

Supplementary Table S1

Proximate analyses (%), forms of sulfur (%), and vitrinite random reflectance (%) of No.11 and No.3 coals from the Sangshuping Coal Mine, Weibei Coalfield.

Sample	M _{ad}	A _d	V _{daf}	S _{t,d}	S _{o,d}	S _{p,d}	S _{s,d}	R _o
SSP11-R	2.9	68.9	58.8	25.40	6.67	16.40	2.34	nd
SSP11-1	2.2	22.7	16.9	8.80	4.34	3.55	0.90	1.32
SSP11-2	1.4	11.5	13.7	6.56	4.99	1.30	0.27	1.76
SSP11-3	1.1	8.4	14.8	5.97	5.44	0.42	0.10	1.68
SSP11-4	1.0	8.1	14.6	5.62	5.48	0.10	0.04	1.71
SSP11-P1	0.7	60.7	31.3	2.37	1.36	0.92	0.09	nd
SSP11-6	0.9	15.8	13.2	4.06	3.99	0.05	0.02	1.78
SSP11-7	0.8	18.5	27.8	4.00	3.93	0.04	0.03	0.70
SSP11-8	0.8	22.6	15.5	3.70	3.66	0.02	0.02	1.58
SSP11-9	0.8	13.3	15.2	4.00	3.95	0.03	0.02	1.70
SSP11-P2	0.6	58.0	31.2	1.69	1.48	0.15	0.06	nd
SSP11-11	0.5	12.2	15.4	4.27	4.09	0.16	0.02	1.63
SSP11-F	0.6	68.8	43.4	1.23	1.02	0.16	0.05	nd
Coal Avg.	1.0	14.8	16.3	5.41	4.53	0.71	0.18	1.54
SSP3-R	0.9	85.5	93.8	0.19	nd	nd	nd	nd
SSP3-1	0.6	21.0	18.3	0.38	nd	nd	nd	1.20
SSP3-2	0.7	14.2	17.2	0.49	nd	nd	nd	1.29
SSP3-3	1.1	9.4	16.7	0.30	nd	nd	nd	1.33
SSP3-4	0.9	9.0	15.3	0.28	nd	nd	nd	1.63
SSP3-5	3.1	7.4	13.7	0.35	nd	nd	nd	1.75
SSP3-6	1.0	8.4	15.2	0.40	nd	nd	nd	1.71
SSP3-7	1.1	9.7	15.6	0.42	nd	nd	nd	1.53

