Supporting Information

Dehydration Effect on the Pore Size, Porosity, and Fractal Parameters of Shale Rocks: Ultrasmall-Angle X-ray Scattering Study

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Table S1. Calculated parameters of Air-dry shale rock samples.

No	Sample name	Depth[1]	Porosity[2]	Porod exponent[3]	
				High Q	Low Q
1	GO1	1416	11.0	3.2	3.3
2	GO2	1415	10.2	3.4	3.3
3	GO3	1415	9.5	3.4	3.3
4	GO5	1355	10.3	3.5	3.3
5	GO6	1349	10.2	3.5	3.2
6	KE1	1518	10.2	3.5	3.3
7	KE2	1517	10.7	3.3	3.4
8	KE3	1516	10.5	3.3	3.4
9	KE5	1512	10.2	3.9	3.3
10	KE6	1511	9.2	3.9	3.3
11	BA1	1595	10.9	3.8	3.3
12	BA2	1591	9.0	3.8	3.2
13	BA4	1585	9.3	3.6	3.2
14	SE1	1808	9.8	3.7	3.3
15	SE2	1806	9.0	3.6	3.2
16	BT3	1798	9.6	3.3	3.3
17	BT4	1796	9.3	3.6	3.3
18	BT5	1793	7.8	3.9	3.3
19	BT6	1792	10.0	3.6	3.2
20	BT8	1782	9.6	3.7	3.3
21	PI1	1965	8.8	3.8	3.2
22	PI2	1964	9.6	4.0	3.3
23	PI3	1963	7.1	3.7	3.3
24	PI10	1914	7.7	3.9	3.2
25	PI8s	1954	6.6	3.6	3.4
26	WI1	2000	5.6	3.1	3.4
27	WI2	1998	6.2	3.1	3.5
28	WI3	1973	6.7	3.5	3.4
29	GL1	2152	7.7	3.7	3.3
30	GL2	2150	8.0	3.7	3.2
31	OL2	2372	5.2	3.9	3.2
32	OL3	2368	4.4	3.0	3.3
33	OL6	2360	4.9	3.3	3.3
34	OL8	2356	5.6	3.7	3.3
35	OL10	2348	4.7	3.7	3.3
36	BG1	2628	5.2	2.9	3.4
37	BG3	2626	4.2	2.4	3.3
38	BG4	2623	3.5	2.7	3.5
39	BG5	2618	4.3	2.7	3.6
40	BG6	2613	3.9	2.2	3.5
41	BG9	2546	4.0	3.0	3.4
42	PA1	2637	4.6	3.0	3.2
43	PA3	2634	4.9	3.8	3.3
44	PA4	2631	5.8	3.8	3.3
45	PA6	2626	6.2	3.9	3.3
46	PA7	2622	4.5	3.1	3.3
47	PA10	2617	4.5	3.3	3.4
48	PA14	2602	5.7	3.7	3.2
49	PA16	2589	5.8	3.6	3.2
50	LB1	2672	7.2	3.1	3.6
51	LB3	2670	7.9	3.6	3.6
52	LB4	2669	4.8	3.0	3.4
53	LB6	2657	7.3	3.1	3.4
54	LB7	2651	4.6	2.7	3.4
55	DA1	2943	4.7	3.4	3.8
56	DA2	2942	4.3	2.7	3.4
57	DA5	2936	5.4	3.0	3.3
58	DA9	2926	5.2	3.2	3.3
59	DA11	2863	5.5	2.8	3.4
60	DA12	2804	4.4	2.5	3.4
61	DA0	3015	4.7	2.5	3.5
62	HE1	3034	5.2	2.6	3.5
63	HE2	2975	5.2	2.5	3.7
64	HE3	2973	5.0	3.0	3.3
65	HE6	2968	5.1	3.3	3.3
66	HE7	2966	7.1	3.3	3.4
67	HE8	2962	4.8	3.1	3.4
68	HE11	2952	5.5	2.8	3.5
69	HE12	2941	5.8	2.7	3.5
70	HE13	2935	4.4	2.7	3.5
71	GD2	3079	5.2	2.8	3.5
72	GD4	3066	5.0	3.4	3.3
73	GD5	3063	4.1	3.3	3.3
74	GD6	3040	5.4	3.4	3.3
75	GD7	3038	5.6	3.5	3.3
76	LE1	3267	4.2	3.5	3.3
77	LE9	3238	5.2	3.0	3.4
78	LE10	3225	4.2	3.2	3.4
79	KO1	4393	5.0	2.7	3.5
80	KO3	4386	4.3	2.8	3.6
81	KO4	4384	5.6	3.2	3.3
82	KO5	4377	6.7	2.6	3.3
83	KO8	4369	4.5	2.6	3.3
84	KO10	4326	4.5	3.1	3.2
85	KO11	4319	6.3	2.5	3.4
86	KO13	4310	5.4	2.9	3.3
87	KO14	4306	5.0	2.7	3.5
88	SL1	4410	4.2	2.7	3.6
89	SL2	4408	3.9	2.7	3.6
90	SL3	4406	6.8	3.4	3.6
91	SL4	4402	4.3	3.0	3.6
92	SL5	4400	4.3	2.6	3.6
93	SL6	4367	4.3	2.7	3.5
94	SL9	4358	3.6	2.8	3.5
95	PO1	4456	4.4	3.3	3.4
96	PO2	4455	4.8	3.1	3.4
97	PO6	4402	4.6	3.2	3.6
98	PO7	4397	4.8	3.2	3.7
99	PO8	4393	4.4	3.2	3.6

