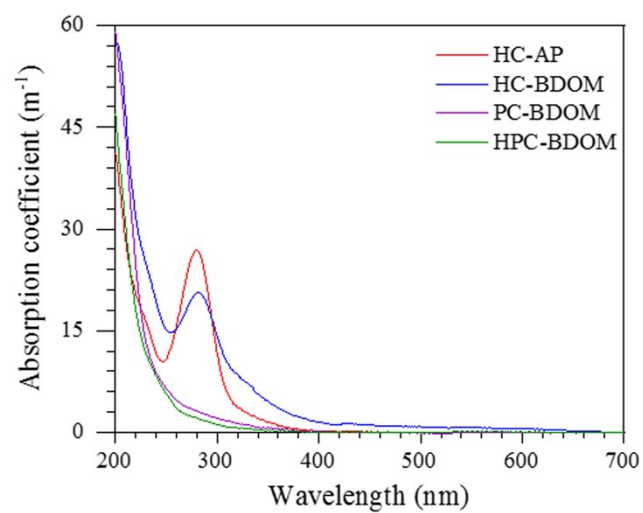
Fig. S2 FT-IR spectra of biochars.

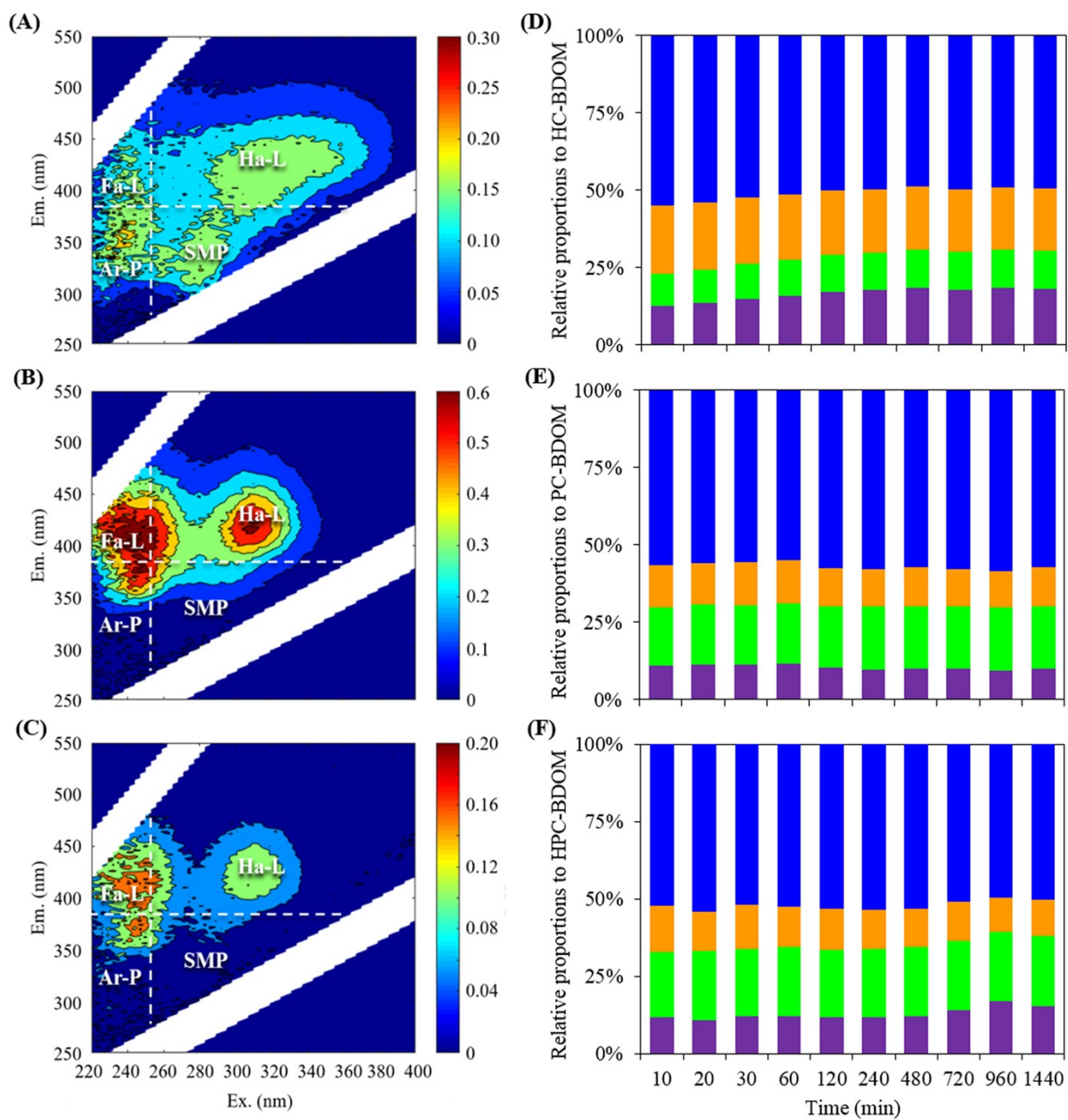**Fig. S3** UV-Vis spectra of BDOM derived from hydrochars and pyrochars.

Fig. S4 Excitatione emission matrix (EEM) fluorescence spectra and corresponding distribution of fluorescence intensity