Li	342	163	61.0	83.7	105	583	93.4	214	79.1	457	90.8	1467	111	31.8	12	33
Be	3.66	2.05	1.65	0.87	0.93	4.4	1.18	1.78	1.21	2.89	1.53	3.54	1.40	2.11	1.6	2.3
B	19.8	10.5	1.75	8.41	6.62	22.3	22.6	15.5	12.5	26.6	6.25	46.8	10.5	53.0	52	34
Sc	2.29	6.34	2.17	<dl	0.90	14.7	5.41	3.20	2.69	4.76	10.0	10.61	4.39	4.38	3.9	16
V	238	157	14.3	7.88	56.5	87.4	32.7	22.1	29.5	29.2	51.9	45.6	46.4	35.1	25	121
Cr	114	77.2	9.66	2.77	21.4	76.9	19.0	10.4	11.1	15.8	18.9	28.5	21.3	15.4	16	92
Co	19.0	11.2	<dl	<dl	<dl	<dl	<dl	<dl	<dl	<dl	<dl	<dl	<dl	11.2	7.08	5.1
Ni	24.8	15.1	0.05	1.81	5.67	17.9	1.08	3.82	4.16	13.9	4.38	9.89	4.50	13.7	13	50
Cu	33.4	27.7	11.6	3.88	8.90	47.7	10.6	17.2	16.8	44.2	19.2	65.6	14.5	17.5	16	39
Zn	35.5	71.3	33.4	3.95	3.40	9.49	4.03	6.15	8.23	2.49	10.4	8.41	17.6	41.4	23	75
Ga	12.6	15.4	6.49	5.89	36.2	16.1	9.62	22.2	15.7	7.83	28.5	27.6	17.5	6.55	5.8	16
Ge	3.83	5.76	1.58	2.19	3.77	3.14	1.11	4.74	1.44	2.20	2.95	<dl	2.94	2.78	2.2	1.3
As	27.7	13.2	3.14	1.67	1.32	6.66	1.11	1.56	0.65	5.47	1.65	5.29	3.04	3.79	8.3	5.6
Se	7.08	5.52	4.55	1.55	1.11	8.16	3.14	4.68	4.20	7.09	3.29	5.60	3.51	2.47	1.3	0.15
Rb	96.5	34.8	3.35	3.88	3.04	12.6	6.71	3.10	3.45	24.9	2.15	10.7	7.57	9.25	14	98
Sr	585	93.4	45.5	66.2	71.0	53.7	74.8	383	68.8	27.7	110	242	114	140	110	270
Y	10.85	11.8	8.34	5.41	8.6	19.6	12.1	13.7	15.8	13.0	37.2	30.9	14.1	18.2	8.4	26
Zr	138	84.1	38.2	26.5	69.7	274	75.6	102	122	140	176	193	86.7	89.5	36	16
Nb	14.5	10.7	4.25	1.53	9.54	46.1	3.40	9.11	7.79	18.1	7.50	22.7	6.73	9.44	3.7	12
Mo	3.77	21.5	6.78	3.39	4.10	12.6	0.00	1.38	0.80	<dl	2.81	<dl	5.09	3.08	2.2	1.56
Cd	<dl	<dl	<dl	<dl	<dl	<dl	<dl	<dl	<dl	<dl	<dl	<dl	<dl	<dl	0.25	0.22
Sn	1.41	1.91	1.10	<dl	3.97	4.64	0.00	2.29	2.93	0.80	7.64	6.34	2.83	2.11	1.1	3.5
Sb	<dl	<dl	<dl	<dl	<dl	<dl	<dl	<dl	<dl	<dl	<dl	<dl	<dl	<dl	0.84	0.92
Cs	8.01	5.07	<dl	<dl	<dl	1.33	<dl	<dl	<dl	1.59	<dl	1.28	5.1	1.13	1	5.5
Ba	88.1	55.6	3.28	1.83	3.13	18.7	3.38	8.41	2.52	8.64	4.73	15.8	10.4	159	150	510

La	88.3	20.2	5.97	6.01	3.90	58.1	20.4	42.2	3.10	16.6	12.1	118	14.2	22.5	11	32
Ce	132	41.6	13.5	13.3	9.50	92.4	25.5	68.3	7.25	39.6	29.8	191	26.1	46.7	23	63
Pr	14.0	4.47	1.44	1.38	1.17	10.8	2.55	7.62	0.99	5.05	3.91	18.3	2.94	6.42	3.5	8.7
Nd	48.9	16.9	5.34	5.00	4.95	35.6	8.90	26.4	4.31	18.0	16.7	60.1	11.1	22.3	12	29
Sm	10.3	3.95	1.43	1.23	1.53	5.53	2.44	5.21	1.96	4.67	6.58	13.7	3.04	4.07	2	5.7
Eu	1.23	<dl	<dl	<dl	<dl	<dl	<dl	<dl	<dl	<dl	1.17	1.59	1.17	0.84	0.47	1.3
Gd	5.75	3.08	1.25	1.17	1.55	4.23	2.66	4.13	2.58	3.65	7.57	9.51	3.00	4.65	2.7	6.3
Tb	<dl	<dl	<dl	<dl	<dl	<dl	<dl	<dl	<dl	<dl	1.37	1.26	1.37	0.62	0.32	0.89
Dy	2.66	2.57	1.52	1.05	1.77	4.27	2.56	3.21	3.27	2.87	7.77	6.74	2.96	3.74	2.1	4.8
Ho	<dl	<dl	<dl	<dl	<dl	0.81	<dl	<dl	<dl	<dl	1.29	1.17	1.29	0.96	0.54	1.3
Er	1.62	1.43	0.87	<dl	1.01	2.59	1.33	1.60	1.74	1.48	3.63	3.52	1.45	1.79	0.93	2.7
Tm	<dl	<dl	<dl	<dl	<dl	<dl	<dl	<dl	<dl	<dl	<dl	<dl	<dl	0.64	0.31	0.33
Yb	1.77	1.46	0.90	<dl	0.83	2.69	1.19	1.48	1.52	1.36	3.08	3.19	1.31	2.08	1	2.5
Lu	<dl	<dl	<dl	<dl	<dl	<dl	<dl	<dl	<dl	<dl	<dl	<dl	<dl	0.38	0.2	0.48
Hf	4.50	2.51	1.06	0.88	1.90	9.08	2.27	3.23	3.68	5.04	5.50	6.65	2.63	3.71	1.2	4.5
Ta	<dl	<dl	<dl	<dl	<dl	2.56	<dl	<dl	<dl	0.97	<dl	1.70	<dl	0.62	0.28	1,4
W	0.84	0.89	0.92	1.51	2.45	5.94	<dl	1.50	<dl	3.03	0.00	2.17	1.21	1.08	1.1	2.03
Tl	1.53	1.34	<dl	<dl	<dl	<dl	<dl	<dl	<dl	<dl	<dl	<dl	1.34	0.47	0.63	0.75
Pb	136	24.1	5.90	3.79	2.63	14.5	2.00	3.90	6.61	16.1	7.16	17.8	7.01	15.1	7.8	17
Bi	<dl	<dl	<dl	<dl	<dl	2.21	<dl	<dl	<dl	0.97	<dl	0.94	<dl	0.79	0.97	0.29
Th	17.7	7.78	3.85	2.45	3.85	41.6	3.69	7.24	3.75	25.0	15.2	27.6	5.98	5.84	3.3	9.1
U	7.47	11.4	3.40	0.96	3.58	6.83	2.65	3.19	4.65	3.85	6.99	9.84	4.60	2.43	2.4	2.5