[1]Depth : meter

[2]Porosity : %

[3]Porod exponent were determined by unified fit under two structural levels

Table S2. Calculated parameters of dehydrated shale rock samples.

No	sample name	Depth[1]	Porosity[2]	Porod exponent[3]	
				High Q	Low Q
1	GO1	1416	10.7	2.7	3.3
2	GO2	1415	12.8	3.0	3.3
3	GO3	1415	13.3	3.3	3.3
4	GO4	1358	11.1	3.5	3.3
5	GO5	1355	12.5	3.5	3.3
6	GO6	1349	11.4	3.5	3.3
7	KE2	1517	11.1	3.4	3.3
8	KE3	1516	10.2	3.4	3.3
9	KE5	1512	13.5	3.4	3.3
10	KE6	1511	10.9	3.4	3.3
11	BA1	1595	13.2	3.4	3.3
12	BA4	1585	15.5	3.4	3.3
13	SE2	1806	12.9	3.1	3.5
14	BT3	1798	9.5	3.0	3.3
15	BT4	1796	14.0	2.8	3.5
16	BT5	1793	10.8	3.3	3.4
17	BT6	1792	10.6	3.2	3.3
18	BT8	1782	10.6	3.2	3.2
19	PI1	1965	9.4	2.8	3.3
20	PI2	1914	11.2	2.9	3.2
21	PI10	1963	9.3	2.8	3.3
22	PI8s	1954	8.8	3.0	3.3
23	WI1	2000	10.7	3.3	3.4
24	WI2	1998	7.7	2.7	3.3
25	WI3	1973	9.8	3.2	3.4
26	GL1	2152	11.4	3.1	3.4
27	GL2	2150	10.8	3.1	3.3
28	OL2	2348	7.2	3.3	3.3
29	OL8	2360	7.1	3.3	3.4
30	OL10	2356	6.6	3.1	3.3
31	BG1	2628	5.4	3.4	3.4
32	BG3	2626	5.1	3.0	3.4
33	BG4	2623	5.2	2.9	3.5
34	BG9	2546	6.3	2.9	3.5
35	PA1	2637	7.8	2.7	3.5
36	PA3	2617	7.7	3.1	3.4
37	PA4	2602	8.1	3.0	3.3
38	PA6	2589	7.1	3.1	3.3
39	PA7	2634	6.7	2.8	3.5
40	PA10	2631	8.7	3.1	3.5
41	PA14	2626	7.7	3.0	3.4
42	PA16	2622	6.8	2.9	3.5
43	LB2	2671	8.5	2.7	3.4
44	LB3	2669	9.2	3.0	3.4
45	LB4	2669	6.8	2.8	3.3
46	LB6	2657	7.6	3.4	3.3
47	LB7	2651	8.8	3.4	3.3
48	DA1	2944	7.4	3.4	3.3
49	DA2	2943	5.8	2.6	3.4
50	DA0	3015	5.3	2.7	3.4
51	DA5	2863	5.7	2.7	3.3
52	DA9	2804	6.6	2.9	3.4
53	DA11	2942	6.5	2.6	3.4
54	DA12	2938	5.9	2.6	3.4
55	DA0	2936	5.8	2.5	3.4
56	HE1	2926	4.3	2.7	3.4
57	HE2	3034	6.5	2.7	3.6
58	HE11	2941	6.4	2.7	3.4
59	HE3	2941	6.2	2.8	3.4
60	HE6	2935	5.7	2.9	3.3
61	HE7	2975	5.4	2.7	3.6
62	HE8	2973	6.2	2.7	3.6
63	HE11	2968	6.2	2.7	3.4
64	HE12	2966	8.0	2.6	3.4
65	HE13	2962	4.7	2.7	3.4
66	GD2	3079	4.0	3.0	3.5
67	GD4	3066	4.6	3.1	3.4
68	GD5	3063	6.5	3.0	3.5
69	GD6	3040	6.7	3.2	3.4
70	GD7	3038	6.8	3.4	3.3
71	LE1	3267	4.6	3.1	3.4
72	LE10	3225	5.4	3.2	3.3
73	LE9	3264	4.7	2.9	3.3
74	LE10	3238	5.0	2.4	3.4
75	KO1	4393	5.3	2.7	3.4
76	KO3	4326	5.6	2.5	3.4
77	SL1	4410	4.3	3.0	3.5
78	SL5	4400	4.9	3.0	3.5
79	PO1	4456	4.9	3.2	3.4
80	PO7	4397	7.7	2.7	3.5