of DOM extracted from HC (A, D), PC (B, E) and HPC (C, F).
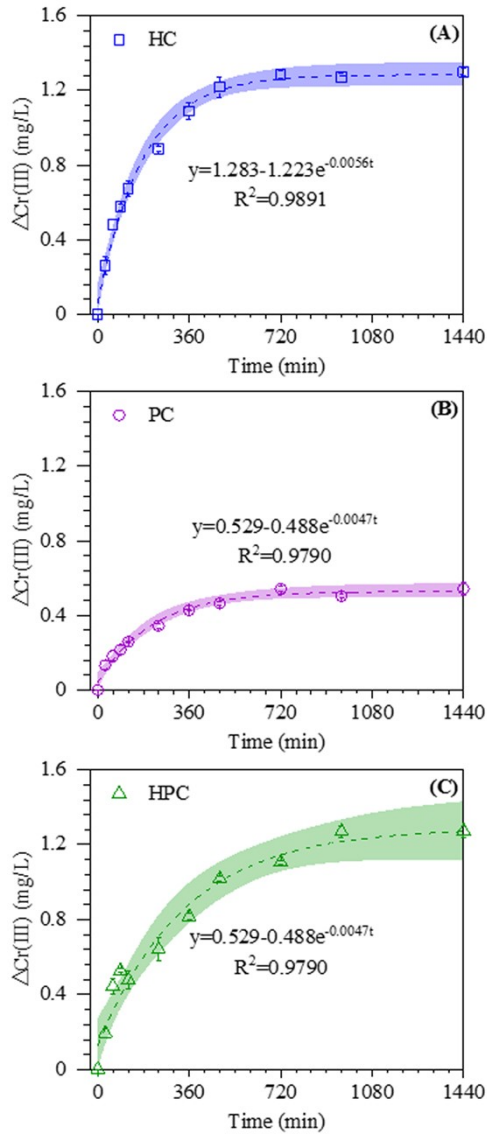
Fig. S5 The Cr(III) concentration residued in solution during the adsorption of Cr(VI) over HC (A), PC (B) and HPC (C). Experimental conditions: pH 2; biochar dosage: 0.5 g/L; Cr(VI) concentration: 2 mg/L.