<dl, under detected limit; nd, no data; ^aDai et al., 2012b; ^bKetris and Yudovich, 2009; ^cGrigoriev, 2009.

Table S3

Percentages of major-element oxides (%) and concentrations of trace elements ($\mu\text{g/g}$) of the No.3coal from the Sangshuping coal mine, Weibei Coalfield (on whole coal basis)

%	SSP3-R	SSP3-1	SSP3-2	SSP3-3	SSP3-4	SSP3-5	SSP3-6	SSP3-7	SSP3-8	SSP3-9	SSP3-10	SSP3-11	Coal avg.	Chinese Coal ^a	world Coal ^b	Word Clays ^c
SiO ₂	40.6	9.80	5.91	2.71	3.79	1.40	2.39	3.35	5.46	7.17	2.47	2.25	4.25	8.47	nd	nd
TiO ₂	1.21	0.40	0.28	0.07	0.25	0.07	0.08	0.11	0.17	0.16	0.04	0.07	0.15	0.33	nd	nd
Al ₂ O ₃	36.2	6.03	9.42	3.42	3.02	2.22	2.72	3.23	4.90	5.48	2.93	2.70	4.19	5.98	nd	nd
Fe ₂ O ₃	0.49	0.36	0.24	0.14	0.08	0.17	0.68	0.43	0.60	0.63	0.63	0.73	0.43	4.85	nd	nd
MgO	0.09	0.04	0.06	0.09	0.08	0.07	0.33	0.27	0.20	0.33	0.26	0.42	0.20	0.22	nd	nd
CaO	0.05	1.39	1.29	1.59	0.38	1.31	1.35	1.12	1.52	0.88	1.74	2.50	1.37	1.23	nd	nd
MnO	0.001	0.005	0.004	0.005	0.001	0.004	0.02	0.01	0.01	0.01	0.01	0.02	0.01	0.02	nd	nd
Na ₂ O	0.24	0.03	0.04	0.02	0.02	0.04	0.04	0.04	0.05	0.07	0.04	0.04	0.04	0.16	nd	nd
K ₂ O	0.84	0.04	0.06	0.01	0.01	0.02	0.03	0.04	0.14	0.31	0.06	0.04	0.07	0.19	nd	nd
P ₂ O ₅	0.11	0.02	0.03	0.02	0.02	0.11	0.35	0.09	0.36	0.02	0.67	0.01	0.15	0.09	nd	nd
SiO ₂ /Al ₂ O ₃	1.12	1.62	0.63	0.79	1.26	0.63	0.88	1.04	1.11	1.31	0.84	0.83	1.00	1.42	nd	nd
$\mu\text{g/g}$																
Li	313	76.3	116	39.4	32.7	42.5	60.3	70.1	149	158	88.4	89.2	83.8	31.8	12	33
Be	7.60	12.8	13.4	1.25	<dl	<dl	0.88	0.87	1.19	1.16	<dl	<dl	4.50	2.11	1.6	2.3
B	59.9	2.51	3.09	3.29	6.36	47.6	37.7	31.9	33.8	17.9	56.4	40.4	25.5	53.0	52	34
Sc	10.28	4.41	<dl	<dl	<dl	<dl	<dl	0.93	2.11	2.78	<dl	<dl	2.56	4.38	3.9	16
V	82.7	42.2	24.3	7.34	10.4	7.10	7.38	10.7	12.6	12.51	6.37	11.2	13.8	35.1	25	121
Cr	33.5	22.2	12.4	2.68	14.8	4.49	6.88	5.96	5.91	4.88	3.95	3.94	8.01	15.4	16	92
Co	26.0	11.2	32.0	14.3	4.13	2.47	1.29	0.88	<dl	1.05	1.04	1.42	6.98	7.08	5.1	17