[1]Depth : meter
[2]Porosity : %
[3]Porod exponent were determined by unified fit under two structural levels

Figure S1. A USAXS scattering intensity (open red circle) and a volume size distribution fit (black line) as a function of q range (A^{-1}, bottom axis) or pore size (Å, top axis) of air-dry sample LB1. A histogram indicates a volume size distribution in the range of 25 – 10^4 Å

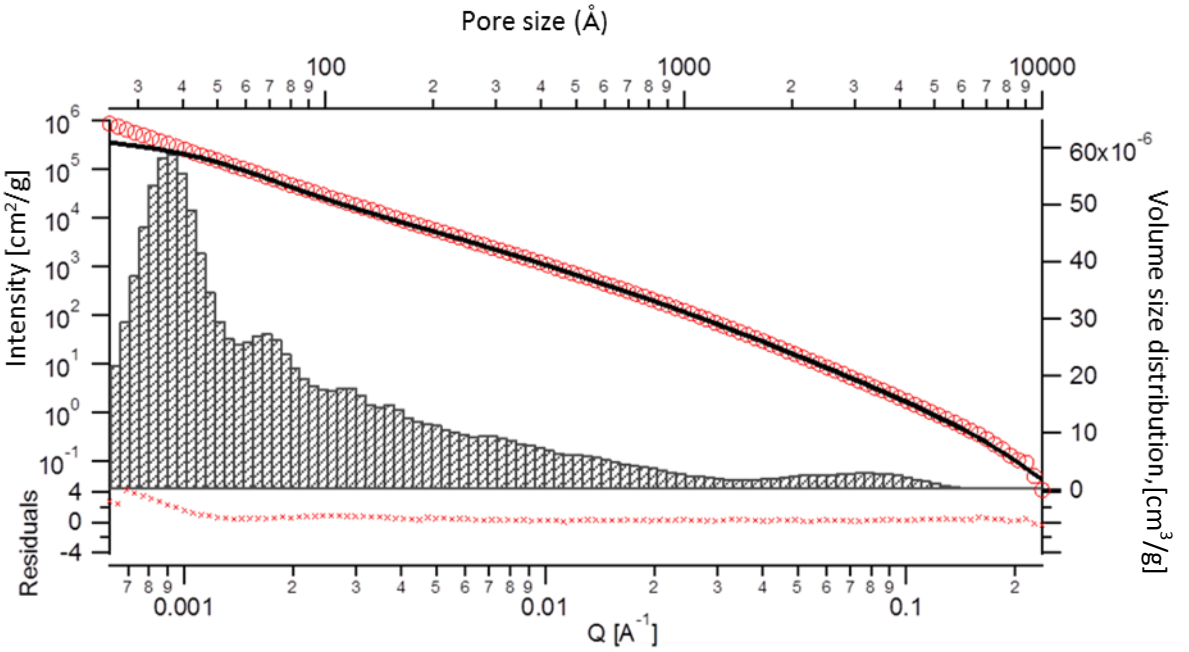
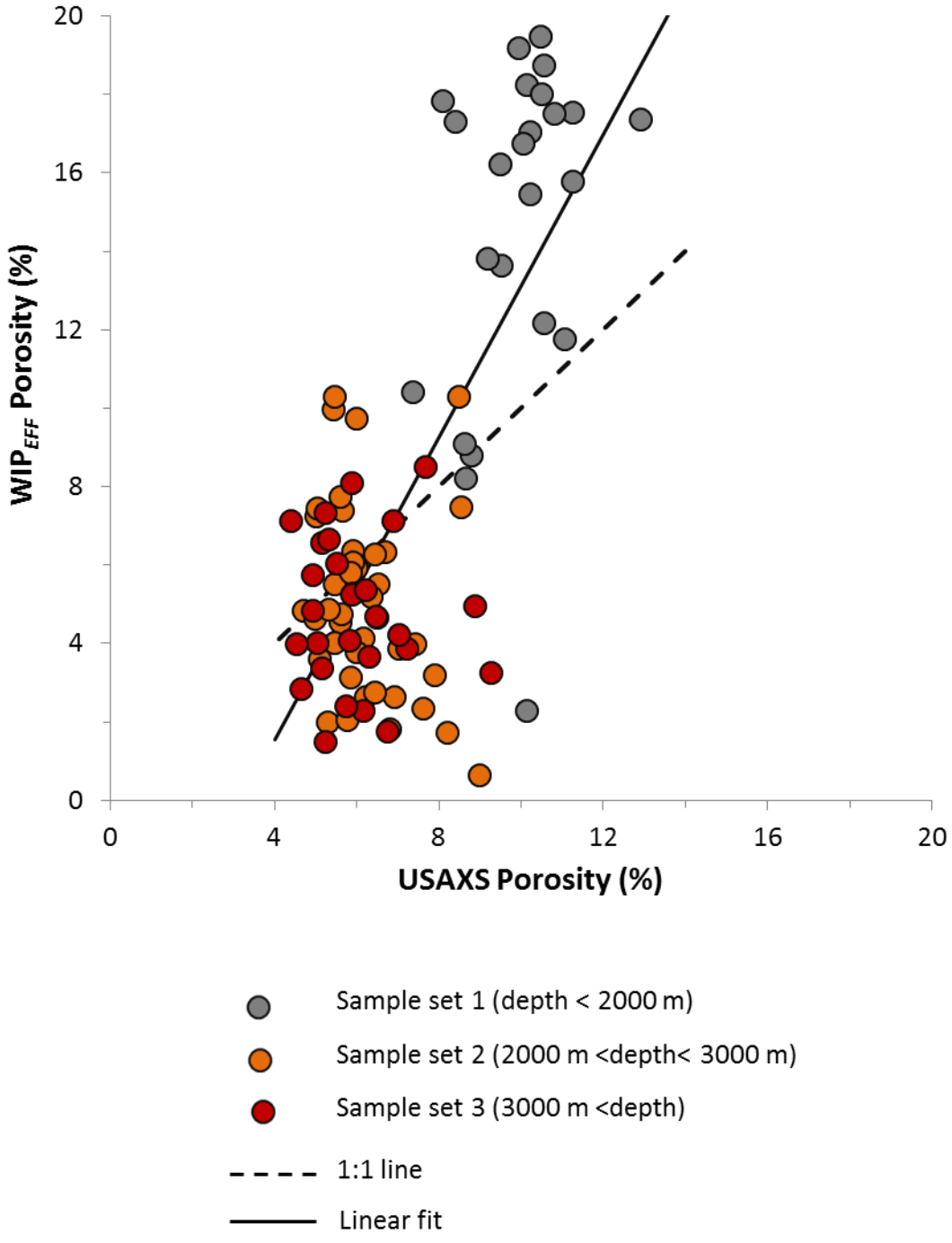