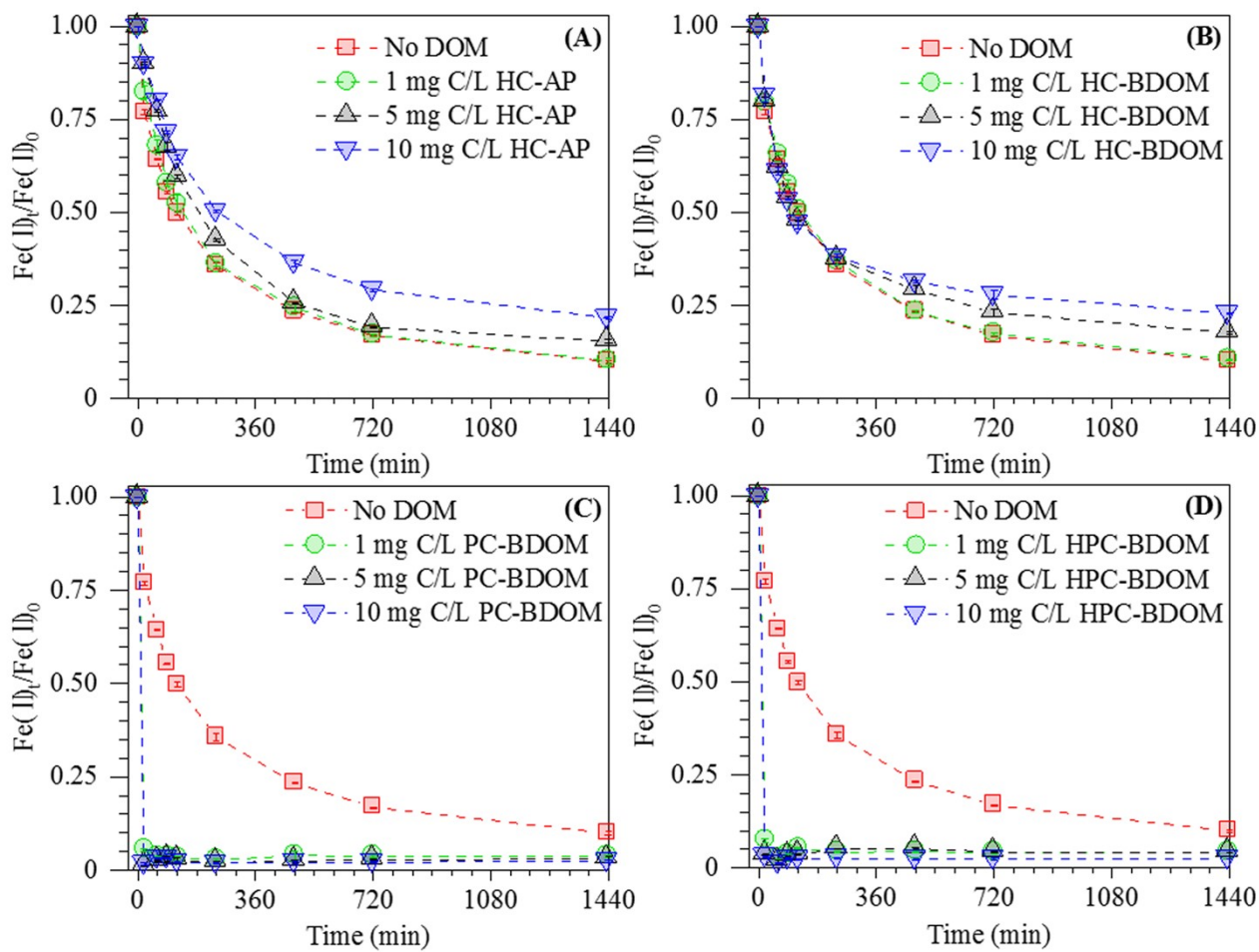
Fig. S6 The changes in Fe(II) during the reaction of Cr(VI) reduction by BDOM-Fe(II) system.

Experimental conditions: pH 2; Cr(VI) concentration: 2 mg/L; Fe(II) concentration: 4 mg/L.