Ni	23.0	13.7	34.1	14.3	6.57	6.31	3.39	2.63	1.86	2.82	2.56	2.35	8.23	13.7	13	50	
Cu	13.3	23.9	21.7	6.35	10.7	7.55	9.14	10.1	10.0	10.0	10.8	7.37	11.6	17.5	16	39	
Zn	18.6	7.21	23.52	8.67	10.0	22.7	19.4	26.91	14.4	29.8	28.6	70.9	23.8	41.4	23	75	
Ga	42.9	8.89	18.2	4.28	2.78	2.30	2.22	3.55	7.17	11.2	3.95	4.43	6.27	6.55	5.8	16	
Ge	2.05	4.95	19.63	<dl	<dl	<dl	<dl	<dl	0.83	1.07	<dl	<dl	6.62	2.78	2.2	1.3	
As	18.6	2.37	2.53	0.67	0.32	0.69	2.30	0.95	1.63	2.11	0.50	2.26	1.49	3.79	8.3	5.6	
Se	<dl	1.93	6.27	1.53	0.26	<dl	<dl	2.47	2.44	2.63	0.90	0.96	2.16	2.47	1.3	0.15	
Rb	32.2	1.12	1.86	<dl	<dl	0.98	1.63	2.03	6.82	14.91	3.20	1.56	3.79	9.25	14	98	
Sr	292	74.7	143	102	89.6	238	348	239	411	108	347	124	202	140	110	270	
Y	13.0	18.5	18.9	8.43	10.8	8.55	10.6	6.48	13.5	8.12	16.3	4.58	11.3	18.2	8.4	26	
Zr	149	94.5	85.3	19.9	48.7	16.4	13.5	34.6	61.3	55.4	12.9	25.2	42.5	89.5	36	16	
Nb	45.7	10.7	9.42	1.67	4.42	1.97	1.48	4.25	7.34	7.23	1.13	2.50	4.74	9.44	3.7	12	
Mo	2.43	<dl	<dl	<dl	<dl	<dl	<dl	<dl	<dl	0.86	<dl	1.47	1.17	3.08	2.2	1.56	
Cd	<dl	<dl	<dl	<dl	<dl	<dl	<dl	<dl	<dl	<dl	<dl	<dl	<dl	<dl	0.25	0.22	0.64
Sn	3.05	1.27	1.67	<dl	<dl	<dl	<dl	<dl	1.98	2.24	<dl	<dl	1.79	2.11	1.1	3.5	
Sb	2.95	<dl	<dl	<dl	<dl	<dl	<dl	<dl	<dl	<dl	<dl	<dl	<dl	<dl	0.84	0.92	0.81
Cs	1.51	<dl	<dl	<dl	<dl	<dl	<dl	<dl	<dl	0.79	<dl	<dl	0.79	1.13	1	5.5	
Ba	140	64.8	52.4	27.6	25.4	38.2	38.5	39.6	56.8	54.0	54.2	29.8	43.7	159	150	510	
La	110	13.2	30.4	20.5	18.5	29.5	27.6	20.6	39.1	3.33	23.6	1.40	20.7	22.5	11	32	
Ce	198	27.80	52.6	33.1	33.9	40.7	46.1	37.2	70.5	9.36	48.2	4.82	36.7	46.7	23	63	
Pr	17.7	3.16	5.29	3.27	3.51	3.55	4.00	3.25	6.44	1.13	4.92	<dl	3.85	6.42	3.5	8.7	
Nd	57.3	11.3	18.3	11.4	12.4	12.	13.2	10.1	21.0	4.66	18.1	2.96	12.3	22.3	12	29	
Sm	10.6	2.83	3.85	2.27	2.68	2.55	2.61	1.77	4.19	1.62	4.28	0.99	2.69	4.07	2	5.7	
Eu	1.74	<dl	<dl	<dl	<dl	<dl	<dl	<dl	<dl	<dl	<dl	<dl	<dl	<dl	0.84	0.47	1.3
Gd	7.37	2.86	3.61	1.98	2.25	2.25	2.42	1.40	3.57	1.33	3.87	0.85	2.40	4.65	2.7	6.3	