Figure S2. Comparison of USAXS porosity and WIP porosity of samples.



* WIP_{EFF} porosity was obtained by subtracting the strongly bound water (%) from measured WIP porosity[7]

Table S3. Minimum Clay bound water (% BV) of samples.

sample name	CBW (%BV)	sample name	CBW (%BV)
GO1	12.4	LB4	1.8
GO3	14.2	LB6	4.8
GO5	17.1	LB7	3.5
GO6	17.4	DA Or	1.4
KE1	16.9	DA1	2.8
KE2	18.4	DA2	3.3
KE3	18.6	DA4	3.2
KE5	15.7	DA5	4.8
KE6	15.9	DA9	3.4
BA1	16.6	DA11	2.7
BA2	13.2	DA12	2.7
BA4	16.6	DA0	2.0
SE1	13.9	HE1	0.9
SE2	11.0	HE2	2.3
BT3	15.2	HE3	3.0
BT4	11.4	HE6	1.0
BT6	9.2	HE7	4.5
BT8	10.1	HE8	3.2
PI1	8.5	HE11	4.0
PI2	6.9	HE12	2.9
PI3	12.7	HE13	3.0
PI10	13.9	GD2	3.0
PI8s	23.9	GD4	3.1
WI1	6.9	GD5	3.4
WI2	6.7	GD6	3.2
WI3	8.6	GD7	3.5
GL1	10.3	LE1	3.1
GL2	10.7	LE3	6.2
OL2	5.3	LE9	5.3
OL3	4.4	LE10	5.2
OL6	4.2	KO1	3.6
OL8	4.4	KO3	5.0
OL10	4.0	KO4	7.4
BG1	2.5	KO5	4.9
BG3	3.5	KO8	3.0
BG4	1.6	KO10	5.1
BG5	2.2	KO11	5.8
BG6	2.0	KO13	4.8
BG9	2.9	KO14	4.6
PA1	5.0	SL1	2.2
PA3	3.9	SL2	0.8
PA4	3.4	SL3	1.0
PA6	4.1	SL4	1.6
PA7	3.5	SL5	1.1
PA10	4.4	SL6	1.3
PA14	3.0	SL9	1.9
PA16	3.3	PO1	2.9
LB1	2.5	PO2	3.2
LB2	4.1	PO6	2.9
LB3	4.0	PO7	2.7