SSPP11-5	<dl	53.81	<dl	<dl	<dl	<dl	<dl	<dl	<dl	<dl	0.48	6.25	<dl	<dl	0.05	<dl
SSPP11-6	<dl	12.52	<dl	<dl	<dl	<dl	<dl	<dl	<dl	<dl	<dl	3.29	<dl	<dl	0.01	<dl
SSPP11-7	<dl	19.30	<dl	<dl	<dl	<dl	0.68	<dl	<dl	<dl	<dl	2.60	<dl	<dl	0.02	<dl
SSPP11-9	<dl	9.10	<dl	<dl	<dl	<dl	2.05	<dl	<dl	<dl	<dl	2.20	<dl	<dl	<dl	<dl
SSPP11-10	<dl	46.02	1.04	<dl	<dl	<dl	0.13	<dl	<dl	<dl	0.13	11.09	<dl	<dl	<dl	<dl
SSPP11-11	<dl	6.26	<dl	<dl	<dl	<dl	5.98	<dl	<dl	<dl	<dl	<dl	<dl	<dl	<dl	<dl
SSPP11-12	<dl	68.18	<dl	<dl	<dl	<dl	0.82	<dl	<dl	<dl	<dl	<dl	<dl	<dl	<dl	<dl
SSP3-R	<dl	84.28	<dl	<dl	1.18	<dl	<dl	<dl	<dl	<dl	<dl	<dl	<dl	<dl	<dl	<dl
SSP3-1	<dl	14.46	<dl	<dl	3.04	<dl	3.46	<dl	<dl	<dl	<dl	<dl	<dl	<dl	<dl	<dl
SSP3-2	<dl	11.80	<dl	<dl	0.39	<dl	1.97	<dl	<dl	<dl	<dl	<dl	<dl	<dl	<dl	<dl
SSP3-3	<dl	5.79	<dl	<dl	<dl	<dl	3.47	0.18	<dl	<dl	<dl	<dl	<dl	<dl	<dl	<dl
SSP3-4	<dl	7.12	<dl	<dl	<dl	<dl	0.67	0.27	<dl	<dl	<dl	0.95	<dl	<dl	<dl	<dl
SSP3-5	<dl	2.46	<dl	<dl	<dl	<dl	4.21	<dl	<dl	<dl	<dl	0.52	<dl	<dl	<dl	<dl
SSP3-6	<dl	3.48	<dl	<dl	<dl	1.96	0.33	<dl	<dl	<dl	<dl	1.55	<dl	<dl	<dl	1.05
SSP3-7	<dl	4.12	<dl	<dl	<dl	2.02	0.70	<dl	<dl	<dl	<dl	2.89	<dl	<dl	<dl	<dl
SSP3-8	<dl	5.09	<dl	<dl	<dl	1.61	0.83	<dl	<dl	<dl	<dl	6.24	<dl	<dl	<dl	1.38
SSP3-9	<dl	5.50	<dl	<dl	<dl	2.62	0.00	<dl	<dl	<dl	<dl	9.33	<dl	<dl	<dl	<dl
SSP3-10	<dl	1.93	<dl	<dl	<dl	1.83	0.76	<dl	<dl	<dl	<dl	3.18	<dl	<dl	<dl	2.91
SSP3-11	<dl	3.66	<dl	<dl	<dl	2.23	3.70	<dl	<dl	<dl	<dl	1.10	<dl	<dl	<dl	<dl

Ms, muscovite; Kln, kaolinite; Clc, clinocllore; Pas, palygorskite; Qtz, quartz; Ank, ankerite; Cal, calcite; Dol, dolomite; Py, pyrite; Gp, gypsum; Mic, microcline; Tol, tobellite; Szm, szomolnokite; Men, melanterite; Fap, fluorapatite; Ant, anatase; <dl, under detected limit.